

ANEXO 5 .- FUNDAMENTALS OF RESEARCH AND ACTION IN FOOD SYSTEMS FOR THE PREVENTION OF NONCOMMUNICABLE CHRONIC

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Fundamentals of research and action in food systems for the prevention of noncommunicable chronic diseases (NCCD): a scoping review

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1. Introduction

It is a fact that today we have enough food on the planet to feed us all and have a healthy and productive life (WFP, 2011). However, it is estimated that nearly 800 million people in the world are hungry and 2000 million more would be in this condition by 2050. Currently, hunger and undernutrition are part of the main problems that our civilization faces and thus, comprehension and action on food systems (FS) is a priority, not just for health, but also for education and global economy.

FSs are an outcome of diverse elements, activities and actors that make possible food production as well as its transformation, distribution, and consumption (FAO, 2017). FS influence their environment since they need non-renewable natural resources (FAO, 2017). As a consequence, high input demand FS have devastating effects on environmental and human health, therefore justifying the need to incorporate sustainability principles, in order to establish a balance in social and economic relationships and also in productive factors of natural resources (Salcedo & Guzmán, 2014). In this sense, the high High-Level Task Force on global food and nutrition security, through its working group on “Zero Hunger Challenge”, considers that a sustainable FS is defined as sustainable because of its capacity to strengthen the social, environmental and economic basis to generate food and nutritional security, without compromising the resources of future generations (U. FAO, UNIDO, & World Bank, 2015).

In a wide sense, sustainability of social, environmental and economic dimension implies, from agricultural production and food transformation, to reduce greenhouse gases emission (GHG) and to produce more nutritional and caloric balanced products, fostering food and nutritional security. For this, there have been policies proposed to encourage favourable environments for the development of sustainable FS that generate gender-sensitive transitions in the field (prioritizing

the protection of women and children), strengthen the value chain (besides the economic value, the nutritional composition of the final product) and improve food access, with equity and social inclusion (U. FAO, UNIDO, & World Bank, 2015).

According to the United Nations Organization, through its High Level Task Force on Food and Nutrition Security, the alignment of the short and medium term goals of the FS with several of the World Sustainable Development Goals would facilitate the scope of the transition to sustainability, not only with regard to the objective of Zero Hunger, but also with objectives related to: health and wellness; gender equality; clean water; industry, innovation and infrastructure; sustainable cities and communities; responsible production and consumption; and underwater life and terrestrial ecosystems (HLPE, 2014).

Despite advances in the way of conceiving FS in a more integral way, the World Committee on World Food Security (HLPE, 2014) reports that the use of the FS concept is mainly descriptive, and it is used in a general way in the literature with a definition lacking of characteristics of performance or outcomes of the system according to different contexts where it is developed. The same committee points out, however, that systems theory offers the FS concept a transdisciplinary nature and an integrating thinking approach, which would allow a better understanding of the food-health relationship.

In the same sense, for some time, Sobal et al. had suggested to expand the FS concept towards the idea of food and nutritional system to emphasize and focus attention on the vital links that exist between food production, consumption and nutritional health (Sobal, Khan, & Bisogni, 1998). Three subsystems proposed by Sobal et al.: production, consumption and nutrition possess inputs, processes and outputs, as well as tools, actors and contextual interactions with other systems and political, environmental, economic and health areas, among others, that provide elements for FS

functional characterization (Sobal et al., 1998). For example, marketing and commerce processes influence producer and consumer components (actors). For nutrition sub-system case, it is composed by digestion and utilization of nutrients, as well as anthropometric and biochemical markers, which allow to reflect and measure changes in an individual's health.

For a broad understanding of the FS concept, Ericksen (2008) adds that it is necessary to know the determinants and outcomes of the activities of its sub-systems; the determinants involve biological, geological, physical, environmental and human interactions that determine its development; in turn, the activities produce results that are affected by their determinants. This author states that the main political aim of FS is food security and its outcomes revolve around three components: availability (production, distribution, exchange), access (affordability, allocation and preference) and use (social preferences and nutritional value).

In summary, through different interactions going from production to consumption, and their expression in the nutritional health of the individual, it is expected that the FS provide adequate quantities of food (products) quality, that meet the nutritional needs in all life stages (Cuéllar, 2011). Such food disposal must be supported by policies that promote production, processing, consumption and adoption of healthy eating behaviour. In particular, modification of practices and interactions between different FS activities alters the availability of food that contributes to healthy and complete nutrition, and generates diet transitions, affecting people health. Increasing prevalence of diet related diseases, mainly named non communicable chronic diseases (NCCD), it is usually observed in the later stages of life. However, nowadays there is trend for earlier occurrence of NCCD and its risk factors in the life course. This group of diseases includes a variety of complex, long lasting, multi-etiological pathologies of slow evolution, that include, among

many other factors, diet, genetic polymorphisms, physical activity, and interaction among them (OMS, 2014).

NCCD represent one of the leading causes of disease, disability and death worldwide; including cardiovascular diseases, cancer, chronic respiratory diseases and diabetes (OMS, 2014). A predisposing factor for the NCCD is obesity, which is characterized by an increase in the accumulation of body fat that alters blood circulation, vascular function and hepatic function (Aguilar-Salinas, 2007). There also are different types of cancer among NCCDs, that, being less prevalent than cardiovascular or diabetes, have high mortality rates among those affected. According to the World Health Organization (WHO, 2014), NCCDs are responsible for 70% of deaths worldwide (40 million people/year) and 80% of this percentage is concentrated in low and middle income countries.

Diet, as a FS attribute directly influences cardiovascular and cancer risk. This diet, however, should be understood in the context of food environment in which an individual is placed. Specifically, the Centre for Disease Control and Prevention (CDC) defines a food environment as: "The physical presence of food that affects a person's diet, the proximity of a person to food store locations, the distribution of food stores, food service and any physical entity by the which can be obtained food, or a connected system that allows access to food "(Cerdeira Rioseco, 2016). Therefore, a FS have a fundamental role in determining food security, environment and diet of a community in terms of number, type, and quality of nutrients.

Many contributions to FS concept, including some of those previously mentioned, have led to broadening definitions and approaches for intervention, resulting in the creation of different typologies or approaches of FS (HLPE, 2014). For example, in relation to the historical moment of FS development, some call the older "traditional" FS and the recent, "industrialized or modern"

FS; according to the spatial scale of development, there are local, regional or global FSs; on the basis of the characteristics of the actors that are involved, FS types can make reference to native, ancestral and community FSs; finally, there are other approaches to FSs that include sustainability, health or equity principles, and involve a broader analysis of nutritional, socioeconomic and environmental interactions. HLPE (2018) also points out that there is an interconnection among all FSs and the sum of all them forms a global FS. It is important to highlight that the previous FS definitions obey academic and political positions, that seek to emphasize and detect relevant aspects of FS.

This scoping review aims to characterize the research and actions on food systems for the prevention of NCCD. Additionally, it aims to analyse coincidences, differences and possible synergies with Ecohealth principles. The purpose of this analysis is to contribute to the strengthening of research methodologies and strategies for FS and to build a common mobilization and intervention agenda in this topic

2. Materials and methods

This review follows the rules and procedures of the Manual for Exploratory Reviews of the Joanna Briggs Institute (Peters et al., 2015) and the methodology of Preferred Reporting Items for Systematic Reviews and Meta-Analysis PRISMA (Moher, Liberati, Tetzlaff, & Altman, 2009) in all its stages of development, including: formulation of research questions, search and identification of documents, extraction of information, content analysis and narrative synthesis. The searching of documents was carried out in five databases through the application of an algorithm. These algorithms were generated from the research questions, and allowed the identification and subsequent selection of the documents. The review of documents was carried

out by two researchers applying inclusion and exclusion criteria. Finally, with the information extracted, descriptive analyses and a narrative synthesis were performed to summarize and explain the findings or data of the multiple documents selected with respect to the research questions of this scope review.

2.1 Research questions

The specific research questions were formulated to account for the objective of the exploratory review and were the following:

- What conceptual approaches have been addressed in the study of FS for the prevention of NCCD?
- What are the methodological approaches used in FS research for the prevention of NCCD?
- What is the context of the investigations and actions conducted in FS?
- What are the NCCD addressed in the research on the FS?
- What components (or subsystems) of FS are analysed in the investigations and actions?
- What type of actions in FS are used and evaluated for the prevention of NCCD? Is there evidence of impact in the prevention of NCCD from food systems research?
- What are the barriers and facilitators for the prevention of NCCD in the framework of actions in FS?
- What Ecohealth principles are highlighted in the research on food systems and prevention of NCCD? How do they get involved in the FS research framework for the prevention of NCCD?

2.2 Identification and selection of relevant studies

To identify and select relevant documents for this review, the following inclusion criteria were considered: research reports published in both indexed journals and grey literature not reviewed

by academic peers (i.e., theses, reports, policy guidelines) that had described FS in relation to the prevention of NCCD. In order to avoid documents that were very specific about the study or analysis of isolated components of the FS and to privilege more complex proposals, those pre-selected documents that did not describe at least one of the notions related to some of the 6 principles of Ecohealth (Charron, 2012) were excluded, as well as those that did not address FS with an integral vision of several of its components.

Two researchers carried out the search to identify the published articles and the grey literature (reports, health policies) in 5 databases: IDRC, EBSCO, PubMed, Scopus, Web of Science. In particular, four thematic axes were used in the search: food systems, NCCD, prevention, and Ecohealth. The documents collected from the search were exported to a bibliographic reference manager software (Endnote).

The research questions formulated were the basis to define the operative terms of the search. Appendix 1 shows the relationship between the research questions and the search terms used for this exploratory review. Each of the two researchers reviewed, excluded and selected documents independently. A first pre-selection stage was carried out based on the screening of titles and abstracts. Subsequently, the full-texts of the pre-selected documents were reviewed according to the inclusion criteria to obtain a final list of selected documents. The documents excluded were grouped into categories according to the cause of exclusion. In this exploratory review, the discrepancies between the two researchers regarding the inclusion or exclusion of documents were resolved without the need of a third investigator by reaching consensus.

2.2 Tabulation or data mapping

Tabulation of the general information was done from the initial reading of the documents, this general information consisted of author(s) name, title, year of publication, type of document, publication format, country (s) where the research was developed and question or objective of the document. Then, the specific information of each document was obtained with the data related to the research questions of this exploratory review. These specific data to answer the research questions were consigned from categories created by the researchers, as well as text segments identified with Atlas-TI software in the case of questions of an open nature and complex or highly heterogeneous response. For example, for the question about the conceptual frameworks used for the analysis of the FS, the answers were identified according to concepts previously referenced (global, sustainable, traditional, etc.), and to answer about the barriers and facilitators of the research in FS and prevention of ECNT, the paragraphs and phrases identified with information describing barriers and facilitators were extracted. Appendix 1 describes the response options to the research questions.

2.3 Summary of data, content analysis and synthesis

Descriptive statistics were calculated from information extracted using the SPSS 22.0 software. Additionally, the ATLAS TI software was used to select and classify asides of the documents with information related to the research questions of the exploratory review, to document and facilitate the narrative synthesis.

3. Results

3.1 Search and final selection of documents

In the application of the search algorithms indicated in Appendix 1, a filter was used to cover two decades (1997-2017). In total, 466 records were obtained (Figure 1). After excluding automatically detected duplicates (n = 41), finally, 425 titles and their abstracts were reviewed. This review was carried out independently by each researcher. The selection of the titles took into account the fulfilment of the four thematic axes formulated in the search strategy (researcher 1 n = 125, researcher 2 n = 134), and the results obtained by each researcher were compared to determine the percentage of agreement. The non-concordant documents (n=30) were reviewed and their relevance was discussed, leaving a total of 135 preselected documents for full reading and registration in an extraction matrix for basic information. During this extraction and review process, it was determined which documents required analysis and reading of the complete text, to extract information about the research questions into a specific information matrix. During this stage, there were 89 additional exclusions, leaving a total of 46 documents selected (Figure 2).

