



# A Net-Map analysis to understand the roles and influence of stakeholders in street food safety - A study in Ecuador

Araceli Pilamala Rosales, Anita R. Linnemann, Pieterneel A. Luning\*

Food Quality and Design Group, Department of Agrotechnology and Food Sciences, Wageningen University, P.O. Box 17, 6700 AA Wageningen, the Netherlands

## ARTICLE INFO

### Keywords:

Street food  
Food safety  
Stakeholders  
Control  
Improvement

## ABSTRACT

Street food is a public health concern due to the prevalence of foodborne diseases. Interventions aim to control and improve street food safety. However, the limited knowledge about the roles and influence of stakeholders impedes the best way to allocate efforts and therefore needs to be studied. This study, conducted in Ecuador, elucidates the roles and influence of stakeholders in street food safety by identifying the stakeholders and assessing their linkages, impact, and goals regarding street food safety using the Net-Map methodology as a basis to improve street food safety. Eight stakeholders, their goals (i.e., improvement and control) and linkages were identified for the networks of information supply, training, financial support, and provision of basic services. Most stakeholders are mutually connected in the information and training networks. The municipalities and the National Agency for Health Regulation, Control and Surveillance (ARCSA) are the main stakeholders in street food control. Academic institutions and vendor associations are the main stakeholders in improvement. The municipalities are centrally positioned and influential in the information supply, financial support, and provision of basic services, but external consultants have the best capacity to connect with other stakeholders. The ARCSA is prominent in the training network, but the vendor associations can more easily reach other stakeholders. The positions of the vendor associations and external consultants create opportunities for allocating resources to control and improve street food safety. This is the first study to show the use of the Net-Map methodology in understanding stakeholders' roles and influence on street food safety.

## 1. Introduction

Street food is a public health concern due to the high prevalence of foodborne diseases (Ngo et al., 2021; Tuglo et al., 2021). Foodborne diseases are a significant cause of mortality worldwide (WHO, 2022), particularly in Latin America (Gargiulo et al., 2022). According to the World Health Organization (WHO), almost 10% of the world's population becomes sick from consuming contaminated food, resulting in more than 420,000 fatalities yearly (WHO, 2022). Several researchers have recommended improving the hygiene of street food vendors through regular inspections in addition to providing basic facilities, training programs and regular medical check-ups (Jores et al., 2018; Reddy et al., 2020). To effectively control food safety, national legal frameworks should cover all food value chains and enforce them systematically (Mwamakamba et al., 2012). However, food legislation concerning hygiene and safety-related practices of street food vendors is often fragmented or even not applicable (Contreras et al., 2020). The legislation also varies by country. In Latin America, for example, Peru has an

official resolution that includes hygiene rules for selling food on public roads (Bamu, 2019). In Mexico, the regulatory requirements on food products, beverages, and cosmetics are constantly evolving and changing to anticipate societal trends (Stahlhut Espinosa, 2022). However, street food vendors are still part of the informal economy, so city officials do not regulate them. On some occasions, they have been forcefully removed from the streets (López-García, 2017). Street food safety control is thus challenging, especially in developing countries (Alimi, 2016; Khairuzzaman et al., 2014).

FAO (2021) emphasised that food safety is a shared responsibility among the stakeholders. There is a need for more institutional efforts and interventions involving social participation alongside existing political initiatives and regulatory processes concerning the street food sector (Contreras et al., 2020). Other authors argued that the social participation of all stakeholders could support the formulation of strategies that strengthen food safety in the street food vending system (Al Mamun & Turin, 2016; Haque & Kohda, 2020).

Social network analysis (SNA) is a tool to understand, visualise, and

\* Corresponding author.

E-mail address: [pieterneel.luning@wur.nl](mailto:pieterneel.luning@wur.nl) (P.A. Luning).

discuss the role and influence of stakeholders in a given network (Yadav et al., 2019; Zhang & Luo, 2017). Such an analysis requires a flexible and open methodological framework that clarifies one's situation view, promotes discussion and develops a strategic approach to networking activities (Buccini et al., 2020; Schiffer & Hauck, 2010). For SNA, a so-called Net-Map methodology has been developed to improve the understanding of situations where several people, groups and organisations work together to achieve common or conflicting goals (Poku et al., 2018; Schiffer & Hauck, 2010). This Net-Map methodology has been applied to prepare and monitor policy interventions, improve and coordinate multi-stakeholder governance, and understand and strategically improve stakeholder networks (Buccini et al., 2020; Poku et al., 2018). Nyokabi (2023), for example, used the Net-Map methodology to examine stakeholder roles and relationships and their complementary and competing interests in the Kenyan dairy sector to enhance dairy safety and quality.

Ecuador is no exception regarding street food safety control. In recent years, Ecuadorian authorities joined governmental organisations to improve current conditions and food safety knowledge. For instance, street food vendors have been trained on food hygiene practices by municipalities and the National Agency for Health, Control and Surveillance (ARCSA, 2018b). A previous study (Pilamala et al., 2023) showed that street food vendors' knowledge of personal hygiene in Ambato, Ecuador, was applied correctly. However, the translation of knowledge into hygiene practices can be improved. Moreover, the current water supply conditions and sanitary facilities seem to support their hygiene practices satisfactorily, whereas waste collection, disposal facilities and pest control require improvement. To further improve food safety control, we need to understand all stakeholders in the street food vending system who can influence food safety. SNA using the Net-Map methodology can be used for analysing the street food vending system. To our knowledge, no empirical studies have applied the Net-Map to understand the role and influence of stakeholders in the street food vending system. This study elucidates the role and influence of stakeholders on street food safety by identifying the stakeholders and assessing their linkages, influence, and goals regarding street food safety using the Net-Map methodology.

## 2. Materials & methods

### 2.1. Research design

SNA was conducted to identify stakeholders, linkages, influences, and goals regarding street food safety at local markets using an adapted version of the Net-Map methodology described by Schiffer (2007). The Net-Map methodology usually involves participatory interviews, but in our case, this technique was transformed into an online questionnaire due to the Covid-19 pandemic. Fifteen Ecuadorean participants from governmental and non-governmental entities (Appendix A) were part of the Net-Map analysis from May to July 2020. The Social Sciences Ethics Committee at Wageningen University, the Netherlands, approved the study (CoC 09215846). All participants accepted the consent agreement before starting the questionnaire. Document analysis was conducted to support the findings from the online questionnaire.

### 2.2. Principles of the Net-Map methodology

The Net-Map methodology involves participatory interviews for stakeholder mapping, linking stakeholders, power mapping, and establishing the stakeholders' goals (Schiffer, 2007). Stakeholder mapping refers to identifying and categorising the key stakeholders who play a role in the network. Linking stakeholders means identifying relationships that connect stakeholders considering domains of influence (e.g., financial support). Power mapping refers to ranking each stakeholder on a scale defined by the researcher to determine how much a stakeholder can potentially influence the issue at stake. Establishing stakeholders'

goals means identifying the direction in which they will use their linkages and influence to support (or hamper) the achievement of a particular goal of the stakeholder network. Before conducting the actual Net-Map analysis, Schiffer (2007) recommends predefining the stakeholders, linkages, and goals, the so-called preliminary work.