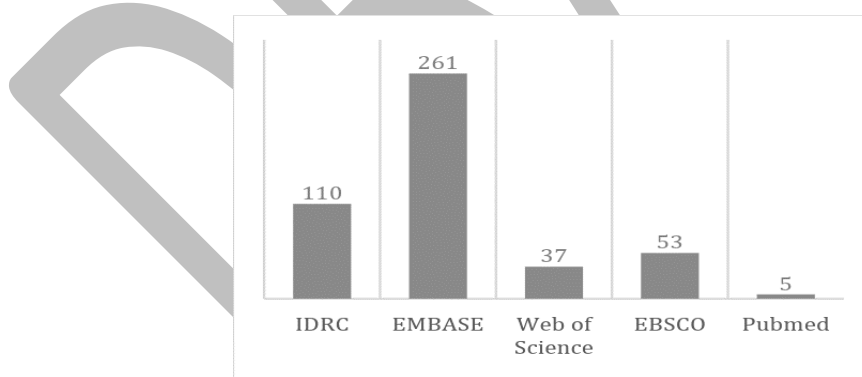


Figure 1. Records obtained in the different search platforms.

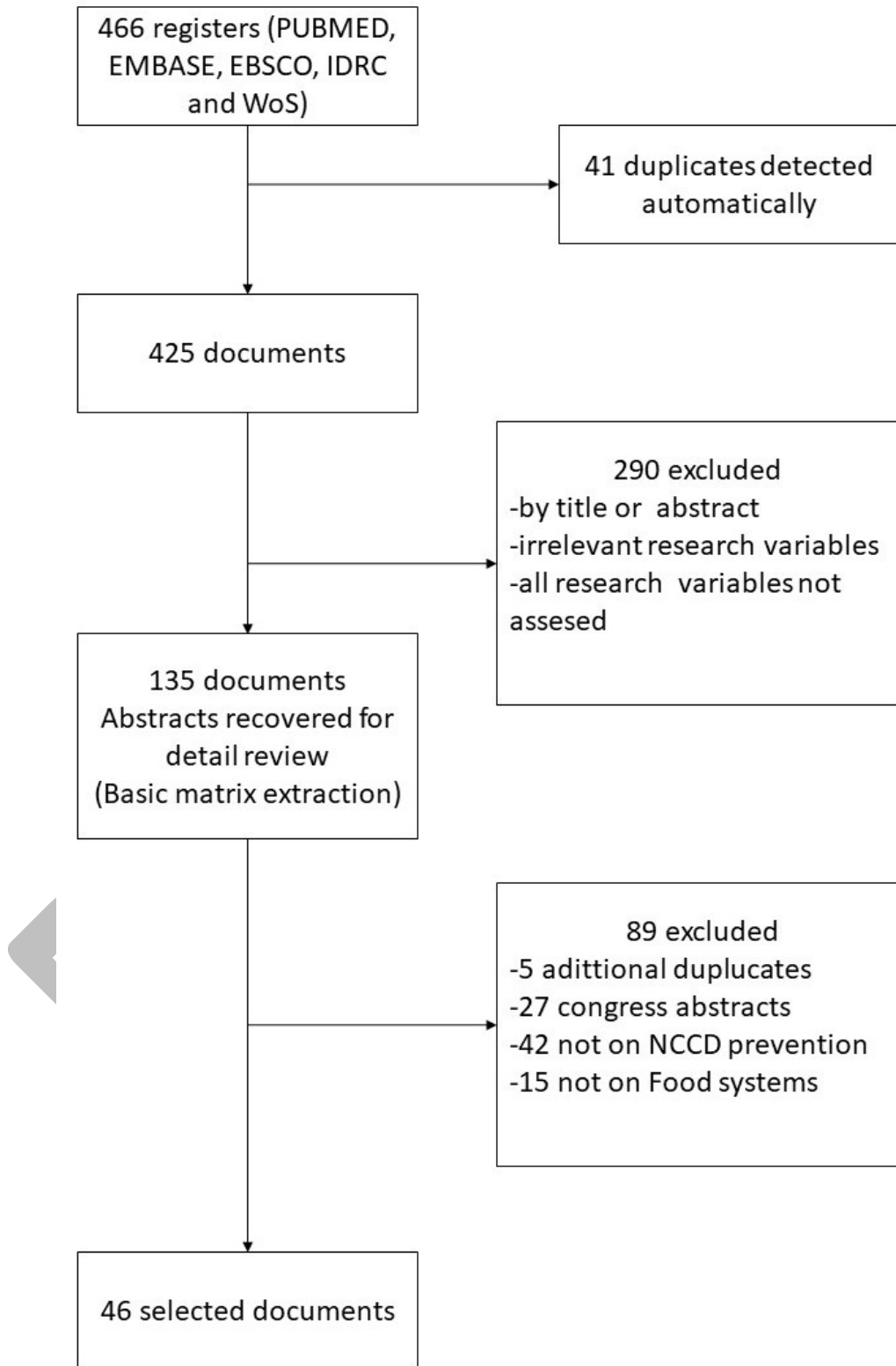


Figure 2. Flow chart of search and selection of documents

3.2 General information of analysed documents

Appendix 2 describes the general characteristics of the selected documents. A 89% (n = 41) are articles published in scientific journals, while grey literature publications, books, reports or theses were only 4.3% of the documents. More than half of the articles published in scientific journals were reviews (n = 24, 52.2%). The publication of documents on food systems and NCCD increases progressively from 1999 to 2015, year in which the highest peak of publications occurs (15 publications, 32.6%) with a decrease during 2016 (4 publications, 8.7%) and a new increase in the number of publications in 2017 (8 publications, 17.4%).

A 41.3% (n = 19) of the documents reviewed did not develop their contents on the food systems and NCCD for a particular country. Among the publications that mentioned a specific country, U.S was the most frequently referred, with about a third of the documents (30.4%).

A third of the documents deal with the population in global terms, and another 22% of the documents, although it does not mention a specific population, can also be associated with studies with interest in global FSs. Additionally, 35% of the included studies focused on a specific region, mostly from the United States, and only 9% of the documents reviewed describe very specific populations, such as the indigenous people from Guatemala, or the farmers of the corn belt from U.S.

3.3 Results and discussion of findings

3.3.1 Conceptual approaches in the study of FS for the prevention of NCDT

Less than a third of the documents reviewed (28.9%) describe or analyze some conceptual framework of the FS, either in a general way or by characterizing and analyzing the implications of some of them. In the other documents (71.1%) the term is used only as a reference, without characterizing the actors, structure or components of the system.

The conceptualization of FS is diverse. The concept of "food systems" began to be widely used in the second half of the 20th century, incorporating both humans, as owners of tools, and all the surrounding environment (Solomons, 2000). The applications of the concept of FS can be made, then, to societies from the age of hunter-gatherers, with its implications in the production, selection, preparation, processing and consumption of food for human diet (Solomons, 2000).

According to O'Kane, 2012, a FS includes the set of operations and processes involved in transformation of raw materials into food and in transformation of nutrients into health. FS basis are the human and natural resources in a specific biophysical and sociocultural context, and the elements that mainly affect its operation are technology, politics, economics, education, socio-cultural trends and research (O'Kane, 2012).

Food systems typology

Without necessarily including a detailed conceptual characterization of the system, in the documents selected for this scoping review, there was a predominant use or mention of several FS categories: on one hand the globalized, modernized and industrialized FSs, and on the other the sustainable, local, healthy, ancestral and decolonized ones.

Specifically, 42.2% of the documents referred only to FS without being involved with a concept or functional development of the system; another 24.4% of the selected documents referred to a global food system mentioning the concepts of globalization and industrialization, as predominant categories. Interestingly, 11.1% of documents that addressed the concept of a sustainable food system were found. Two categories for food systems used in a very related way were those of local FS and healthy FS, sometimes also addressed with functional characteristics of sustainability, and represented 15.5% of the documents. Ancestral food systems were poorly represented in the

documents found (4.4%), although these can also be assimilated within local and healthy FS concepts.

Globalized, modern and industrialized food systems

Several authors agree that globalization has impacted FS towards the development of industrialized systems that have influenced the origin of the NCCD epidemic in high and low income nations (Dube, Pingali, & Webb, 2012; Corinna Hawkes, 2006)

In particular, one of the main problems resulting from modern, globalized and industrialized FSs is to conceive food as a good or commodity, subject to market laws and competitiveness. Consequently, the fundamental purpose of these FSs is not to supply the nutritional needs of the consumer, but to generate benefits for the industry that produces it. This has had a negative effect on people's health, since disconnections and inequities within the system are generated along with environmental, social and economic impacts. Thus, for example, people are unaware of the source of the food they eat and have low-quality, anonymous and homogeneous products in their diets that ultimately contribute to the NCCD development (Figure 3).

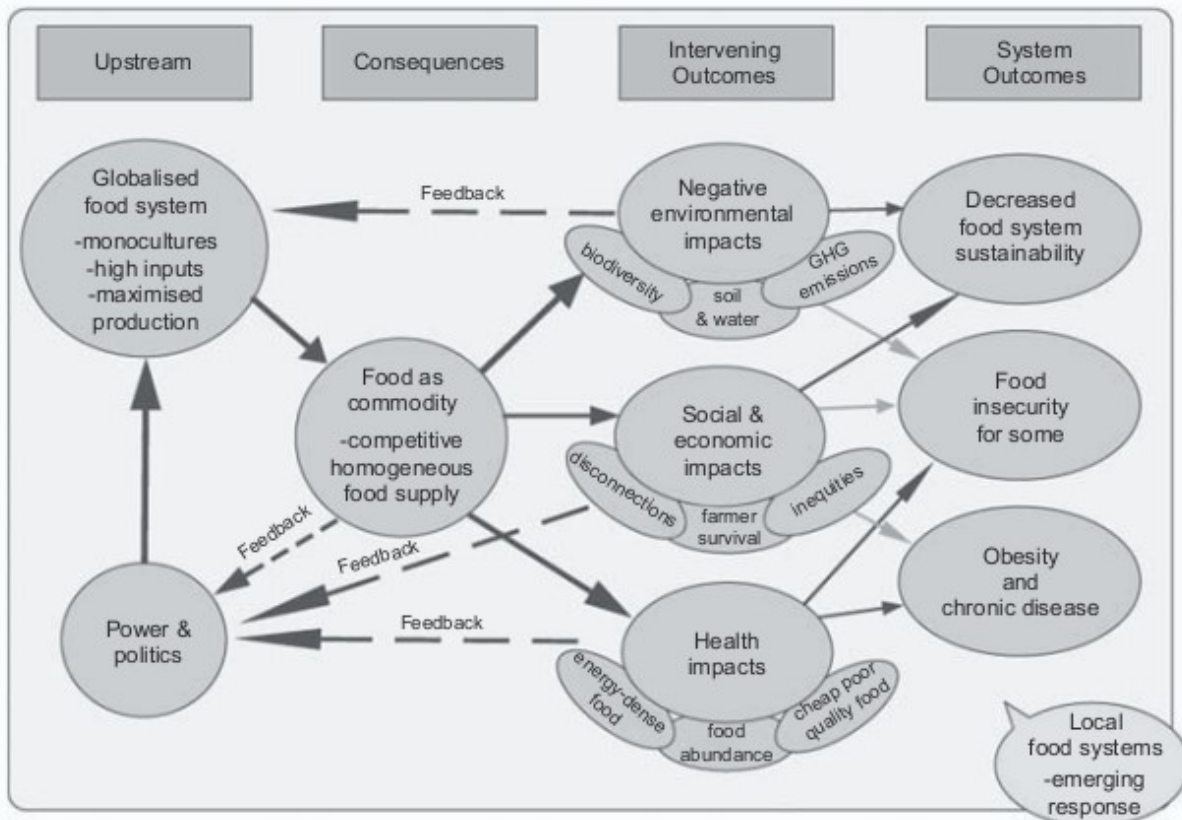


Figure 3. The modern food system. Source: O'Kane (2012)

According to Jackson, Minjares, Naumoff, Shrimali, & Martin (2009), although the food supply is described as a linear system, which begins with production, processing and distribution, and continues with marketing, trade retail and consumption; the specific variables in each of these subsystems interact with each other in a non-linear way, with many interdependencies that balance and reinforce the feedback loops. However, within modern FS, these feedback loops are centrally influenced by the unequal distribution of power and its influence on policies.

In particular, the documents on FS research for prevention of NCCD present conceptual generalities about the system, its components and its interconnections, as well as the outcomes in health and the role of each actor involved. Through this conceptualization the impacts of global, modern and unsustainable FS on health have been identified, proving the need to apply stronger

or more precise legislation on them or to strengthen the development of local, traditional systems with transdisciplinary participation (Hammond & Dube, 2012).

Different dimensions of a modern or industrialized food system proposed by Lang (2007) are shown in Table 1: Policy, production, processing, culture, nutrition, and economics. Each dimension is composed of development alternatives that differ in the scale and/or scope in which they occur. E.g., the processing dimension can be given at the level of simple cooking processes or as a more complex assembly of food molecules to obtain a macroproduct. In the case of production dimension, it can focus on animal or vegetable products, monocultures or polycultures, on imported or locally distributed foods (Table 1).

Table 1. Dimensions of the modern food system. Source: Lang (2007)

Dimensiones del sistema alimentario moderno		
Intensification	Policy goals	Extensification
Quantity		Quality
Food control		Food democracy
Animal focused	Farm	Plan-focused
Large farms		Small farms
Labor replacement		Labour retention
Monoculture		Biodiversity
Long distance food		Local food
Assembly	Processing	Cooking
Factory cooking		Home cooking
De-skilled/machine minder		Skilled/Artisanal
Hypermarkets	Culture	Street market
Global food		Regional food
Fast food		Slow food
Consumerist		Citizen
Advertising/Marketing		Education
Nutrient- light	Nutrition	Nutrient rich
Domination by cheap commodities like sugar and fat		Nutrient diverse
Individual approach to health		Population approach to health
Nutrigenomics		Social nutrition
Food prices exclude external costs (e.g. health, environment)	Economy	Full cost accounting

Dimensiones del sistema alimentario moderno	
Cheap/Low prices Industrial/Post-industrial	Expensive/high prices Craft/industrial

On the other hand, globalized and industrialized FSs have high transportation requirements, which leads to a high demand for inputs with a trend to maximize productivity, negatively affecting the environment, and generating social inequities since the benefits are mostly for a few actors (Lang, 2007).

An example of the development policies of the modern FS is the implementation of the "Farm policy" or "Farm Bill" in 2009 in the United States that consisted of a package for agriculture, rural development, research and food assistance (<https://www.farmpolicyfacts.org/farm-policy-history/>). This package was considered as a policy opposed to regional and global needs in terms of nutrition, environment and economy (Jackson, Minjares, Naumoff, Shrimali, & Martin, 2009), since it was based on reducing the diversity of crops by forcing homogenization of products available for consumption. This panorama was exacerbated by the fact that there were no social questions about the limited access to healthy foods, despite the fact that the relation between diet and the appearance of chronic diseases was evident (Jackson et al., 2009).

As mentioned, industrialized and globalized FSs are associated with diet changes related to obesity, malnutrition and diabetes, among other NCCD. This is because such FS involve, among others, the development of animal-based products, the addition of amounts of sugar and salt that exceed those recommended and the presence of pesticide residues that contaminate the food chain through air, water or food and increase the risk of some cancers, endocrine and reproductive disorders, among others (Horrigan, Lawrence, & Walker, 2002). However, it should be noted that some industrialized societies exceptionally conserve traditional FS and recognize the roles of health, culture and ecology in FSs (physiological, cultural and ecological congruence) in the

prevention of the development of chronic diseases. Example of these traditional FS are the cases of Asian and Mediterranean diets.

According to some authors, the global epidemic of NCCD is due to the lack of policies that regulate systems and put forward adequate nutrition (Horrigan, Lawrence, & Walker, 2002). In this sense, the links between globalization and diet have been little investigated, so it is necessary to analyze the influence of the following factors (Corinna Hawkes, 2006): 1) trade and global food supply, 2) direct foreign investment, 3) advertising and global promotions of food, 4) retail restructuring (especially the development of supermarkets), 5) emergence of global and transnational food business and agribusiness, 6) development of global rules and institutions that govern the production, trade, distribution and marketing of food, 7) urbanization and 8) the influence of the cultural changes. Analysis and intervention of the relationship between these factors and the quality of the diet is a challenge, which reflects the complexity and multidimensionality of the interactions among global economy and health.

Sustainable, local, healthy, ancestral and decolonized FS.

Given that food systems involve, among other components, health and the environment, the latter would be better protected if a transition towards sustainability is made (Horrigan et al., 2002). In particular, sustainable FSs involve closer connections between actors and processes of the three components (production, consumption and nutrition), equivalent to a more direct trade, carried out mainly by local producers towards local consumers.

One of the main purposes of sustainable FS is to reduce the energy used in transport that involves the entire food chain (Horrigan et al., 2002). Development of a sustainable food system, involves not only sustainable agriculture through the re-use of inputs and waste generated and a low

environmental impact, but also in responsible consumption. Sustainability in this last aspect would be supported by the equitable access to products by consumers, and these in turn are responsible for making choices that favor the environment, health and well-being. However, since production has profound effects on the environment, health and society, its transformation is a critical part towards sustainability.

The High Level Group of Experts on Food Security and Global Nutrition of the United Nations (FAO, UNIDO, & World Bank, 2015) also highlights the importance of the following principles to promote FSs transition towards sustainability: Interdisciplinary thinking with representatives of all the components of the FS and their effective participation in the formulation of policies; construction of consensus, to develop policies that address the causes of FS sustainability; mapping and evaluation, to improve the understanding of FS and its results, and to define priorities, from production to nutrition; interconnected decision making, to improve communication of the actions among actors of the FS; strengthen evidence based decision making, and measurement, so that discussions focus on changes with specific, measurable, achievable, realistic actions with temporary limits.

On the other hand, for the Institute of Sustainable Agriculture of the University of California (California-Davis, 2013), the sustainable FS must include the community dimension, as this is a collaborative network of allied partners (farmers, consumers and communities) that create a more local food economy. This sustainable community FS differs mainly as production is based on family units that develop their production sustainably with local inputs. In this way, consumers are located at short distance with a suitable access to nutritious food. Economic surpluses recirculate in the community, improving living and working conditions of producers and other actors of the FS. Additionally, this FS is developed through policies that promote the sustainable

operation of FS and the adoption of healthy dietary habits at the individual, community and environmental levels.

In the year 2000, almost 40 years after the emergence and start-up of the green revolution (1960-1980), micronutrients deficiencies were estimated to affect 40% of the world's population. As a possible solution for this problem, from a holistic perspective, it has been proposed that technologies are aimed at improving the nutritional quality of crops in a sustainable manner, with the participation of producers and consumers (Welch & Graham, 2005) (Figure 4); such perspective gathers elements of sustainable FS with a systemic approach considering integration and interrelationships of components and actors in their different economic, biophysical, social, political and public health dimensions in order to impact health and well-being..

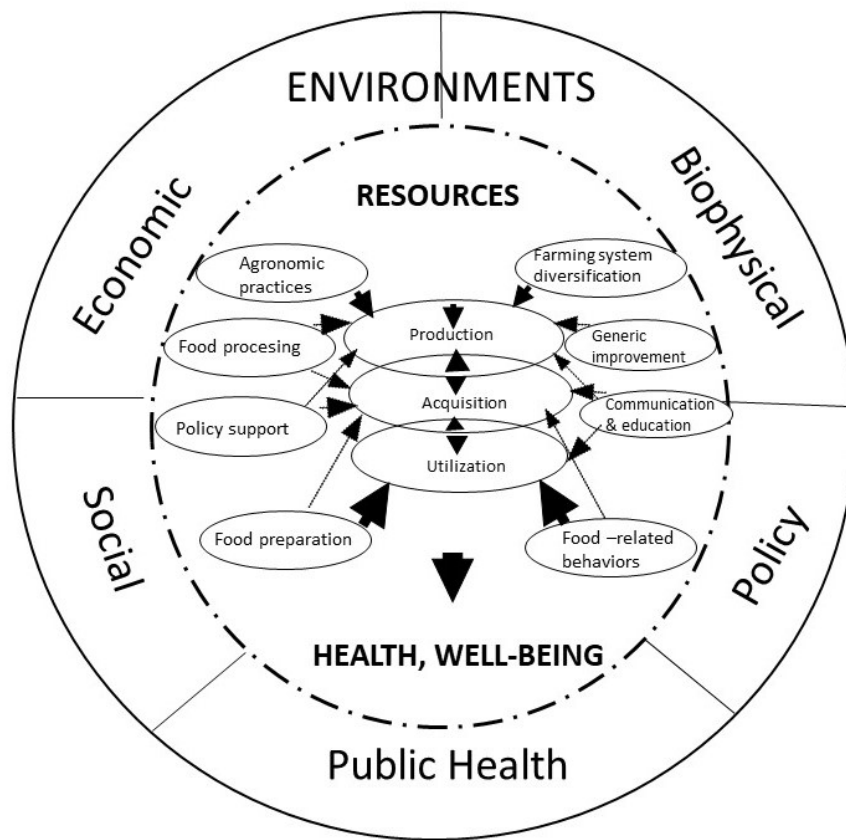


Figura 4. Sistema alimentario holístico. Fuente Kuhnlein (2004)

On the other hand, FSs are considered healthy if they ensure welfare of both consumers and farmers, processors and distributors (Jackson et al., 2009). Among models of healthy FS that propose a change are organic and local food production. In particular, the healthy FSs consider the impact of agricultural policies on health; thus their main objective is the creation of an agricultural policy that maximizes positive results and minimizes negative impacts on health. Importantly, the structure of these systems requires maintaining a broad discussion on health and agriculture with multidisciplinary participation. In addition, in the productive phase, these FS need to maintain in force legislation on the use of inputs, especially those toxic to human health and the environment; In the consumption component, the healthy FSs require to strengthen the implementation of food labeling and improving consumer access to information (Welch & Graham, 2005).

In general, it is considered that traditional FS have a low potential to promote the evolution of NCCD (Solomons, 2000). However, some of these systems may have deficiencies in micronutrients levels they offer. In addition, traditional FSs, like modern or industrialized FS, can generate environmental threats in productive systems, although to a lesser extent. E.g., in a traditional FS there may be unsustainable agricultural practices, based on the use of agro-toxic inputs or the expansion of the agricultural frontier in search for new fertile lands that cause biodiversity loss, deforestation and water resources; therefore, the challenge is to find solutions for these shortcomings, while retaining and increasing their benefits. Among alternatives that research proposes for the development of traditional FSs are the improvement in production, mainly through crops in soils with bioavailability of micronutrients, such as Zinc and Selenium, and rotations or associations of complementary crops (Solomons, 2000).

On the other hand, the knowledge from traditional FS is sometimes used by the industry, and led by economic and market forces. This makes unclear the origin of the product to the consumer, the

modified nutritional content, and in some cases may try to mask the nature of a product (Horrigan et al., 2002).

3.3.2 Research aims and problems

Research objectives described in the documents are diverse. Some relate to a general theme such as the state of global nutrition (Achadi et al., 2016, Haddad et al., 2015), nutritional security (Ganry, Egal, & Taylor, 2011, Hammond & Dube, 2012, Poms, 2017; van Zanten, Parodi, Hornborg, Ziegler, & de Boer, 2017) and inequities (Friel, Hattersley, Ford, & O'Rourke, 2015; Larson & Story, 2015; Otero, Pechlaner, Liberman, & Gurcan, 2015 Smith, 2015). Other documents focus on FSs interrelations with agricultural (Jackson et al., 2009, Welch & Graham, 2005) or nutritional policy (Dube et al., 2012; Lang, 2007), the environment (Horrigan et al. , 2002; Johns & Sthapit, 2004), industry (Cabada & Calvillo, 2014; Yach, 2014) and economics (Johns & Sthapit, 2004; O'Kane, 2012). Another group of documents review factors associated with NCCD occurrence (Lobstein, 2015, McCarthy et al., 2011) or diets determinants (Corinna Hawkes, 2006, Keane, Ortega, & Linville, 2015, Popkin, 2017, Ridoutt et al., 2017; Solomons, 2000). Additionally, some documents carry out a FS approximation for the prevention of diseases, in particular in micronutrient deficiencies (Popkin, 2017), cancer (Vanamala, 2017) or chronic diseases in general (Bertuccioli & Ninfali, 2014; Corinna Hawkes & Popkin, 2015, C. Hawkes et al., 2013, Kraak et al., 2016, McCarthy et al., 2011, Migliozi, Thavarajah, Thavarajah, & Smith, 2015). A smaller number of documents evaluate local strategies at the nutritional level to improve health (Cogill, 2015, Kuhnlein, 2004) or diet in general (Banwell et al., 2015, Galli et al., 2017, Ishikawa, Kusama, & Shikanai, 2015; Libman, Freudenberg, Sanders, Puoane, & Tsolekile, 2015; Morgan & Fitzgerald, 2014; Mwanamwenge & Harris, 2017). Finally, three documents seek to determine health impact of diet changes (Hallström, Gee, Scarborough, & Cleveland, 2017,

Moreira et al., 2015, Springmann, Godfray, Rayner, & Scarborough, 2016) and another article aim to define a framework to evaluate diets sustainability.