### 2.3. Preliminary work

Table 1 shows the preliminary identification of potential stakeholders, linkages, and goals obtained by literature analysis and expert validation. We selected documents, including regulations, ordinances, and internal procedures related to food control and safety hygiene, as well as those published by Ecuadorian governmental entities and currently in force, for our literature analysis. Nine of 43 official documents were useful and further analysed with a critical appraisal form. The form had five questions identifying legal stakeholders' responsibilities and actions in the street food industry (see Appendix B). As a result, we identified five main stakeholders (1) the Ministry of Health, (2) the National Agency for Health Regulation, Control and Surveillance (in Spanish: *Agencia Nacional de Regulación, Control y Vigilancia Sanitaria, ARCSA*), (3) the municipalities, (4) street food vendors and (5) consumers, and their tasks. Relevant information was translated into English by the first author.

The document review yielded four linkages and two goals (Reddy et al., 2020; Trafialek et al., 2018). The four linkages are (1) financial support, (2) provision of basic services, (3) training, and (4) information supply. Financial support promotes economic and social policies through direct (cash grants, interest-free loans) or indirect (tax breaks, insurance, low-interest loans, accelerated depreciation, rent rebates) support (Bach, 2014). Basic services include resources for good hygiene practices (Soon, 2019). Training develops specific skills through instruction and practice (Mcfarland et al., 2019; Reynolds & Dolasinski, 2019). Information supply transfers facts and data to increase knowledge (Cui et al., 2019). The two stakeholder's goals were identified as control (C) and improvement (I). Control refers to measures taken to ensure the quality and safety of street food, and improvement encompasses all activities to enhance food safety.

Once potential stakeholders, linkages, and goals were identified, five representatives from governmental and non-governmental entities were randomly selected to validate the findings from the literature. Through interviews, these representatives identified three additional stakeholders: academic institutions, street food vendor associations, and external consultants. They also confirmed the four linkages (information supply, training, financial support, and provision of basic services) and

**Table 1**

Step-by-step process to apply the Net-Map methodology (Schiffer, 2007).

Stepwise process	Methods used
Preliminary work	<ul style="list-style-type: none"> <li>Document and literature analysis</li> <li>Expert validation</li> </ul>
Actual Net-Map analysis to establish:	<ul style="list-style-type: none"> <li>An online questionnaire (i.e., design, pretesting, and administering)</li> </ul>
<ul style="list-style-type: none"> <li>Stakeholders</li> <li>Linkages</li> <li>Stakeholders' influence</li> <li>Stakeholders' goals</li> </ul>	
Data analysis	<ul style="list-style-type: none"> <li>Preparation of symmetric square matrix</li> <li>Development of attribute sheets</li> </ul>
<ul style="list-style-type: none"> <li>Stakeholder mapping</li> <li>Power mapping</li> <li>Analysis of connectivity and stability of the network</li> </ul>	<ul style="list-style-type: none"> <li>Calculation of measures<sup>a</sup> at the network level (i.e., network density, reciprocity, transitivity, core-periphery structure)</li> </ul>
<ul style="list-style-type: none"> <li>Quantifying the network positions of stakeholders</li> </ul>	<ul style="list-style-type: none"> <li>Calculation of measures at the stakeholder level (i.e., in and out degree, closeness, betweenness, eigenvector)</li> </ul>

<sup>a</sup> In the framework of this paper, "measure" is defined as a unit used for describing a particular characteristic of a social network.

the two goals (control and improvement).

### 2.4. Execution of the Net-Map analysis

#### 2.4.1. Questionnaire design

The online questionnaire consisted of six sections. The first section described the purpose of the questionnaire. The second section contained questions to specify which stakeholders play a role in the street food vending system, using the initial list from the preliminary work (i.e., identification of potential stakeholders, linkages, and goals). The third section consisted of multiple-choice questions to assess how the stakeholders are linked (i.e., by information supply, training, financial support, and provision of basic services). So, for each stakeholder, the expert had to indicate to which other stakeholders it linked and the character of the linkage, financial support, provision of basic services, training, and information supply (i.e., linking stakeholders). The fourth section comprised single-answer multiple-choice questions to identify the degree of influence (i.e., high, medium, low, nihil) of each stakeholder (i.e., the information needed for the power mapping). The fifth section consisted of single-answer multiple-choice questions to choose the goal (i.e., control, improvement, or both) of each stakeholder in the street food vending system (i.e., establishing stakeholder's goals). Those who answered "both" had to indicate if the stakeholder had a stronger focus on either control or improvement. The last section contained a general closing statement. We drafted the questionnaire in English and then translated it into Spanish, the official language of Ecuador (see Appendix C).

#### 2.4.2. Pretesting the questionnaire

The same five people involved in the preliminary work (section 2.3) conducted the pretesting. They checked the feasibility of the questionnaire and the comprehensibility of the questions. After pretesting, we constructed a preliminary Net-Map, depicting the potential stakeholders, their linkages, degree of influence and goals.

#### 2.4.3. Recruitment of participants and administration of the questionnaire

For our research, we aimed to recruit high-level experts with knowledge and/or experience in food safety (control) in street food vending at local markets in Ecuador. Firstly, an invitation to participate in the study was made to all relevant governmental institutions (Ministry of Health, National Agency for Health Regulation, Control and Surveillance (ARCSA), Municipality of Ambato) and non-governmental (external consultants and academic institutions) located in zone 3 (according to the territorial division by the National Secretary for Planning and Development (SENPLADES)). Zone 3 includes the provinces of Tungurahua, Chimborazo, Cotopaxi, and Pastaza. Zone 3 was selected due to the major number of cases of foodborne disease reported in 2019 for the province of Tungurahua (Ambato) (Ministerio de Salud Pública, 2019). After accepting the invitation to participate, we asked the institutions to suggest other high-level experts complying with our selection criteria using the snowball technique. We stopped recruiting new experts when no new information was generated, i.e. when we reached the point of data saturation. As a result, 15 participants were included in the study, employed by governmental entities (8), non-governmental entities (3), and academic institutions (4). The validated questionnaire in the Google Forms survey was emailed to the participants. The questionnaire was enabled between June and July 2020.

### 2.5. Data analysis

#### 2.5.1. Stakeholder mapping

To establish the stakeholders in the street food system, the data about the stakeholders were combined with the insights from the expert validation and document analysis. The data from the online questionnaire were exported from the Google Forms survey to an Excel file. Then, a symmetric square matrix was generated (i.e., all stakeholders were lined

up in the same order in columns and rows). Next, the matrix was filled with information from the questionnaire about the linkages among the stakeholders. A score number indicates a linkage, whereas a score of 0 indicates the absence of a linkage. The linkage can be two-way, i.e., from the perspective of each stakeholder. For example, Table 2 illustrates that the municipality is linked to the street food vendors (score 1, row 1). In contrast, street food vendors do not link to the municipality (score 0, row 4).