As objectives, research justifications or rationales are very diverse. One of the main problems reported was nutritional transition from fresh to highly processed foods (Banwell et al., 2015, Galli et al., 2017, Moreira et al., 2015, Otero et al., 2015, Popkin, 2017). Beyond ultra-processed food, the main concerns are the lack or low contribution of micronutrients in low-priced products, as well as the flavoring effect of salt, fat and sugar as additives of this type of food that encourage their consumption over healthier options (Banwell et al., 2015). Given this, initiatives are sought not only around reduction of ultra-processed food consumption, but also to make its ingredients healthier (Moreira et al., 2015).

In particular, Otero et al. (2015) emphasize on the need for studies that estimate the impact of interventions aimed to reduce ultra-processed food consumption. This transition to processed foods is the basis of the so-called "neoliberal diet" described in the United States context, and defined as a nutritionally compromised, highly caloric (empty calories), and affordable food. This diet, would explain the food insecurity in the USA (~ 12%), and highlights that the situation is due to the easy access to processed food, supported by an income inequality, and justifies the characterization of the diet according to the socioeconomic status (Otero et al., 2015)

In addition, other studies analyzed diet as an influential factor for NCCD occurrence (Corinna Hawkes, 2006, Ishikawa et al., 2015, Keane et al., 2015, Libman et al., 2015, Springmann et al., 2016) in health (O'Kane, 2012), or in the epidemiological transition to a greater number of cases of NCCD (Lobstein, 2015, Morgan & Fitzgerald, 2014, Ridoutt et al., 2017).

Food environments play a critical role in the establishment and exposure to a specific diet. In this regard, Libman et al. (2015) affirm that cities should be a special target in the prevention of NCCD

since the increase in the world population is concentrated in them, and they have a unique capacity to modify the contributing environments to the appearance of NCCD. The same authors highlight the need for conceptual reference frames for an effective formulation of NCCD prevention in large cities, which involve analysis of opportunities and obstacles in each level of participation (e.g. individual, community) (Libman et al., 2015) .

The need to reduce or change animal source products such as meat, which is highly associated with the development of cardiovascular disease (CVD), is another of the dietary contexts described in FS research and prevention of NCCD. The meat industry monopolizes the use of land and displaces agricultural crops, which could function as healthier alternatives for consumption (Springmann et al., 2016). Other authors focused on malnutrition (Cogill, 2015, Migliozzi et al., 2015, Mwanamwenge & Harris, 2017, Poms, 2017) or on the need to prevent a particular nutritional alteration such as micronutrient deficiency (Kuhnlein, 2004), 10), obesity (Yach, 2014), CVD (Bertuccioli & Ninfali, 2014), cancer (Vanamala, 2017), or NCCDs in general (3, (McCarthy et al., 2011); and other documents focused on policies to increase consumption of fruits and vegetables (Ganry et al., 2011), protect breastfeeding (Smith, 2015) and decrease consumption of sugary drinks (Kraak et al., 2016).

3.3.3 Methodological approaches

Among the documents selected , only 5 of them (15%) mention a methodological proposal or describe the application of a method of research in FS for NCCD prevention. Among these, two are mathematical models that measure the impact of a FS intervention in its consumption and nutrition phases and are described later (Moreira et al., 2015, Ridoutt et al., 2017).

In the selected documents, all the methodological approaches of FS research for NCCD prevention use system thinking tools. Keane et al. (2015) conducted a cross-sectional study introducing

system thinking tools at the community level to assess the effect of an intervention to prevent obesity, and promote healthy eating habits in children from Cuba, a small city in the state of New Mexico. This tool allowed to develop behavior diagrams over time, and systems to identify causes and feedback systems. Also Moreira et al. (2015) used the International Model for the Analysis of Agricultural Products and Trade Policies (IMPACT) which was developed to analyze the long-term challenges faced by public policies designing for sustainable reduction of hunger and poverty. The purpose was to implement the model to estimate the reduction in mortality due to cardiovascular disease and to determine the effect of the decrease in the consumption of ultra-processed foods.

C. Hawkes et al. (2013) describe three participatory methodologies to analyze FS from a nutrition and health perspective. A first methodology is the tree of problems and solutions (C. Hawkes et al., 2013) (Figure 5), which includes the factors that contribute to a particular problem and the participatory development of potential solutions aimed at making an intervention. For analysis oriented to FS, the critical evaluation of the structure on which decisions are made is included in order to identify points where political changes are required (C. Hawkes et al., 2013). Required elements for its application are documentation and data review, as well as field work in order to have a spatial, temporal and historical perspective. This methodology, aimed at mapping the food supply, can be applied by integrating the production, consumption and nutrition components of FS (C. Hawkes et al., 2013).

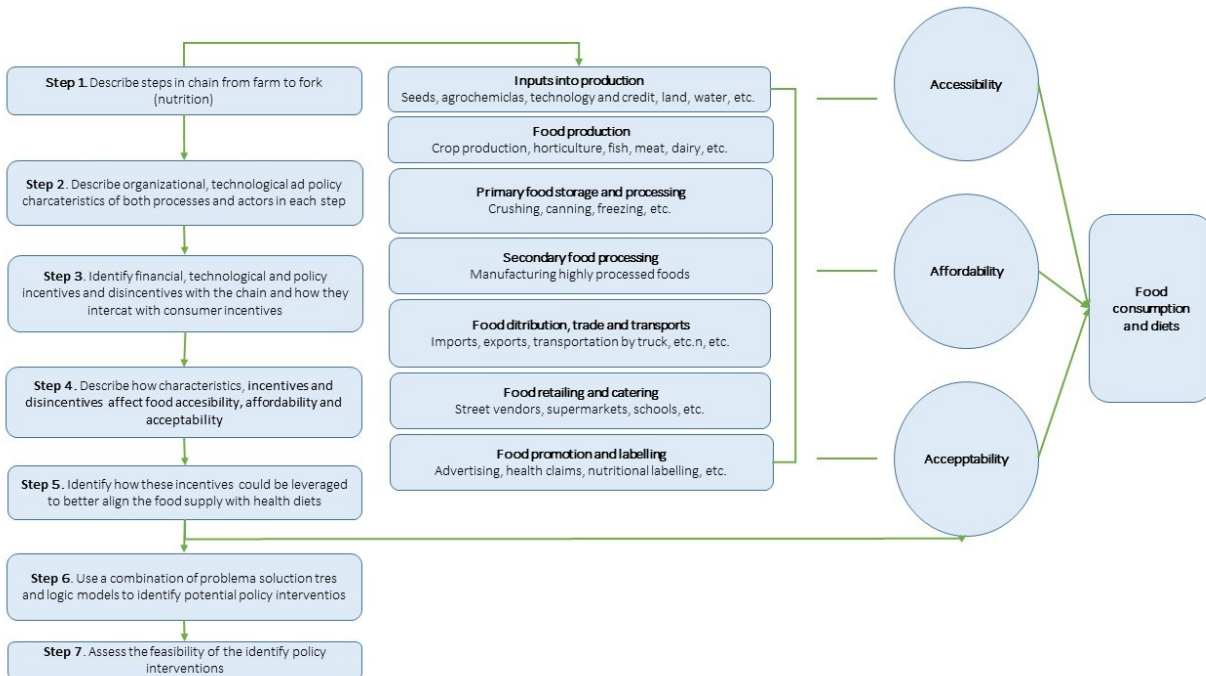


Figure 5. Mapping of the food supply focused on analysis by components. Source: C. Hawkes et al., 2013

A second method described is the FS analysis oriented to consumption, which consists of a critical evaluation of the structure that encourages decision making for consumption in each component of the system. This method tries to redirect the incentives of FS consumption with public health challenges and is based on interventions and secondary data review. If it is the case, it also uses qualitative information of fieldwork to know, with historical antecedents, how and why a FS develops. The third methodology or analysis of the value chain proposes to evaluate specific products in order to discover strategies to create or add added value to healthy food products, mainly fruits and vegetables. The development is based on participatory research, interviews, observation and review of secondary data, which evaluate the effectiveness and efficiency of value flow in the system (C. Hawkes et al., 2013).

Diet is one of the main factors, among other, responsible for the development of NCCD. For this reason, McCarthy et al. (2011) expressed the need for multidisciplinary research to promote in consumers, better dietary choices, describe food and health systems, and in addition, report their strengths and weaknesses. For this purpose, a consultation with experts was proposed, to investigate the interdependent terms "food and health". According to authors, the research dealt with production, marketing, choice, regulation and food policy, since these are the ones that have effects on health.

The development of topics was the responsibility of a group of experts in the central research issues and diverse actors to ensure a multidisciplinary approach. The experts developed thematic proposals in a transversal way for food, society and health axes. The proposal had an impact by identifying areas of research and intervention at the population level to influence dietary patterns. Among these strategies were: the promotion of research on food processing in the public domain and aligned with public health challenges; the balance between commercial opportunities and consumer protection, through social studies on diseases associated with food and the interventions required; and, finally, research on policies and regulation and its connection with governmental structures, especially of health.

Hammond and Dube (2012) propose a structure for FS and nutrition analysis, based on system dynamics and a model based on actors. This method seeks to identify key points of feedback within FS, and connections among components and future trends of the system, focusing on production, the health system and the environmental system, since these three are the ones that drive food and health. The structure is organized around two positions: health outcomes that depend on personal decisions (what to buy, eat and prioritize) and other components that do not depend on them (availability of food, nutritional or health status). On one hand, the way in

which FS affect quantity and nutritional quality of food is analyzed; on the other, the way in which FS influence consumer decision making through interconnected channels (e.g. prices, marketing, advertising) is also assessed.

Additionally, some nutritional states affect the metabolism of nutrients, and consequently can modify mood and individual performance, such as the ability to access a job, which leads to economic conditions that determine the priorities of food. The above can occur in the same actors related to production, as it is the case of farmers malnourished or with nutritional deficiencies, who can suffer consequences in the productivity of their crops and limit the availability of their products. The Hammond and Dube (2012) method is relevant because it involves complex relationships, which require the design of effective policies, the use of standard research methods and interdisciplinary participation (Hammond & Dube, 2012).

3.3.4 Actions for NCCD prevention within a FS framework

Appendix 3 shows FS components information as well as barriers and facilitators for NCCD prevention identified in each document of this scoping review. Production, consumption and nutrition are the three components of the FS and two thirds of the documents addressed more than one of them. An integral analysis of the three components was found in 29% (n = 13) of the texts selected, while others refer only to two of them (mainly to production and consumption, 24%). The remaining third of the analyzes are on only one of the FS components, mainly consumption. With respect to barriers and facilitators, half (n = 22) of the documents recognized some barrier and only 7% (n = 3) recognized some facilitator. Actions for each of the three system components are described below.

Actions in production

Interventions in FS at production level range from actions in agriculture and production of protein of animal origin (i.e., fishing, livestock) to the food industry. Specifically for NCCD prevention from actions in FS production, the following strategies are described:

1) Strengthening and stimulating small and medium scale agriculture, based on traditional practices, including community gardens (Donini et al., 2016, Galli et al., 2017, Keane et al., 2015). These community gardens would help to generate sense of belonging, social commitment, healthy practices and to supply local markets (Keane et al., 2015).