#### 2.5.2. Power mapping

An attribute sheet was generated for the power mapping that comprised the influence scores, the relative influences, and the goals. If a stakeholder played a control and an improvement goal, the goal is indicated on which the stakeholder focused the most (see Table 3). The influence score represents how strongly a stakeholder can influence an issue. It was calculated by multiplying the number of citations across the 15 interviews and the corresponding score (i.e., 0 = nihil, 1 = low, 2 = medium, 3 = high) described by Buccini et al. (2020). The relative influence was calculated by dividing the influence score for each participant by the highest influence score on the map. Stakeholders' goals were represented by codes 1, 2, and 3, which mean control, improvement or both, respectively.

#### 2.5.3. Centrality measures to analyse the networks and stakeholder positions

Finally, the data were imported into UCINET 6 (Borgatti et al., 2002) to transform the matrices into Net-Maps and calculate the multiple measures at the network and stakeholder level (Borgatti et al., 2013; Rahimi-Feyzabad et al., 2022). In this paper, "measure" is defined as a unit for describing a particular characteristic of a social network. These measures help to understand the network positions of individual stakeholders (Brandes et al., 2016; Uddin et al., 2017) in the domain linkages (i.e., information supply, training, financial support and provision of basic services). Table 4 presents the definitions of these measures and their interpretations.

## 3. Results and discussion

### 3.1. Identified stakeholders and their roles in the street food vending system

Based on the document analysis, the following stakeholders and their roles in the street food vending system were identified: the Ministry of Health, National Agency for Health Regulation, Control and Surveillance, municipalities, street food vendors, and consumers. Moreover, based on the validation by the participants during the preliminary work, three more stakeholders were identified, namely street food vendor associations, academic institutions, and external consultants. The relevance and roles of these additional stakeholders were further confirmed by additional literature.

The document analysis and literature provided insight into their roles.

More in detail, the **Ministry of Health** provides health and wellness

**Table 2**  
Symmetric square matrix example.

	Municipalities	Consumers	Vendor associations	Street food vendors
Municipalities→	0	0	1	1
Consumers	0	0	0	1
Vendor associations	0	0	0	0
Street food vendors	0	0	0	0

\*Arrow indicates the direction of the linkage from the stakeholder in that row to the stakeholder in that column.

**Table 3**  
Attribute sheet for the power mapping.

Stakeholder <sup>a</sup>	Influence value	Relative influence <sup>b</sup>	Goal <sup>c</sup>	Stronger focus on (1) or (2)
SFV	27	1.00	2	- <sup>d</sup>
NA	20	0.74	3	1
AI	24	0.89	2	-
M	16	0.59	3	1
VA	14	0.52	3	2
MH	0	0.00	1	-
EC	0	0.00	1	-
C	0	0.00	2	-

SFV: Street food vendors; NA: National Agency for Health Regulation, Control and Surveillance; AI: Academic institutions; M: Municipalities; VA: vendor associations; MH: Ministry of health; EC: External consultants; C: Consumers.

<sup>a</sup> Stakeholders are enlisted according to the relative influence (highest to lowest).

<sup>b</sup> The relative influence was calculated by dividing the influence value and the highest influence value. For instance, the Relative influence of the municipality was 0.59 (16/27).

<sup>c</sup> Numbers mean [1] = Control; [2] = Improvement; [3] = Both.

<sup>d</sup> The symbol [-] means no applicable.

services to the country’s population (Constitución de La República Del Ecuador 2008; 2011; *Ley & de Salud, 2015*). The Ministry of Health encourages the Municipal Autonomous Decentralized Governments (GAD) to take care of the hygienic conditions that guarantee the sales of nutritious and safe food at local markets (*Ministerio Coordinador de Desarrollo Social Ministerio de Salud Pública & Organización Panamericana de la Salud, 2016*).

The **National Agency for Health Regulation, Control and Surveillance** (ARCSA) is the technical, governmental body in charge of the regulations, technical control and health surveillance of processed foods, food additives, processed water, medicines and others, and the establishments subject to sanitary surveillance and control. The last responsibility is established in the Organic Law of Health and other applicable regulations (*Crea Agencia Nacional de Regulación Control y Vigilancia ARCSA, 2016*). The street food vendors of local markets are not part of its scope of control.

**Local municipalities** prioritise community health and well-being, support small businesses and safe food production, and create necessary infrastructure (*Código Orgánico de Organización Territorial, COOTAD, 2015*). Public Service departments in municipalities are responsible for managing hygiene, food quality, public space, livestock services, and urban fauna. This is outlined in official documents like the Ambato Canton’s "Substitute ordinance" (*Ordenanza Sustitutiva que regula el funcionamiento de plazas, ferias populares, mercados y/o centros Comerciales Populares Minoristas del Cantón Ambato, 2013*) and the "Organic Statute of Organizational Management by Processes Decentralized Autonomous Government Municipality of Ambato" (*Estatuto Orgánico de Gestión Organizacional por Procesos Gobierno Autónomo Descentralizado Municipalidad de Ambato, 2020*).

**Street food vendors** offer food for sale to the public from a temporary static or mobile stall (*Ayodele & Panama, 2016*; Regulation for the Sanitary Control of Food Sold in Public Ways, 1992). According to the Internal Regulation of the Ambato Municipality (*Reglamento Interno del GADMA Pub. L. No. DA-14-0156 1, 2014*), street food vendors in the local markets must comply with the cleaning and maintenance measures for the stalls, payment of rental fees for the stalls and basic services, and attend the training program of the municipal market administration.

**Street food consumers** mainly belong to the middle and low-income groups (*Thatchinamoorthy & Meenambigai, 2018*). Consumers’ food safety awareness is thought to contribute to developing appropriate public policies that address all the facets of street food vending, from raw materials to the hygiene of the vendors and the vending environment (*Hilmi, 2020*).

**Table 4**  
Definitions and interpretations of the measures typifying the network and characterising the stakeholder positions.