2) Diversifying agricultural production not only in the number of products grown (Cogill, 2015, Haddad et al., 2015, Johns & Sthapit, 2004, Larson & Story, 2015, Mwanamwenge & Harris, 2017, Vanamala, 2017), but also also in the varieties of these products (Vanamala, 2017).

3) Protecting and encouraging the use of native seeds (Galli et al., 2017, Ishikawa et al., 2015).

An example of this strategy is the preservation of traditional practices rich in micronutrients such as the Toscana bread (Galli et al. , 2017). In the preparation of this product, the germ of wheat is preserved, a compound rich in antioxidants that counteract the risk of CVD and cancer. On the contrary, industrialized practices for obtaining white flours eliminate this component (Galli et al., 2017). In this regard, the regional administration of Tuscany promoted a project to maintain and homogenize the agronomic practices of wheat sowing through protocols, as well as monitoring the quality of the chemical composition of the bread from that region. This initiative has been successful in terms of the undertaking of this dynamic, although no evaluation of the impact on the health of the inhabitants is described (Galli et al., 2017).

4) Biofortification to increase the availability of micronutrients or phyto-compounds with capacity to prevent NCCD (Galli et al., 2017, Migliozzi et al., 2015).

5) Recovery of products that are discarded due to color or shape defects, but with a normal nutrient content (Bertuccioli & Ninfali, 2014).

6) Elimination of meat or substitution of beef for a more sustainable protein of animal origin (Hallström et al., 2017; Springmann et al., 2016). Springmann et al. (2016) used a region-specific global health model to project changes in health according to the change in diet. These authors found in their projections that the smaller the fraction of foods of animal origin in the diet the greater the benefits of change for less occurrence of NCCD. A 75% of all benefits would occur in low-income countries, although per capita impact of a change in diet would be greater in high-income countries (Springmann et al., 2016).

The barriers identified for FS intervention of agricultural processes are mainly economic.

Limitations on land access and poor infrastructure for transport of both products and inputs required for crops, make local small-scale agriculture difficult (Haddad et al., 2015). There are also difficulties with land distribution and obtention of subsidies for certain types of crops (Larson & Story, 2015). Additionally, prioritization of certain products or varieties cultivated for their visual attractiveness or profitability, instead of their nutritional value (Larson & Story, 2015) makes growing different products or indigenous varieties significantly more expensive (Galli et al., 2017). Among the barriers to replace meat in diets for other sustainable sources of animal protein are the cultural rejection of, for example, consumption of insects or the unsustainability of increasing the consumption of certain types of fish (van Zanten et al. al., 2017)

Both in the United States and in Zambia, state policies have been established to favor the production of certain crops such as wheat in the USA (Larson & Story, 2015) and corn in Zambia (Mwanamwenge & Harris, 2017). These policies have not only favored small farmers,

but since they are low-cost products have encouraged the production of highly processed and calorically dense foods (Larson & Story, 2015). It is necessary for decision makers to analyze the possible long-term consequences of this type of policy, since it can lead to the production of unhealthy foods, related to the development of NCCD.

At the food production industry level an intervention was identified in terms of products reformulation with a reduction in salt, saturated fats and simple carbohydrates, and elimination of trans fats (Haddad et al., 2015; Hayashi & Takemi, 2015; Libman et al., 2015; Yach, 2014) and fortification with micronutrients and fiber (Galli et al., 2017). The barriers identified for this type of product reformulation are the increase in costs, which leads to the lack of will of production companies (Jackson et al., 2009, Moreira et al., 2015, Yach, 2014). In particular, by eliminating unhealthy components, industrialized products lose flavor, smell or texture characteristics that lead to losses in the profit margin for producers (Moreira et al., 2015).

On the other hand, a facilitator identified is that by reformulating a greater number of product lines, costs could decrease. Additionally, products reformulation could be facilitated through the implementation of public-private partnerships that promote these modifications, favoring the interest of the general population (Yach, 2014). Although, public policies that put pressure on products reformulation are being implemented in countries such as the USA (Hayashi & Takemi, 2015), their effects are long-term and none of the selected documents presents an evaluation of their effectiveness in NCCD prevention.

Actions in consumption

The interventions identified in the consumption component are: 1) Improving availability and affordability of healthy products and 2) reducing availability and affordability of unhealthy products. To improve the availability of fresh plant products, it is important to acknowledge the

role of fresh markets (Banwell et al., 2015; Mwanamwenge & Harris, 2017) and farmers' stores (Keane et al., 2015) that allow the purchase of products of local origin is recognized (Ishikawa et al., 2015; Lobstein, 2015). Similarly, the modern "Food hubs" are presented, which are structures that connect local producers with buyers. These "Food hubs" have modern facilities that can be more attractive for consumers (Banwell et al., 2015).

To improve the affordability of fresh vegetable products, there are strategies from taxes with subsidies (Friel et al., 2015, Moreira et al., 2015) and tax exemptions, to elaboration of exclusive bonds (Yach, 2014) for acquisition of these products. The barriers identified for healthy food consumption are the lack of adequate infrastructure to transport fruits and vegetables produced locally to the markets (Haddad et al., 2015). Similarly, there has been a gradual replacement of local markets that sell fresh products by supermarkets (Banwell et al., 2015), and subsidies for healthy foods also carry a high cost.

On the other hand, to reduce availability and affordability of unhealthy products, such as highly processed products, strategies are identified at institutional, tax and marketing levels. At an institutional level, the sale of these products is limited in schools (Hayashi & Takemi, 2015, Libman et al., 2015, Popkin, 2017, Yach, 2014), hospitals (Libman et al., 2015, Poms, 2017) and governmental facilities (Hayashi & Takemi, 2015; Libman et al., 2015) or during activities financed with public funds (Libman et al., 2015). Taxes on sugary drinks as well as products with high salt and fat content are also described (Friel et al., 2015, Moreira et al., 2015, Otero et al., 2015, Popkin, 2017). Finally, at the marketing level, there are strategies to restrict advertising of these products to children (Haddad et al., 2015, Hayashi & Takemi, 2015, Kraak et al., 2016, Moreira et al., 2015, Popkin, 2017) or to discourage the purchase of them by marking the products in a way that allows them to be identified as healthy or not (Haddad et al., 2015,

Hayashi & Takemi, 2015, Popkin, 2017). The barriers are mainly identified for the taxes strategy, on the basis of pressure of the food industry (Cabada & Calvillo, 2014; Kraak et al., 2016) and conflicts of interest of the legislators (Cabada & Calvillo, 2014).

The interventions in the consumption component have been translated into public policies that seek to encourage consumption of fresh fruits and vegetables (Yach, 2014), as well as reduce consumption of products rich in fats and carbohydrates, considered deleterious to health (Friel et al., 2015; Ganry et al., 2011; Haddad et al., 2015; Kraak et al., 2016). The first policy package includes subsidies, and tokens for access to healthy food, which in the case of the United States have shown an increase in the consumption of fruits and vegetables (Yach, 2014). The second group of policies is about taxes on unhealthy products, and restrictions for their advertising and marketing for children and adolescents. This last policy has been promoted by the World Health Organization (Kraak et al., 2016) and implemented in countries such as Mexico where the consumption of sugary drinks has decreased (Cabada & Calvillo, 2014). These policies have been evaluated in the short term at increasing or decreasing consumption of certain foods; their impact on NCCD prevention is long term, which is why their effect should be monitored. At the policy level, there is an additional barrier and it is that consumers tend to pursue other unhealthy products, of lower price but with similar characteristics to replace taxed unhealthy products (Cabada & Calvillo, 2014).



Actions in nutrition

The documents that address the nutrition component include mechanisms through which consumption of certain foods can prevent NCCD (Bertuccioli & Ninfali, 2014; Vanamala, 2017). Recognized barriers to nutrition with healthy products include cultural confusion induced by

advertising, lack of time to prepare food and the belief that benefits can be obtained only with nutritional supplements (Bertuccioli & Ninfali, 2014; Cogill, 2015).

Four documents (Achadi et al., 2016, Haddad et al., 2015, Corinna Hawkes & Popkin, 2015, Smith, 2015) address breastfeeding as a FS that in the long term have an impact on NCCD prevention. Breastfeeding barriers, from production, correspond to very short and poorly paid maternity leave. From the point of view of consumption, advertising and commodification of breast milk substitutes, as well as products rich in salt and sugar (Lobstein, 2015), with a nutritional content lower than that of breastfeeding (Haddad et al., 2015; Corinna Hawkes & Popkin, 2015; Smith, 2015) also represent barriers for breastfeeding FS.

Regarding facilitators of FS interventions for NCCD prevention, there are documents that report how to contribute to improving nutrition from the following strategies: the association between the industry and the authorities to prevent the commercialization of non-nutritive products to children (Yach, 2014), state funding to protect traditional agricultural practices (Mwanamwenge & Harris, 2017) and the wide availability of plant products in some areas (Bertuccioli & Ninfali, 2014).

Food transition is one of the drivers of the epidemiological transition towards NCCD predominance (Otero et al., 2015). In this sense, FSs as determinants of the availability and affordability of food are fundamental for the prevention of NCCD (Lobstein, 2015). The components of production, consumption and nutrition are interrelated, and isolated interventions in only one of the components would have little impact (Corinna Hawkes & Popkin, 2015, Johns & Sthapit, 2004). For example, the consumption of polyphenols has been associated with a reduction in the risk of cancer. To reach this nutritional effect, products rich in this compound must be available and have an affordable price, which encourages consumers to choose them

over other products. Without the product nothing of the above mentioned would be possible, reason why it is required that these be cultivated and transported. Finally, we must recognize the political will (Horrihan et al., 2002) as a fundamental determinant of the path taken by the FS and that this will may be influenced by the resources and pressures of external agents.

3.3.5 NCCD in the FS context

A traditional conception since the mid-twentieth century was to argue that while in the developed and industrialized regions, FS affected the health of the population with predominance of NCCD, in developing regions the effects occurred mainly with an increase in the occurrence of infectious diseases with affectation of growth and physical and cognitive development of children (2). However, based on existing evidence, the UN controverted these arguments, since it was possible to confirm the occurrence of NCCD in both high and low income populations (Welch & Graham, 2005). In general it is accepted today that increase in the affectation by diseases related to the diet is a tendency that does not distinguish gender, ethnic or racial category, geographic region or socioeconomic status.

Appendix 4 describes NCCDs addressed in the selected documents. Most of the documents address NCCDs in a general way (n = 35, 78%), although almost half of them (47%, n = 21) deal with obesity in the context of FS. Malnutrition, cancer, cardiovascular disease and diabetes are specifically addressed in less than 20% of the documents, while other diseases such as hypertension, Alzheimer's, chronic anaemia and cognitive decline were addressed in less than 3% of documents. A 40% (n = 18) of the documents did not present formal evidence for NCCD prevention, followed by 33% (n = 15) that presented as evidence that NCCD is secondary to nutritional transition and therefore, reversing nutritional transition, would prevent NCCD.

Around 20% (n = 9) of the documents cited previous works, 15% (n = 7) citing observational

studies that showed how diets rich in fresh products decreased NCCD risk and the remaining 5% (n = 2) quoting biomedical research on compounds that could prevent NCCD.

Only three studies presented original evidence on NCCD prevention, and corresponded to mathematical simulation models. These studies found that by changing the consumption of highly processed foods by minimally processed products, the decrease in mortality due to cardiovascular disease could be up to 13% (Moreira et al., 2015), as well as the relative risk of cardiovascular disease, type diabetes 2 and colon rectal cancer could decrease by 20 to 40% (Hallström et al., 2017). The third mathematical model found that, by eliminating the consumption of products of animal origin, up to 7.3 million deaths could be avoided (Springmann et al., 2016).

There is solid evidence on how the food transition has been one of the determinants of the epidemiological transition. There is also evidence on how nutritional habits decrease or increase the risk of NCCD, but in the context of FS research there is no solid evidence to privilege the implementation of certain strategies over others. Effectiveness and cost-effectiveness studies are required (Horrigan et al., 2002), whose results allow decision makers to implement the most appropriate strategies, considering the possible budget constraints, that have an impact on NCCD prevention.