Measure	Description	Interpretation
Measures to typify the network		
Network density	Network density shows the number of linkages expressed as a proportion of the total number of possible connections ( <i>Borgatti et al., 2013</i> ).	The higher the value, the more linkages between stakeholders in the network. A value 1 means that all stakeholders are linked to one or more stakeholders. The higher the value, the more complex the network.
Reciprocity	Reciprocity value shows direct mutual relationships between two stakeholders ( <i>Rahimi-Feyzabad et al., 2022</i> ).	A higher reciprocity value reflects a higher number of mutually connected stakeholders. A high value may indicate a stable network.
Transitivity	Transitivity is the overall probability for the network to have adjacent interconnected nodes, thus revealing the existence of tightly connected communities (or clusters, subgroups, cliques) ( <i>Sagr et al., 2020</i> ).	A higher transitivity value means that the network is complex. Also, a high value can be an indication of a stable network.
Core-periphery structure	The core-periphery structure is a fundamental network pattern, referring to the presence of two qualitatively distinct components, i.e., core (central) and periphery ( <i>Borgatti et al., 2002</i> ).	Centrally positioned stakeholders in the network are tightly connected stakeholders who are also central in the network. The peripherally positioned stakeholders are loosely connected to the core and among themselves.
Measures to characterise stakeholder positions		
In-degree centrality $C_{D-in}$	In-degree centrality refers to the number of inputs or directions a stakeholder receives from other stakeholders ( <i>Borgatti et al., 2013</i> ).	A high value means that the stakeholder receives inputs from many other stakeholders. A high value indicates that many other stakeholders influence the stakeholder.
Out-degree centrality $C_{D-out}$	Out-degree centrality refers to the number of inputs or directions a stakeholder provides to other stakeholders ( <i>Borgatti et al., 2013</i> ).	A high value means that the stakeholder provides inputs to many other stakeholders. A high value indicates that the stakeholder is very influential.
Closeness centrality $C_C$	Closeness centrality refers to the average length of the paths linking the stakeholder to others. This centrality measure reveals the reachability of a stakeholder to others in the network ( <i>Borgatti et al., 2013</i> ).	A high value means the stakeholder is relatively close to all other stakeholders. A high value indicates that the stakeholder is closely interlinked in the network.
Betweenness centrality $C_B$	Betweenness centrality shows a stakeholder’s potential for being an intermediary in the network ( <i>Rahimi-Feyzabad et al., 2022</i> ).	A stakeholder with a high betweenness score means that he has multiple intermediary positions in the network. A high value indicates that the stakeholder has a strategic role in the network.
Eigenvector centrality $C_G$	Eigenvector centrality indicates the extent to which a stakeholder is connected to other well-connected stakeholders ( <i>Rahimi-Feyzabad et al., 2022</i> ).	A high eigenvector score means the stakeholder has a more central position and is influential in the network. High eigenvector centrality indicates that a stakeholder is a leader of the network.

\*In this paper, “measure” is defined as a unit used for describing a particular characteristic of a social network.



**Vendor associations** provide channels for street vendors to involve the collective voice of street vendors in local decision-making. They represent the communication channel between local authorities and vendors (Roever & Skinner, 2016).

**Academic institutions**, either with a public or private character, may provide information or training through, e.g. social research projects focused on food safety (Contreras et al., 2020; Ortiz-Ulloa et al., 2020). The findings of their studies can contribute to decisions on improving the street food sector (Alimi, 2016).

**External consultants** can add value by assisting street food vendors in complying with specific requirements and improving their situation. They may support the development of regulations to control or improve the sector (Mcfarland et al., 2019).

### 3.2. Characteristics of the stakeholder Net-Maps

Fig. 1 shows the Net-Maps of the stakeholders involved in street food safety for the four types of linkages (i.e., [A] information supply, [B] training, [C] financial support and [D] the provision of basic services). The node size indicates a stakeholder's influence (i.e., a larger node reflects a stronger relative influence), the lines and arrows between stakeholders reflect the relationship between them, and the line's thickness shows the strength of the relationship. The node colour represents the stakeholder's role (blue = control, green = improvement, yellow = both). If a stakeholder is involved in both roles, the coloured rim around the yellow node indicates whether control (blue) or improvement (green) is more important.

From the street food vendors' perspective, the relatively stronger influence was with the academic institutions, National Agency for Health Regulation, Control and Surveillance (ARCSA), municipalities and vendor associations. The major relationships between stakeholders were in the information network. For this network, the strongest relationships were between (1) municipalities-street food vendors-the National Agency for Health Regulation, Control and Surveillance, and (2) municipalities-academic institutions, shown by the thicker lines. The ARCSA and municipalities focus on food safety control (blue nodes), whereas academic institutions focus on improvement (green nodes) in street food safety.

Table 5 shows the measures that typify the studied networks. The information supply network has the highest density value (0.714), implying that all stakeholders are strongly connected. This network also scored highest for the reciprocity value (0.739) because most stakeholders are mutually connected, thereby contributing to the network's stability. The stakeholders at the core of the information supply network

are street food vendors, municipalities, vendor associations and academic institutions. The ARCSA, the Ministry of Health, external consultants and consumers are peripherally positioned and more loosely connected to the stakeholders in the core.

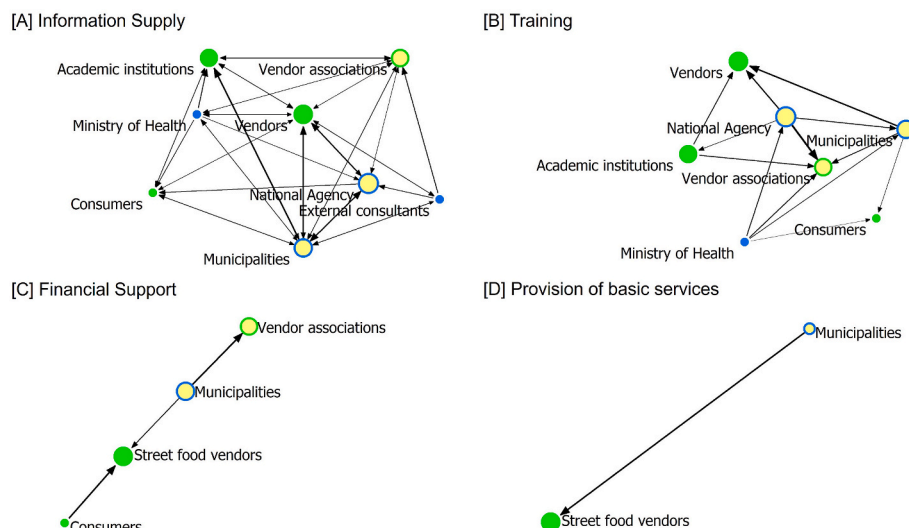
The training network ranks second in the density of the network and has the highest transitivity score (0.667), which indicates a stable and durable network.

### 3.3. Characteristics of the stakeholder's network positions

Table 6 shows the centrality measures for the individual stakeholders in the networks, characterising their network positions. In-degree centrality indicates the number of inputs a stakeholder receives from other stakeholders, whereas out-degree centrality reflects the number of inputs a stakeholder provides to other stakeholders. Closeness centrality depicts the accessibility of a stakeholder to the other stakeholders in the network. Eigenvector centrality indicates the extent to which a stakeholder is connected to other well-connected stakeholders. Betweenness centrality shows a stakeholder's potential to be an intermediary in the network (Nunes & Abreu, 2020; Uddin et al., 2017).

From the perspective of the street food vendors, the municipalities are the most important stakeholders. The municipalities scored highest for the degree centrality measures ( $C_{D-in} = 7$  and  $C_{D-out} = 7$ ) in the information supply network, which means that they receive and provide more information in the network than others (Table 6). For the same network, municipalities scored highest on betweenness ( $C_B = 6.283$ ), indicating that they have a strategic role in the network. They also scored high for the eigenvector centrality ( $C_G = 0.408$ ), which implies that the municipalities have a central position and are influential in the information supply network. The municipalities scored lowest for the closeness centrality measure ( $C_C = 7$ ), and the external consultants ( $C_C = 12$ ) scored highest. This implies that the municipalities are relatively less reachable in the network as they have the longest average lengths of paths linking them to other stakeholders.

Furthermore, the municipalities scored the highest out-degree regarding the financial support network ( $C_{D-out} = 2$ ) and the provision of the basic services network ( $C_{D-out} = 1$ ), which indicates that the municipalities are the main stakeholders able to connect with others in these networks. The highest eigenvector centrality values of municipalities for the financial and basic service networks ( $C_G = 0.602$  and  $0.707$ , respectively) further indicate that they are relatively influential and have a central position in those networks. Moreover, the municipalities are the most important intermediary in the training network, with a high betweenness centrality ( $C_B = 1.500$ ), indicating a strategic



**Fig. 1.** Net-Maps of the relationships between stakeholders involved in street food safety in Ecuador regarding [A] Information supply, [B] Training, [C] Financial support, [D] Provision of basic services. Node size indicates a stakeholder's influence; Lines and arrows reflect the relationship between the stakeholders; Line's thickness shows the strength of the relationship; Node colour represents the stakeholder's role (blue = control, green = improvement, yellow = both); Coloured rim around the yellow node indicates whether control (blue) or improvement (green) is more important.

**Table 5**  
Typification of the information supply, training, financial support and provision of basic services networks.

Network	N° Linkages	Network density <sup>a</sup>	Transitivity	Reciprocity	Stakeholders at the core	Stakeholders at the periphery
Information supply	40	0.714 ± 0.452	0.347	0.739	Municipalities, vendor associations, academic institutions, street food vendors	ARCSA, Ministry of Health, external consultants, consumers
Training	13	0.232 ± 0.422	0.667	0 <sup>b</sup>	ARCSA, Ministry of Health, municipalities, vendor associations	Street food vendors, academic institutions, consumers
Financial support	3	0.054 ± 0.225	N/A	0	Municipalities, street food vendors	Vendor associations, consumers
Provision of basic services	1	0.018 ± 0.132	N/A	0	Street food vendors, municipalities	

N/A: Not applicable because there is only one “in” or one “out” connection.

<sup>a</sup> Mean value and standard deviation.

<sup>b</sup> Mean no direct mutual relationships among the stakeholders.

**Table 6**  
Centrality measures to typify the position of individual stakeholders in the network.

Measures	Network	Street food vendors	Municipalities	National agency for health regulation, control and Surveillance	Street food vendor associations	Ministry of Health	Consumers	External consultants	Academic institutions
In-degree C <sub>D-in</sub>	Information supply	7	7	5	6	3	5	2	5
	Training	3	2	1	4	*	2		1
	Financial support	2			1				
	Provision Basic Services	1							
Out-degree C <sub>D-out</sub>	Information supply	7	7	4	5	6	3	4	4
	Training		3	4		4			2
	Financial support		2				1		
	Provision Basic Services		1						
Closeness C <sub>C</sub>	Information supply	7	7	9	8	11	9	12	9
	Training	5	2	1	4		4		3
	Financial support	2			1				
	Provision Basic Services	1							
Eigenvector C <sub>G</sub>	Information supply	<b>0.408</b>	<b>0.408</b>	0.362	0.362	0.370	0.317	0.262	0.317
	Training	0.313	0.458	<b>0.476</b>	0.413	0.395	0.216		0.304
	Financial support	<b>0.602</b>	<b>0.602</b>		0.372		0.372		
	Provision Basic Services	<b>0.707</b>	<b>0.707</b>						
Betweenness C <sub>B</sub>	Information supply	<b>6.283</b>	<b>6.283</b>	0.533	1.917	0.200	0.250	0.000	0.533
	Training		<b>1.500</b>	<b>1.500</b>					

Note: **Bold numbers** represent the maximum value of the measures according to descriptive statistics (See Appendix B).

\* a space means score 0.

role (Table 6).

Our findings about the important position of the municipalities in multiple networks, such as information supply, financial support and provision of basic services, are corroborated by their independent position to organise, manage and allocate resources for administrative, economic and political activities. These activities are described in the National Law (Código Orgánico de Organización Territorial, COOTAD, 2015). Nevertheless, Garcés Proaño (2017) concluded in his study about managing municipal markets in Ambato that municipalities did not contribute to improving the interior and exterior of the workplaces of the street food vendors because of insufficient financial resources. Likewise, our previous study revealed that the street food vendors perceived shortcomings in the current garbage collection and disposal and pest control services, which may jeopardise street food safety. In contrast, the characteristics of the current facilities regarding water

supply and sanitation supported practising their profession and working hygienically (Pilamala et al., 2023).

The National Agency for Health Regulation, Control and Surveillance (ARCSA) is the second most important stakeholder from the perspective of street food vendors. They also obtained relatively high values for multiple centrality measures, particularly for the training network, such as for the out-degree (C<sub>D-out</sub> = 4), the eigenvector (C<sub>G</sub> = 0.476) and the betweenness centrality measures (C<sub>B</sub> = 1.500). These values suggest that ARCSA is rather influential in the training network. The ARCSA indeed has the responsibility to develop information, education, communication and community participation activities to safeguard the health of Ecuadorians in coordination with the local governments, the chambers of production and university centres (Pérez Parra et al., 2017). For example, the ARCSA and the Municipal Autonomous Decentralized Government of different cities, within the "Correct Hygiene Practices for

Markets" strategy, conducted training sessions to strengthen knowledge on preventive actions and basic principles necessary to guarantee the safety and quality of food. These training sessions reached over 3000 food handlers from different local markets in Ambato, Guaranda, Cuenca and Quito (ARCOSA, 2018a; 2018c, 2019). Furthermore, Table 6 shows relatively high values for the in-degree ( $C_{D-in} = 4$ ) and the closeness centrality measures ( $C_C = 4$ ) in the training network for the vendor associations. This finding indicates that vendor associations have a central position, can be influenced by other stakeholders and are relatively close to other stakeholders. In Ecuador, vendor associations combine efforts to improve street food vendors' organisational, commercial and production circumstances at the local markets (Cueva et al., 2020). For example, in Machala, Ecuador, the National Government allocated resources to improve the workplace conditions at the local markets through vendor associations (Galvez, 2016).

The external consultants scored highest on the closeness centrality measure ( $C_C = 12$ ) in the information supply network. This finding implies that external consultants have the best capacity to connect with the other stakeholders in the network. Currently, the external consultants in Ecuador only provide training and technical assistance upon request by food companies and do not play a role in the street food vending sector. Studies in food service establishments in Brazil (da Cunha, 2021; Dolberth Dardin et al., 2020; Stangarlin-Fiori et al., 2016) demonstrated that the intervention of external professionals with technical expertise in food safety helps the implementation of good hygiene practice programs. They conduct unbiased and rigorous evaluations, besides paying regular visits to the venues and motivating owners and food handlers to make the necessary adaptations. de Lima et al. (2019) concluded that the participation of food safety consultants during interventions targeting the food safety of food service establishments significantly increased the compliance to hygiene practices of food handlers. External consultants may play a supportive role in improving hygiene practices in the street food sector. Still, this is not yet common in the street food sector in Ecuador.