3.3.6 Ecohealth in FS research for NCCD prevention

Ecohealth approach bases its practice on six principles, described in detail in the literature, as presented in the exploratory review carried out on this subject (sent prior to this document): system thinking, sustainability, gender and social equity, participation, transdisciplinarity and from knowledge to action. It is evident that these principles are not exclusive to the Ecohealth approach, and were therefore tracked in the analyzed documents on FS and prevention of NCCD.

Appendix 5 describes Ecohealth approach principles identified in each document. Although none of the authors frame their work as Ecohealth, 29% (n = 13) of the documents addresses one of its principles and some do it with two or more of them. The principle most widely addressed is system thinking (58%, n = 26), followed by transdisciplinarity and sustainability, each in 29% of the documents reviewed (n = 13). Finally, there are also documents that discuss, although less frequently, the principles of equity, participation and the use of knowledge for action. Only 12 documents (27%) did not include any of the principles of Ecohealth.

System thinking is implicit in FS by the relational view of production and consumption of food for nutrition. Additionally, it is the methodological basis that facilitates a better understanding of how coherent actions between and within sub-systems can improve the self-regulation of feedback relationships and generate changes that help the development of healthier and more sustainable FSs.

In fact, one of the complications caused by FS massification at global level is fragmentation of agriculture, health, well-being, government actors that formulate policies, markets and civil society actors (Dube et al., 2012). Consequently, the integration of these actors to achieve sustainable and healthy local FS within regional or national value chains that meet the needs of nutritional content and physical and economic access to the required food, is a challenge.

On the other hand, those documents that address the principle of sustainability did so from three perspectives. The first one identifies FS as one of the main emitters of greenhouse gases due to its dependence on oil, and therefore establishes the need for changes in the system, especially in the production component, which could reduce the negative environmental impact (Haddad et al., 2015)(Donini et al., 2016)(Hallström et al., 2017; Springmann et al., 2016). The second

perspective is from the protection of the land, by recommending the rotation of crops, especially by legumes that fix their own nitrogen and allow the soil to conserve its nutrients (Lobstein, 2015, Migliozzi et al., 2015). Finally, the third perspective corresponds to the protection of natural resources, such as indigenous or traditional seeds, as well as the multiple varieties of foods from plant origin (Banwell et al., 2015; Ishikawa et al., 2015; Morgan & Fitzgerald, 2014) in addition to actions to ensure sustainability in fish consumption as few species resist an increase in their consumption (van Zanten et al., 2017).

Meanwhile, the equity principle is addressed as a justification for interventions in different FS components, since inequity in nutrition leads to an unequal distribution of the burden of disease (Friel et al., 2015; Larson & Story, 2015; Otero et al., 2015; Poms, 2017) with the triple burden of poor nutrition/malnutrition, obesity and micronutrient deficiencies. This burden of disease affects predominantly the population groups with lower income (Haddad et al., 2015) , and thus, the interventions in FSs should aim to reduce inequities, for the achievement of environmental and health justice (Achadi et al. , 2016; Morgan & Fitzgerald, 2014; Smith, 2015).

The approach to the principle of participation is mainly done with an informative approach and with individual level actions aimed at favoring better decisions of the people when selecting the foods to be consumed (Galli et al., 2017). Nonetheless, collaborative networks as a functional feature of the community FS, where sustainable food production, processing, distribution, consumption and waste management are integrated to improve environmental health, economy and society of a particular place, also constitute evidence of the practice of participation (McCarthy et al., 2011).

Participation is also presented in community health restoration proposals through local, community and healthy FS. This type of proposal requires collaborative interdisciplinary teams

that converge with residents of the communities in the creation of plans that integrate health, economy and environment (Jackson et al., 2009). In addition, they seek to increase the participation of farmers, consumers and communities to strengthen relationships, the local economy and healthy environments. These FSs are recognized as those that best protect the environment and biodiversity, favor the administration of natural resources, in addition to strengthening food security and reinvesting in the local economy, contributing to health equity and social justice.

3.4 Strengths and weaknesses of this scoping review

This scoping review represents a first attempt to characterize the work done from FSs for NCCD prevention. The review was mainly composed of review type articles, and some original research with intervention in food systems and NCCD. Future revisions should be made to build the perspective of research with empirical studies in this subject. This recommendation is highly relevant considering that the vast majority of the selected documents were published in the last 3 years. The fact of having four thematic axes (FS, prevention, NCCD and Ecohealth principles) makes this scope review very specific, which can be considered as both, a strength and a weakness. This specificity accounts for a particular context in FS research. On the other hand, it is important to note that the field of research on FS and health is much broader, so that another characterization could be carried out through future more open scoping reviews around the FS term.

3.5 Conclusions

The present scoping review identified a large number of interventions in FS production and consumption components, which could have an impact on the prevention of NCCDs, especially for the prevention of obesity and cardiovascular disease. The evidence supporting these

interventions is based on observational studies that present evidence of how certain eating patterns could prevent NCCDs. Other studies model the impact of interventions, but an evaluation of their effectiveness in the populations in which they are being applied is required, as well as the analysis of their cost-effectiveness to scale them to other populations and contexts. The group of documents do not present a notable effort to conceptualize FS, although it is necessary to address the relationship of these systems with NCCD from interdisciplinary teams with a focus on sustainability.

Implementation studies are also needed to assess the challenges to put into practice effective interventions at the FS level in real-life conditions that lead to NCCD prevention, taking special consideration of contextual factors that may affect or facilitate implementation of the same, such as the influence that the food industry may have or not on the implementation or not of policies such as taxes on sugary drinks. Possible conflicts of interest of the legislators should also be considered, especially in aspects related to the use and possession of the land, for which an empowerment of the communities is required to oversight of the political decisions that determine FS.

Finally, given the FS complexity, a broad vision is required to allow continuous improvement of the FS for NCCD prevention. The approach of Ecohealth principles to FS research could open new opportunities to advancement of knowledge in this field.



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5. Appendices

Appendix 1. Research questions, answer categories, and search terms

Research questions	Categories	Search terms/Algorithm
What conceptual approaches have been addressed in the study of FS for the prevention of NCCD?	<ol style="list-style-type: none"> 1. Sustainable 2. Global 3. Local 4. Healthy 5. Ancestral 6. Decolonized 7. Others (Wild) 	food system
What are the methodological approaches used in FS research for the prevention of NCCD?	To identify methodologies	
What is the context of the investigations and actions conducted in FS?	To identify problems and objectives / research questions reported	
What components (or subsystems) of FS are analysed in the investigations and actions?	<ol style="list-style-type: none"> 1. All (Food System) 2. Production (Processing or transformation, distribution and transport, marketing) 3. Consumption (preparation, acquisition) 4. Nutrition 	
What are the barriers and facilitators for the prevention of NCCD in the framework of actions in FS?	To identify barriers and facilitators	
What are the NCCD addressed in the research on the FS?	<ol style="list-style-type: none"> 1. NCCD 2. cáncer 3. Enfermedad cardiovascular 4. diabetes 5. hipertensión 6. obesidad 7. desnutrición 	"noncommunicable disease*" OR "non-communicable disease*" OR "chronic disease*"

Research questions	Categories	Search terms/Algorithm
	8. Other (less common)	
What type of actions in FS are used and evaluated for the prevention of NCCD?	<ol style="list-style-type: none"> 1. Government policies for the implementation of healthy food systems 2. Food industry policies for prevention of ECNT 3. Community initiatives to create healthy food systems 4. Food systems created to diversify diets and reduce nutritional deficiencies 5. Policies for the promotion of the production and consumption of native foods (fruits and vegetables) and the recognition of their nutritional values. 6. Recommendations on the consumption of salt, sugar, fats, processed foods 7. Identify actions reported by the authors 	
Is there evidence of impact in the prevention of NCCD from food systems research?	To identify change, impact or difference reported	Prevent* OR intervention OR strategy OR polic* OR reduction OR action* OR plan* OR regulation OR law OR guideline OR framework
What Ecohealth principles are highlighted in the research on food systems and prevention of NCCD? How do they get involved in the FS research framework for the prevention of NCCD?	<ol style="list-style-type: none"> 1. Mentioned / described by the authors 2. Inferred by the researchers 	ecohealth OR "system thinking" OR "holistic thinking" OR "dynamic thinking" OR "complexity thinking" OR "complexity analysis" OR "system analysis" OR "system approaches" OR transdisciplinary OR "transdisciplinary research" OR interdisciplinary OR multidisciplinary OR "transdisciplinary approach" OR participation OR "social participation" OR "community participation" OR "stakeholder participation" OR "population participation" OR sustainability OR "program sustainability" OR sustainab* OR "gender equity" OR "social equity" OR equity OR inequality OR "social inequality" OR "gender inequality" OR "gender perspective" OR "knowledge to action" OR "knowledge translation" OR "knowledge exchange" OR "knowledge management" OR "knowledge-to-action" OR "knowledge in action" OR "knowledge into action"

Appendix 2. General characteristics of the documents selected

Authors	Year	Country	Kind of publication	Kind of article	Research question or aim
Achadi et al.	2016	Not apply	Report	Not apply	To review of the state of the world's nutrition.
Migliozzi et al.	2015	Not apply	Article in journal	Review	To review the potential of lentils and kale as nutrient-dense whole foods to decrease malnutrition, rates of obesity and chronic disease-related mortality and make suggestion for future work in this regard.
Moreira et al.	2015	United Kingdom	Article in journal	Original article	To quantify the consumption of ultraprocessed food in the UK with the development of CVD, and also estimate the potential impact of interventions aimed at reducing ultraprocessed food consumption
Smith	2015	Not apply	Article in journal	Commentary/Letter to editor	To draw attention to the lack of economic justice for women.
Vanamala	2017	Not apply	Article in journal	Review	This review presents current scientific evidence outlining farm-to-fork effects on fruit and vegetable bioactive compounds—the knowledge of which could aid the development of new and reasonable approaches/strategies for cancer prevention.
Banwell et al.	2015	Thailand	Article in journal	Review	To describe the role of fresh markets in nutrition and food security.
Bertuccioli and Ninfali	2014	Not apply	Article in journal	Commentary/Letter to editor	To underlie the biochemical and physiological mechanisms through which nutrients of the Mediterranean Diet foods largely contribute to protect from cardiovascular diseases (CVD), metabolic syndrome (MS) and tumors.

Cabada and Calvillo	2014	México	Article in journal	Original article	This article also illustrates the negative consequences resulting from commercial interests being placed before public ones and explores the role that civil society organizations and social movements play in addressing these challenges.
Cogill	2015	Not apply	Article in journal	Review	This paper examines the role of indigenous fruits and vegetables in improving dietary quality, nutrition and health outcomes. It examines the nutrition-specific relationship between the consumption of these foods and diet.
Combs	2000	United States	Article in journal	Review	Food system based approach discussion for prevention of micronutrient deficiency worldwide
Donini et al.	2016	Not apply	Article in journal	Original article	To define a non-exhaustive ensemble or suite of the most appropriate nutrition and health indicators for assessing the sustainability of diets, using the Mediterranean diet as a case of study.
Dube et al.	2012	United States	Article in journal	Review	a prospective approach to paths of convergence for agriculture, health and wealth
Friel et al.	2015	Australia	Article in journal	Review	To review interventions on determinants of inequity in nutrition
Galli et al.	2017	Italia	Article in journal	Original article	How can the supply chain mobilize to pursue improved nutritional value, compared to conventional processes? And, what are the implications for food system actors?
Ganry et al.	2011	Not apply	Report	Not apply	Integrate approach to food, especially fruits and vegetables, nutrition security , health care and poverty
Haddad et al.	2015	Not apply	Report	Not apply	To monitor progress, accelerate nutrition action, and enhance accountability in order to address malnutrition
Hallström et al.	2017	United States	Article in journal	Original article	To review the combined effect on GHGE from the food and health care systems of the adoption of more healthy diets

Hammond and Dube	2012	United States	Article in journal	Review	To provide a framework, key underlying systems and transdisciplinary modelling tools for food systems and nutrition security research
Hawkes	2006	United States	Article in journal	Review	To review how some policies of globalization agenda contribute to diet trends, and dietary outcomes on socioeconomic and cultural contexts
Hawkes et al.	2013	Not apply	Article in journal	Review	Food system solutions for nutrition related NCDs prevention
Hawkes and Popkin	2015	Not apply	Article in journal	Commentary/Letter to editor	To highlight the need of food system reform to prevent ECNT
Hayashi and Takemi	2015	Not apply	Article in journal	Review	To review certain policies and programs that have been implemented to create a healthy food environment in order to combat diet-related NCD worldwide and discuss possible barriers for future implications
Horrigan et al.	2002	United States	Article in journal	Review	To outline environmental and human health problems associated with food production and discussion on its sustainability
Ishikawa et al.	2015	Japan	Article in journal	Review	To review the Japanese food and nutritional improvement action of communities.
Jackson et al.	2009	United States	Article in journal	Review	Outlining of three major issues influenced by the Farm Policy of USA: obesity, food safety and environmental health impact
Johns and Sthapit	2004	United States	Article in journal	Review	To review interconnections concerning nutritional consequences of economic and environmental changes of food systems
Keane et al.	2015	United States	Article in journal	Original article	To introduce systems thinking at the community level by identifying the essential parts of the system and how it influences policy and environmental change related to healthy eating and active living for prevention of childhood obesity.