### 3.4. Overall discussion

Through the Net-Map analysis, this study identified the formal (i.e., described in official documents) and informal stakeholders and their overall goals in realising food safety in the street food system at local markets in Ecuador. It also provided insights into how these stakeholders are interconnected and how influential they are. The findings provide a basis for identifying which stakeholders, which can be governmental and/or non-governmental entities, are most influential in which type of network (e.g. exchanging information or providing training). The findings also indicate who would be the best stakeholder (s) for implementing interventions to better control or improve street food safety.

From a food safety governance perspective, this study demonstrates that the municipalities' major role is to contribute to control and that they have a strategic and influential position in the information supply, financial support and provision of services networks (Table 6). Municipalities are thus important stakeholders to intervene in food safety control by providing financial resources such as investments in basic infrastructure (e.g., clean water, proper sanitation facilities, disposal facilities at local markets) and services (e.g., waste management, cleaning services). This finding agrees with our previous study that demonstrated that street food vendors stressed the importance of hygiene facilities and services to properly conduct their work (Pilamala et al., 2023).

A major role of the National Agency for Health Regulation, Control and Surveillance (ARCOSA), is to contribute to food safety control by providing training. According to the centrality measures (Table 6), they have a strong influential position in the training network. However, they are less connected with other stakeholders, such as street food vendors. On the contrary, the vendor associations are very reachable because

they are connected to multiple other stakeholders, and street food vendors specifically, in both the training and information supply networks (Table 6). To implement training programs, a joint effort of ARCOSA and the street food vendor associations could be beneficial as the associations could be a channel through which information and knowledge about food safety can be effectively transferred to street food vendors to enhance their beliefs, attitudes, and behaviour related to food safety. External consultants are also well-connected to multiple stakeholders, particularly in the information supply network (Table 6). They could facilitate communication about food hygiene practices between all stakeholders in the street food vending system (i.e., the street food vendors, vendor associations, municipalities, the Ministry of Health and ARCOSA). It could be beneficial to involve them more in improving street food safety as their actual involvement is still limited.

From a research perspective, this study demonstrates how the Net-Map methodology can be applied to food systems. Further Net-Map research in other regions in Ecuador and other countries could help identify common patterns in street food vending systems and ways to implement interventions to ensure the safety of street food worldwide.

## 4. Conclusions

This study was the first to apply the Net-Map methodology in the context of street food safety. Applying the Net-Map methodology resulted in identifying eight stakeholders, two goals (i.e., control and improvement) and four stakeholder networks, namely information supply, training, financial support and provision of basic services for Ambato in Ecuador. Here, the information supply and training networks are the most stable ones because they contain the most stakeholders with direct and mutual relationships. The municipalities and the National Agency for Health Regulation, Control and Surveillance (ARCOSA) are the main stakeholders in street food control. In contrast, academic institutions and vendor associations are the main ones in improvement activities. Our findings suggest that to enhance food safety control, the municipalities should be targeted as they are centrally positioned and influential in the information supply, financial support and provision of basic services networks. However, they are less reachable to other stakeholders. Instead, the external consultants are highly reachable in the information supply network, but they do not yet play a role in supporting food safety control in the street food system. To enhance improvement activities, the ARCOSA should be targeted as they are leading in the training network, although vendor associations have better reachability in this network. Allocation of resources to external consultants and vendor associations may support municipalities and ARCOSA, respectively, in enhancing food control and improvement activities that will benefit street food safety. The Net-Map methodology has shown to be also a useful tool for the analysis of street food vending systems.

### CRedit authorship contribution statement

**Araceli Pilamala Rosales:** Conceptualization, Investigation, Methodology, Writing – original draft, Visualization, Writing – review & editing. **Anita R. Linnemann:** Writing – original draft, Conceptualization, Supervision, Methodology, Writing – review & editing. **Pieterneel A. Luning:** Writing – original draft, Conceptualization, Supervision, Methodology, Writing – review & editing.

### Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

## Data availability

Data will be made available on request.

## Acknowledgements

This research was supported by an Ecuadorian Secretary of Higher Education, Science, Technology and Innovation grant (ARSEQ-BEC-006380-2018).

## Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.foodcont.2023.109966>.