Kraak et al.	2016	Not apply	Article in journal	Commentary/Letter to editor	To examine the actions taken, between 2010 and early 2016, by the World Health Organization (WHO) to offer technical and policy guidance to Member States to implement Resolution WHA63.14. We subsequently assessed the extent of the same resolution's implementation by the national governments of Member States and investigated the supportive actions of relevant civil society organizations, philanthropic institutions and transnational industrial actors. We focused on actions designed to restrict young people's exposure to the powerful and pervasive marketing of branded unhealthy food and non-alcoholic beverage products.
Kuhnlein	2004	Not apply	Article in journal	Review	Reports how indigenous people can successfully use knowledge of local traditional foods to improve health
Lang	2007	United Kingdom	Article in journal	Review	Analysis of current orientation of nutritional and food policy
Larson and Story	2015	United States	Article in journal	Review	To summarize relevant evidence about inequalities according to socioeconomic status, ethnicity and population area, among children aged 2-18 years.
Libman et al.	2015	South Africa and United States	Article in journal	Original article	To assist cities to identify NCD prevention priorities, a conceptual framework was proposed for assessing the influences on food environments and therefore diet at different levels. This has been used to compare food environments and selected policy responses to diet-related NCDs in Cape Town and New York City, two cities that illustrate the complexity of urban food systems in middle and high income countries.

Lobstein	2015	Not apply	Article in journal	Review	How the sustainable development goals accomodate the major nutrition issue of today: the rising and hugely costly poblem of excess consumption of highly processed food rich in sugars, salt, fats, and issuficient consumption of vegetables, pulses, fruit and fish, and whole grains, resultng in obesity and a host diet-related chronic diseases conditions?
McCarthy et al.	2011	United States	Article in journal	Original article	Factors of diet that contribute to Chronic disease in Europe and a multidisciplinary reasearch approach to promote healthy diets
Morgan and Fitzgerald	2014	Not apply	Article in journal	Review	To review the role of extension professionals for developing a systems approach that would support an integrated health-based and sustainable food system.
Mwanamwenge and Harris	2017	Zambia	Grey literature	Not apply	To investigate how Zambian agriculture and food systems can better serve the country's population, in particular by contributing to sustainable diets for all
O'Kane	2012	Australia	Article in journal	Review	To examine the real environmental and health cost of food, especially in the Western world
Otero et al.	2015	United States	Article in journal	Original article	To offer a brief literature review on the class and inequality dynamics of dietary consumption. Much of this literature focuses on the individual as the chief locus to address obesity, as if consumers had equal economic chances of choosing their food. Our major goal is to contribute to this literature by providing an index that measures the risk of exposure to the neoliberal diet and highlighting the structural determinants of food choice. The second section begins our analysis with macro data from the UN FAOSTAT, demonstrating how the US diet has evolved since 1961.
Poms	2017	Not apply	Article in journal	Not apply	This paper discusses one of the thorniest parts of the social determinants of obesity puzzle, food insecurity, and two institutions that have stakes in the ways in which we deal with food insecurity: food banks and hospitals.

Popkin	2017	Not apply	Article in journal	Commentary/Letter to editor	To help the nutrition community (1) understand how rapidly the system underlying what we eat has shifted, and (2) how these shifts are affecting human health across the world, and (3) how these changes have shifted the ways countries are attempting to encourage healthier diets using the policy options they have available to them.
Ridoutt et al.	2017	Australia	Article in journal	Original article	To use a food system model to relate food intake to farm-gate commodity production
Solomons	2000	United States	Article in journal	Review	Lessons and analysis of plant based traditional Guatemalan diets and factors that influence 21 century diets
Springman na et al.	2016	Not apply	Article in journal	Original article	To analyse the environmental and health impacts of four dietary scenarios in the year 2050
van Zanten et al.	2017	Not apply	Book	Not apply	To identify innovations that together can result in a pathway towards sustainable nutrition security.
Welch et al.	2005	United States	Article in journal	Review	To review how agriculture contributes to human malnutrition globally
Yach	2014	Not apply	Article in journal	Review	To review the role of food industry for developing sustainable food.

Appendix 3. Information on food system components, prevention policies and barriers for food systems-NCCD prevention research in documents selected

Authors, year	Kind of population	Problem	FS concept according to authors' approach	Methodological approach	Food system (FS) component			Policy described according to FS component	Barriers
					Production	Consumption	Nutrition		
Achadi et al., 2016	Global	It is a global nutrition report	Global	None or not mentioned	Yes	Yes	No	Production , consumption	Lack of political will, resources and infrastructure.
Hammond and Dube, 2012	Global	Nutrition and food security is part of a complex system and both policy and research would benefit from a systemic approach	Not mentioned	Proposal of methodological tools to use to do research in food systems to improve health	No	No	Yes	Production, consumption, nutrition	Not mentioned

Jackson et al., 2009	Especific	the farm bill had an unexpected effect on food producers and not on family farming as expected, and those effects are criticized here, in three broad traits, on obesity, on the environment and on exposure to pesticides	Global	None or not mentioned	Yes	Yes	Yes	Production	The government and food processors
Johns and Sthapit, 2004	None	Nutritional consequences of the economic and environmental change of the SA	Ancestral/Local	None or not mentioned	Yes	Yes	Yes	None	Yes
Lang, 2007	None	Not provided	Not mentioned	None or not mentioned	No	No	Yes	Production	Not mentioned
Combs, 2000	None	Not provided	Not mentioned	None or not mentioned	Yes	No	Yes	None	Not mentioned
Ganry et al.,2011	None	The inclusion of policies to increase the consumption of fruits and vegetables in developing countries	Local	None or not mentioned	Yes	Yes	Yes	Production, consumption, nutrition	Not mentioned

Horrigan et al.	None	Health and environmental problems can be improved through the development of sustainable	Sustainable	None or not mentioned	Yes	No	Yes	Production	Validity of research on the effect of food systems in the prevention of NCCD
Hawkes et al., 2013	Global	Systems that generate greater coherence between food system and NCCD prevention	Not mentioned	Proposal of methodologies to analyze food systems from an NCCD prevention perspective	Yes	Yes	Yes	Production, consumption, nutrition	Not mentioned
Kuhnlein, 2004	None	Ethnographic importance to identify sources of Vitamin A easily accessible in a traditional food system	Ancestral	None or not mentioned	Yes	Yes	Yes	None	Not mentioned
Dube et al., 2012	Global	Integration and convergence of health, health and economic wealth	Global	None or not mentioned	No	Yes	Yes	Consumption	Not mentioned
Solomons, 2000	None	Herbal diet in the prevention of NCCD	Sustainable	None or not mentioned	Yes	Yes	Yes	Nutrition	Not mentioned

McCarthy et al., 2011	None	the need for a multidisciplinary approach to diet research and NCCD	Not mentioned	Description of a research methodology for the health-food relationship	No	Yes	Yes	Production	Investigation of the food-health relationship is carried out separately historically
Welch et al., 2005	None	modern food systems do not produce enough micronutrients for human nutrition	Other	None or not mentioned	Yes	Yes	Yes	Production	Not mentioned
Hawkes, 2006	None	Relationship between globalization-food systems and changes in diet	Global	None or not mentioned	Yes	Yes	Yes	Consumption	Not mentioned
O'Kane, 2012	Global	The transition from global to local food system has benefits on human health and the environment	Global-Local	None or not mentioned	Yes	No	No	None	Not mentioned
Cogill, 2015	Global	The double bourden of malnutrition and overnutrition	Not mentioned	None or not mentioned	No	No	Yes	None	The reductionist approach to nutrition that focuses on a single nutrient. Difficulties in measuring the effect of the diversity of diets.
Yach, 2014	Especific	Obesity prevention	Not mentioned	None or not mentioned	Yes	Yes	No	Consumption	Industrial thinking of short-term profit. The issue of selling less by the industry.

Morgan and Fitzgerald, 2014	Regional	Increase in NCCD prevalence	Not mentioned	None or not mentioned	Yes	No	No	Production	Not mentioned
Banwell et al., 2015	Regional	Consequences of Food transition	Not mentioned	None or not mentioned	No	Yes	No	Consumption	Large supermarkets have led to the reduction of fresh markets.
Hayashi and Takemi, 2015	Global	Control of NCCD	Not mentioned	None or not mentioned	Yes	Yes	No	Production, consumption	Not mentioned
Ishikawa et al., 2015	Specific	Some diseases are linked to nutritional habits.	Sustainable	None or not mentioned	Yes	Yes	No	Production	Not mentioned
Donini et al., 2016	Global	This consensus position paper attempts to define a Nonexhaustive ensemble or suite of the most appropriate nutrition and health indicators for assessing the sustainability of diets, using the MD as a case study.	Local	None or not mentioned	Yes	No	No	None	Not mentioned

Hallström et al., 2017	Regional	No research to date on the combined effect on GHGE from the food and health care systems of the adoption of more healthy diets. This paper report research that addresses this gap	Local	None or not mentioned	Yes	Yes	No	None	Not mentioned
Haddad et al., 2015	Global	It is a global nutrition report	Global	None or not mentioned	Yes	Yes	No	Production, consumption	Lack of political will, resources and infrastructure.
Friel et al. , 2015	Regional	Inequity in food.	Not mentioned	None or not mentioned	No	Yes	No	Consumption	Not mentioned

Springmann a et al. , 2016	Global	Without targeted dietary changes, the situation (NCCD) is expected to worsen as a growing and more wealthy global population adopts diets resulting in more GHG emissions (5) and that increase the health burden from chronic, Noncommunicable diseases (NCDs) associated with high body weight and unhealthy diets	Global	None or not mentioned	No	Yes	Yes	Consumption	Not mentioned
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Ridoutt et al., 2017	Regional	Australia faces massive challenges related to poor diet with overweight and obesity reaching levels of 60% of adults and 25% of children (NHMRC 2014) and diet related disease increasing and having profound consequences for healthcare costs, human productivity and quality of life. The cost of obesity in Australia has been estimated at \$58.2 billion per annum	Local	Mathematical model about food system	Yes	No	No	Production	With the Australian food system on a trajectory toward increased levels of food imports, especially for nutritionally important foods like vegetables, fruit and seafood, the question arises as to whether this is likely to support or hinder the progress toward improved nutrition at the national level. A structural dependence on imports could be expected to create a closer link between international commodity prices and local retail prices, which in the event of a global price spike could act as a barrier to purchase, especially among lower income households. However, heatwaves, extreme weather events and drought in Australia can similarly elevate food prices,
Larson and Story, 2015	Regional	Not provided	Not mentioned	None or not mentioned	Yes	Yes	No	Production	Inequality

Hawkesand and Popkin, 2015	Global	This commentary focuses on the intersection between health concerns – nutrition-related NCCD– and what needs to be done to move towards achieving both the NCD and nutrition targets.	Global	None or not mentioned	Yes	Yes	Yes	Consumption	Not mentioned
Moreira et al., 2015	Regional	Extensive evidence suggests that global exposure to the problems caused by ultra-processed food is contributing to a growing burden of NCDs	Not mentioned	Mathematical model of the impact of an intervention	No	Yes	No	Consumption	In the UK, ultra-processed products are generally cheaper than fresh, minimally processed foods and culinary ingredients used in preparing meals
Vanamala, 2017	Global	Foods can have an effect on the prevention and management of cancer	Not mentioned	None or not mentioned	Yes	Yes	Yes	None	Not mentioned
Keane et al., 2015	Regional	In rural communities there is greater obesity, and it is sought to model the activities that have an effect on obesity.	Not mentioned	Systems theory	Yes	Yes	No	None	Not mentioned

Cabada and Calvillo, 2014	Regional	Negative consequences resulting from commercial interests being placed before public ones and exploration of the role that civil society organizations and social movements play in addressing these challenges.	Sustainable	ninguNo	Yes	Yes	No	Consumption	1) Great industry pressure on regulations 2) The policy is lax and is promoting that certain products rich in sugars and fats are promoted as healthy. 3) Conflicts of interest during the formulation of policies (Who is financing?)
van Zanten et al., 2017	Regional	Identification of innovations that together can result in a pathway towards sustainable nutrition security.	Not mentioned	NinguNo	Yes	Yes	No	None	1) inability to increase fish production. 2) Beliefs about insect feeding on the western side.
Migliozzi et al., 2015	Global	Micronutrient malnutrition	Not mentioned	No dice	Yes	No	Yes	Production y Nutrition	Calorie-rich foods are cheap, quick and easy. The industry produces low-cost mass food, but these are made from few ingredients and are ultra-processed.