## References

- Al Mamun, M., & Turin, T. C. (2016). Safety of street foods. In *Food hygiene and toxicology in ready-to-eat foods* (pp. 15–29). Academic Press. <https://doi.org/10.1016/B978-0-12-801916-0.00002-9>.
- Alimi, B. A. (2016). Risk factors in street food practices in developing countries: A review. *Food Science and Human Wellness*, 5(3), 141–148. <https://doi.org/10.1016/j.fshw.2016.05.001>
- ARCSA. (2018a). Más de 1100 comerciantes de Cuenca fueron capacitados por ARCSA. <http://www.controlsanitario.gob.ec/mas-de-1100-comerciantes-de-cuenca-fueron-capacitados-por-arcsa/>.
- ARCSA. (2018b). Mercados y plazas de Ambato recibieron asesoría sanitaria de ARCSA. <https://www.controlsanitario.gob.ec/mercados-y-plazas-de-ambato-recibieron-asesoria-sanitaria-de-arcsa/>.
- ARCSA. (2018c). Comerciantes de mercados de Quito reciben capacitación de ARCSA. April 20 <https://www.controlsanitario.gob.ec/comerciantes-de-mercados-de-quito-reciben-capacitacion-de/>.
- ARCSA. (2019). ARCSA capacitó en higiene a vendedores informales de Guaranda. <https://www.controlsanitario.gob.ec/arcsa-capacito-en-higiene-a-vendedores-informales-de-guaranda/>.
- Ayodele, A. A., & Panama, A. E. (2016). Predictors of consumer patronage of street food vendors in a typical developing economy context. *Developing Country Studies*, 6(11), 105–119. <https://ssrn.com/abstract=3118881>.
- Bach, L. (2014). Are small businesses worthy of financial aid? Evidence from a French targeted credit program. *Review of Finance*, 18, 877–919. <https://doi.org/10.1093/rf/rft022>
- Bamu, P. H. (2019). *Street vendors and legal advocacy: Reflections from Ghana, India, Peru, South Africa and Thailand* (Vol. 14). WIEGO Resource Document. <https://www.wiego.org/sites/default/files/publications/file/Bamhu-WIEGO-Resource-Documnt-14-Street-Vendors-Law-Five-Countries-2019.pdf>.
- Borgatti, S. P., Everett, M. G., & Freeman, L. C. (2002). *Ucinet for windows: Software for social network analysis* (Harvard, MA Analytic Technologies).
- Borgatti, S. P., Everett, M. G., & Johnson, J. C. (2013). *Analyzing social networks*. Thousand Oaks, CA: Sage.
- Brandes, U., Borgatti, S. P., & Freeman, L. C. (2016). Maintaining the duality of closeness and betweenness centrality. *Social Networks*, 44, 153–159. <https://doi.org/10.1016/j.socnet.2015.08.003>
- Buccini, G., Harding, K. L., Ferré Eguiluz, I., Safon, C. B., Hromi-Fieller, A., González De Cosío, T., & Pérez-Escamilla, R. (2020). An analysis of stakeholder networks to support the breastfeeding scale-up environment in Mexico. *Journal of Nutrition Sciences*, 9, 10. <https://doi.org/10.1017/jns.2020.4>
- Código Orgánico de Organización Territorial. (2015). COOTAD, pub. L. No. Ley 0, registro oficial suplemento 303 de 19-oct-2010. Constitución de la República del Ecuador 2008, Pub. L. No. Registro Oficial 449 de 20-oct-2008 (2011).
- Contreras, C. P. A., de Cassia Vieira Cardoso, R., da Silva, L. N. N., & Cuervo, R. E. G. (2020). Street food, food safety, and regulation: What is the panorama in Colombia?: A review. *Journal of Food Protection*, 83(8), 1345–1358. <https://doi.org/10.4315/JFP-19-526>
- Crea Agencia Nacional de Regulación Control y Vigilancia ARCSA, Pub. L. No. Decreto Ejecutivo 1290. (2016). Registro oficial suplemento 788 de 13-sep-2012.
- Cueva, M. C., Palacios, A. D. J. R., Jiménez, S. F. R., Corrales, E. N. P., Anchundia, A. A., Tapia, A. A. F., Mendoza, M., Zambrano, M. F., & Catasú, W. G. C. (2020). *Un acercamiento a los mercados populares: Realidad y perspectiva en Ecuador* (1st ed.). Editorial Universitaria.
- Cui, L., Jiang, H., Deng, H., & Zhang, T. (2019). The influence of the diffusion of food safety information through social media on consumers' purchase intentions: An empirical study in China. *Data Technologies and Applications*, 53(2), 230–248. <https://doi.org/10.1108/DTA-05-2018-0046>
- da Cunha, D. T. (2021). Improving food safety practices in the foodservice industry. *Current Opinion in Food Science*, 42, 127–133. <https://doi.org/10.1016/j.cofs.2021.05.010>
- Dolberth Dardin, F., Opolski Medeiros, C., do Nascimento Diz, M., Luiz da Costa, R., & Stangarlin-Fiori, L. (2020). Evaluation of good hygiene practices in food trucks from the perspective of internal and external auditors. *Journal of Quality Assurance in Hospitality & Tourism*, 22(2), 143–162. <https://doi.org/10.1080/1528008X.2020.1756023>
- Estatuto Orgánico de Gestión Organizacional por Procesos Gobierno Autónomo Descentralizado Municipalidad de Ambato. (2020). Pub. L. No. Resolución administrativa N° DA-20-0162.
- FAO. (2021). *Food safety and quality: Food regulations*. <http://www.fao.org/food/food-safety-quality/capacity-development/food-regulations/en/>.
- Galvez, C. (2016). *Análisis Socioeconómico de la Asociación de Comerciantes del Mercado Sur en la Ciudad de Machala* [Master's Thesis. Technical University of Machala. <http://repositorio.utmachala.edu.ec/handle/48000/9618>.
- Garcés Proaño, L. M. (2017). *Modelo de Gestión para el funcionamiento de mercados municipales de la ciudad de Ambato, Provincia de Tungurahua* [Master's Thesis, Technical University of Ambato] <https://repositorio.uta.edu.ec/jspui/handle/123456789/25383>.
- Gargiulo, A. H., Duarte, S. G., Campos, G. Z., Landgraf, M., Franco, B. D. G. M., & Pinto, U. M. (2022). Food safety issues related to eating in and eating out. *Microorganisms*, 10(11), 2118. <https://doi.org/10.3390/microorganisms10112118>
- Haque, I. T., & Kohda, Y. (2020). Understanding the impact of social determinants of health in street food safety: A qualitative study in Bangladesh. *International Journal of Health Promotion and Education*, 58(3), 152–162. <https://doi.org/10.1080/14635240.2020.1719860>
- Hilmi, M. (2020). Street food vendors' entrepreneurial marketing characteristics and practices from 12 countries: What lessons can be learnt for improving food marketing in BOP/subsistence marketplaces. *Middle East Journal of Agriculture Research*, 9(2), 321–348.
- Jores, D., Arif, M. T., & Rahman, M. M. (2018). Factors associated with food hygiene practices among street food vendors in Padawan, Sarawak. *Borneo Journal of Resource Science and Technology*, 8(1), 56–65. <https://doi.org/10.33736/bjrst.824.2018>
- Khairuzzaman, M., Chowdhury, F. M., Zaman, S., Al Mamun, A., & Bari, M. L. (2014). Food safety challenges towards safe, healthy, and nutritious street foods in Bangladesh. *International Journal of Food Science*, Article 483519. <https://doi.org/10.1155/2014/483519>, 2014.
- de Salud, Ley Orgánica (2015). Pub. L. No. Ley, 67.
- de Lima, D. P., Medeiros, C. O., Dardin, F. D., & Stangarlin-Fiori, L. (2019). Implementation of good hygiene practices in food trucks with and without the intervention of a food safety expert. *Journal of Food Safety*, 39(3), Article e12637. <https://doi.org/10.1111/jfs.12637>
- López-García, R. (2017). Food law in Mexico: Regulatory framework and public policy strategies to address the obesity crisis in Latin America. In *International food Law and policy*. [https://doi.org/10.1007/978-3-319-07542-6\\_33](https://doi.org/10.1007/978-3-319-07542-6_33)
- Mcfarland, P., Sielaff, A. C., Rasco, B., & Smith, S. (2019). Efficacy of food safety training in commercial food service. *Journal of Food Science*, 84(6), 1239–1246. <https://doi.org/10.1111/1750-3841.14628>
- Ministerio Coordinador de Desarrollo Social Ministerio de Salud Pública, Organización Panamericana de la Salud. (2016). *Mercados Saludables en Ecuador. Manual para el reconocimiento y la certificación de mercados saludables*. [https://www.salud.gob.ec/wp-content/uploads/2021/03/Manual\\_Mercados\\_Saludables\\_final-25.04.2016.pdf](https://www.salud.gob.ec/wp-content/uploads/2021/03/Manual_Mercados_Saludables_final-25.04.2016.pdf).
- Ministerio de Salud Pública, (Msp). (2019). *Subsistema de Vigilancia SIVE-ALERTA. Enfermedades transmitidas por agua y alimentos Ecuador, SE* (Vols. 1–28), 2019 [https://www.salud.gob.ec/wp-content/uploads/2018/11/gaceta\\_etase28.pdf](https://www.salud.gob.ec/wp-content/uploads/2018/11/gaceta_etase28.pdf).
- Mwamakamba, L., Mensah, P., Takyiwa, K., Darkwah-Odamé, J., Jallow, A., & Maiga, F. (2012). Developing and maintaining national food safety control systems: Experiences from the WHO African region. *African Journal of Food, Agriculture, Nutrition and Development*, 12(4), 6291–6304. <https://doi.org/10.4314/ajfand.v12i4>
- Ngo, H. H. T., Nguyen-Thanh, L., Pham-Duc, P., Dang-Xuan, S., Le-Thi, H., Denis-Robichaud, J., Nguyen-Viet, H., Le, T. T. H., Grace, D., & Unger, F. (2021). Microbial contamination and associated risk factors in retail pork from key value chains in Northern Vietnam. *International Journal of Food Microbiology*, 346, Article 109163. <https://doi.org/10.1016/j.ijfoodmicro.2021.109163>
- Nunes, M., & Abreu, A. (2020). Applying social network analysis to identify project critical success factors. *Sustainability*, 12(4), 1–32. <https://doi.org/10.3390/su12041503>
- Nyokabi, S. (2023). *Bridging the gap: Improving milk quality on smallholder dairy systems in Kenya* [Doctor's Thesis]. Wageningen University.
- Ordenanza sustitutiva que regula el funcionamiento de plazas, ferias populares, mercados y/o centros comerciales populares minoristas del Cantón Ambato, Pub. L. No. Ord. N° 100.48.5 (2013).
- Ortiz-Ulloa, J., Castro, M., Ochoa, A., & Donoso, S. (2020). Revisión sistemática de estudios sobre inocuidad alimentaria en Cuenca, Ecuador, periodo 1981-2017. *Segurança Alimentar e Nutricional*, 27, 1–12. <https://doi.org/10.20396/san.v27i0.8654199>
- Pérez Parra, J., Useche Castro, L., Isea León, F., Cuervo Pérez, M., & Canchingre Bone, E. (2017). Evaluación de la Hepatitis A como enfermedad transmitida por alimentos en Ecuador durante el 2015. *Revista CUMBRES*, 3(1), 25–31.
- Pilamala, A., Linnemann, A. R., & Luning, P. A. (2023). Food safety knowledge, self-reported hygiene practices, and street food vendors' perceptions of current hygiene facilities and services-An Ecuadorean case. *Food Control*, 144, Article 109377. <https://doi.org/10.1016/j.foodcont.2022.109377>
- Poku, A. G., Birner, R., & Gupta, S. (2018). Is africa ready to develop a competitive bioeconomy? The case of the cassava value web in Ghana. *Journal of Cleaner Production*, 200, 134–147. <https://doi.org/10.1016/J.JCLEPRO.2018.07.290>
- Rahimi-Feyzabadi, F., Yazdanpanah, M., Gholamrezai, S., & Ahmadvand, M. (2022). Social network analysis of institutions involved in groundwater resources management: Lessons learned from Iran. *Journal of Hydrology*, 613, Article 128442. <https://doi.org/10.1016/j.jhydrol.2022.128442>



- Reddy, A. A., Ricart, S., & Cadman, T. (2020). Driving factors of food safety standards in India: Learning from street-food vendors' behaviour and attitude. *Food Security*, 12(6), 1201–1217. <https://doi.org/10.1007/s12571-020-01048-5>
- Reglamento Interno del GADMA, Pub. L. No. DA-14-0156, 1. (2014). Regulation for the sanitary control of food sold in public ways. *Pub. L. No. Acuerdo No. 14381, Registro Oficial*, 966, 26. VI-1992 (1992).
- Reynolds, J., & Dolasinski, M. J. (2019). Systematic review of industry food safety training topics & modalities. *Food Control*, 105, 1–7. <https://doi.org/10.1016/j.foodcont.2019.05.015>
- Roever, S., & Skinner, C. (2016). Street vendors and cities. *Environment and Urbanization*, 28(2), 359–374.
- Schiffer, E. (2007). *Net-map toolbox: Influence Mapping of social network*. <https://netmap.files.wordpress.com/2008/06/net-map-manual-long1.pdf>.
- Schiffer, E., & Hauck, J. (2010). Net-map: Collecting social network data and facilitating network learning through participatory influence network mapping. *Field Methods*, 22(3), 231–249. <https://doi.org/10.1177/1525822X10374798>
- Soon, J. M. J. M. (2019). Rapid Food Hygiene Inspection Tool (RFHiT) to assess hygiene conformance index (CI) of street food vendors. *Lebensmittel-Wissenschaft & Technologie*, 113(April), Article 108304. <https://doi.org/10.1016/j.lwt.2019.108304>
- Stahlhut Espinosa, C. (2022). *The Food, Beverage and Cosmetics Law Review: Mexico. The Law Review*. September 22 <https://thelawreviews.co.uk/title/the-food-beverage-and-cosmetics-law-review/mexico>.
- Stangarlin-Fiori, L., Medeiros, L. B., Serafim, A. L., Bertin, R. L., Medeiros, C. O., & Hecktheuer, L. H. (2016). Good hygiene practices in hospital nutrition services: The view of internal and external auditors. *Food Science and Technology*, 36(3), 461–467. <https://doi.org/10.1590/1678-457X.00315>
- Thatchinamoorthy, C., & Meenambigai, J. (2018). Customer relationship management and retention in street food sector. *International Journal of Food and Nutrition Science*, 5(1), 25–29. <https://doi.org/10.15436/2377-0619.18.1789>
- Trafialek, J., Drosinos, E. H., Laskowski, W., Jakubowska-Gawlik, K., Tzamalís, P., Leksawadi, N., Surawang, S., & Kolanowski, W. (2018). Street food vendors' hygienic practices in some Asian and EU countries – a survey. *Food Control*, 85, 212–222. <https://doi.org/10.1016/j.foodcont.2017.09.030>
- Tuglo, L. S., Agordoh, P. D., Tekpor, D., Pan, Z., Agbanyo, G., & Chu, M. (2021). Food safety knowledge, attitude, and hygiene practices of street-cooked food handlers in North Dayi District, Ghana. *Environmental Health and Preventive Medicine*, 26(1), 1–13. <https://doi.org/10.1186/s12199-021-00975-9>
- Uddin, S., Mahmood, H., Senarath, U., Zahiruddin, Q., Karn, S., Rasheed, S., & Dibley, M. (2017). Analysis of stakeholders networks of infant and young child nutrition programmes in Sri Lanka, India, Nepal, Bangladesh and Pakistan. *BMC Public Health*, 17(2), 15–25. <https://doi.org/10.1186/s12889-017-4337-1>
- WHO. (2022). *Food Safety*. <https://www.who.int/news-room/fact-sheets/detail/food-safety>.
- Yadav, A. K., Johari, R., & Dahiya, R. (2019). Identification of centrality measures in social network using network science. In *2019 international conference on computing, communication, and intelligent systems (ICCCIS)* (pp. 229–234). IEEE. <https://doi.org/10.1109/ICCCIS48478.2019.8974553>, 229–234.
- Zhang, J., & Luo, Y. (2017). Degree centrality, betweenness centrality, and closeness centrality in social network. In *Proceedings of the 2017 2nd international conference on modelling, simulation and applied mathematics (MSAM2017)* (pp. 300–303). <https://doi.org/10.2991/msam-17.2017.68>, 132.