Smith, 2015	Specific	Unregulated commodification and marketization of human milk risk reinforcing current social and gender economic inequities. Related policy and regulation need to improve a situation 'where everyone except the woman who donates her milk benefits'	Global		No	Yes	No	Consumption	Greater maternal participation in labour markets through paid employment without workplace accommodation for the maternal role of women. 2) Public policy on the other hand, may neglect breastfeeding because its economic worth is rarely measured in economic terms, and because women's economic contribution through time spent in breastfeeding and other unpaid care work is often discounted and ignored
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Lobstein, 2015	Global	Overweight / obesity has overtaken underweight as the biggest nutritional problem in adults and is growing rapidly among children.	Sustainable	No dice	Yes	Yes	Yes	Production,Consumption,Nutrition	Ignorance, illiteracy, erroneous beliefs and the conscious use of marketing activities (advertising, competitive prices with nutritious meals, promotion in markets, chews and attractive packaging, as well as the attractive design of the product in flavor and color) to recommend the consumption of food that does not meet dietary guidelines. Marketing of complementary food products for children produces long-term taste preferences that encourage children to have a poor diet. For the change: Conflicts of interest on the decision makers.
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Kraak et al., 2016	Especific	Focus on actions designed to restrict young people's exposure to the powerful and pervasive marketing of branded unhealthy food and Non-alcoholic beverage products – i.e. products that are high in saturated fats, trans fatty acids, free sugars and/or salt.	Not mentioned	No tiene	No	Yes	No	Consumption	Some transnational companies use private-sector alliances to persuade legislators and the public to oppose healthrelated restrictions on food and drink marketing.
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Popkin, 2017	Global	Cooking has vanished from many households and the food consumed in much of the world is shifting from purchases made at local fresh markets to packaged and processed ready-to-eat or ready-to-heat food	Global	Es un review	No	Yes	No	Consumption	Colombia and South Africa. Both of these countries are in the midst of serious consideration of implementing taxes of 18% and 20%, respectively, on SSBs. In each country, the Ministries of Health and of Finance support the taxes and the government backs the tax as a critical step towards addressing obesity, diabetes, and other cardiometabolic problems linked with excessive SSB consumption. Both measures face strong industry opposition but, thus far, the governments remain supportive of implementing the taxes
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Galli et al., 2017	Regional	Consequences of food transition	Local	NinguNo	Yes	Yes	No	Consumption	Agriculture, which contributes critically to the nutritional value of food, is increasingly facing land abandonment and urbanization trends, environmental degradation, retailing markets concentration, price transmission along the chains and, not least, policy developments.
Mwanamwenge and Harris, 2017	Regional	Zambia's food and agriculture system is therefore Not providing food security for all, with almost half of Zambians hungry at certain times of the year; Nor good nutrition for all, with 4No per cent of children suffering from stunted growth and increasing overweight in adults.	Not mentioned	No tiene	Yes	Yes	No	Production	1- Scarce budget. 2- Political vision focused on nutritional security but not on nutritional content. 3- Zambia is known to have several barriers to farmers accessing markets to sell their produce beyond maize, including poor road infrastructure and large geographic distances. In addition, a large number of semi-subsistence farmers do not belong to farmer co-operative groups, with a consequent lack of bargaining power.

Bertuccioli and Ninfali, 2014	Regional	Importance of Mediterranean diet to prevent cardiovascular disease	Not mentioned	NinguNo	Yes	Yes	Yes	None	Not mentioned
Otero et al., 2015	Regional	Measurement of the historical transition to an energy-dense or high-fat and highly-refined-carbohydrates diet in the United States. Greater inequality in this nation results in a greater risk of exposure to the neoliberal diet for low-to- middle-income people, with all its extensive health consequences.	Global	No dice	No	Yes	No	Consumption	Not mentioned

Libman et al., 2015	Regional	Around 10% of the global burden of disease can be attributed to dietary factors and physical inactivity, making these the single most significant risk factors for premature mortality, disability and preventable illnesses	Global	No dice	Yes	Yes	No	Production y Consumption	The city health department took action partly because the national regulatory agency, the US Food and Drug Administration, had failed to take action on salt for more than four decades, both because of scientific conflicts on the evidence on salt and food industry opposition
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Poms, 2017	Regional	Obesity and the oversupply of nutrient-poor foods are another form of malnutrition in modern society. All forms of malnutrition, whether stunting, micronutrient deficiency or obesity, contribute to negative health outcomes, and are often the result of social, economic and environmental factors that limit access to healthy foods that lead to positive health and social outcomes	Not mentioned	NinguNo	No	Yes	No	None	Not mentioned
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Kuhnlein	2004	Yes	No	No	No	No	No	No	No	No	Not provided
Dube et al.	2012	Yes	No	No	No	No	No	No	No	No	Not provided
Solomons	2000	Yes	Yes	No	No	No	No	No	No	No	Not provided
McCarthy et al.	2011	No	No	No	No	No	No	No	No	No	Not provided
Welch et al.	2005	No	No	No	No	No	No	No	No	No	Not provided
Hawkes	2006	Yes	No	No	No	No	No	No	No	No	No evidence
O'Kane	2012	Yes	No	No	No	No	Yes	No	No	No	Yes
Cogill	2015	Yes	No	No	No	No	No	No	No	No	Longitudinal studies show that diets with high diversity of fruits and vegetables prevent NCCD. This can be applied to indigenous fruits and vegetables.
Yach	2014	Yes	No	No	No	No	Yes	No	No	No	Not provided
Morgan and Fitzgerald	2014	Yes	No	No	No	No	Yes	No	No	No	Not provided
Banwell et al.	2015	Yes	No	Yes	No	No	No	No	No	No	Cohort study evidence that buying in markets (fresh markets) is associated with a better diet and lower cholesterol level and less coronary ischemic disease.
Hayashi and Takemi	2015	Yes	No	No	No	No	Yes	No	No	No	No evidence
Ishikawa et al.	2015	Yes	No	No	No	No	No	No	No	No	Not provided
Donini et al.	2016	Yes	Yes	Yes	Yes	No	Yes	No	No	Cognitive decline	The health benefits of the MD in preventing chronic diseases have been well recognized by the scientific community, since the pioneer Seven Countries Study conducted by Ancel Keys

Hallström et al.	2017	Yes	Yes	Yes	Yes	No	No	No	No	The risk for CHD and T2D for all foods changed in the high antioxidant diet-study was reduced by 20–45%, with the largest reduction for CHD, followed by T2D
Haddad et al., 2015	2015	Yes	No	No	No	No	Yes	Yes	No	Eating better decreases the NCCD risk, so guaranteeing better nutrition indirectly produces a reduction in risk.
Friel et al.	2015	Yes	No	No	No	No	No	No	No	Taxes on unhealthy food and healthy subsidies, improve the acquisition of healthy products, but some replace unhealthy ones with unhealthy ones. Advertising: restricting the advertising of products high in sugar, fat and salt has an impact on childhood obesity
Springmann et al.	2016	Yes	Yes	Yes	No	No	Yes	No	No	Moving to diets with fewer animal-sourced foods would have major health benefits. Compared with the reference scenario, we project that adoption of global dietary guidelines would result in 5.1 million avoided deaths per year.
Ridoutt et al.	2017	No	No	No	No	No	Yes	No	No	Non-communicable diseases, are related to diet. Food systems are therefore central to addressing several of the most pressing global challenges. Calls for greater integration of agricultural policy and public health nutrition are common. However, the nature of the relationships between the two is not well understood at this time and the evidence for policy intervention is poorly developed.

Larson and Story	2015	No	No	No	No	No	Yes	No	No	Economic incentives for food production and marketing that promote an overall healthier food supply might therefore have the greatest impact on these historically disadvantaged populations.
Hawkesand and Popkin	2015	Yes	No	No	Yes	No	Yes	Yes	No	It is increasingly evident that consumption of highly processed foods based mainly on refined carbohydrates, excessive sodium, added sugar and saturated fat, is linked with increased risk of obesity and diabetes
Moreira et al.	2015	No	No	Yes	No	No	No	No	No	In the mathematical model, the change of products processed by unprocessed or minimally processed products can lead to a reduction of 13% in deaths due to cardiovascular disease

Vanamala	2017	No	Yes	No	No	No	No	No	No	The majority of cancers, particularly colon cancer, appear to be due to environmental factors such as food and lifestyle. A recent explosion of evidence suggests that diet can affect gene expression via epigenetic mechanisms, which can modify cancer risk and tumor behavior Moreover, bioactive compounds may demonstrate pleiotropic effects and thus demonstrate synergistic effects in combination. Therefore, dietary consumption of a wide variety of plant-based foods may protect against cancer in human.
Keane et al.	2015	No	No	No	No	No	Yes	No	No	Sale of healthy products, this strategy could boost community gardens and local markets for the supply of products.
Cabada and Calvillo	2014	Yes	No	No		No	Yes	No	No	Not provided
van Zanten et al.	2017	Yes	No	No	No	No	No	No	No	Consumption-side strategies, focusing on changes in human diet patterns, therefore, can reduce both environmental problems and health issues.
Migliozzi et al.	2015	Yes	Yes	Yes	Yes	No	Yes	Yes	No	Malhotra and others claim that poor diet is the leading cause of obesity in the Western world and therefore solutions will necessarily have a focus on diet.

Smith	2015	Yes	No	No	No	No	No	No	No	Breastfeeding , well known for preventing infectious illness in infants, young children and protecting the health of their mothers, breastfeeding also promotes development of the immune system and cognitive development, and influences later life chronic disease risk, and contributes to maternal reproductive health
Lobstein	2015	Yes	No	No	No	No	Yes	Yes	No	Hipotetizando que modificar los determinantes lleva a mejor salud y prevencion ECNT.
Kraak et al.	2016	Yes	No	No	No	No	Yes	No	No	Not provided
Popkin	2017	Yes	No	No	No	No	Yes	No	No	There is evidence in reducing the consumption of unhealthy foods, but not a direct association with the change in NCCD

Galli et al.	2017	Yes	No	No	No	No	No	No	No	No	Despite the perception that local, or shorter chains, have a supposed ability to benefit consumers with healthier foods – compared to mainstream food chains – the relationship between the configuration of the food system and the contribution to health is still widely debated, especially in socio-economic analysis. A growing body of evidence suggests that regular consumption of cereals may have a role in the prevention of chronic diseases. At the same time, cereal processed products contribute to a considerable proportion of sodium intake; therefore, manufacturers are encouraged to reduce the sodium content of foods, such as breakfast cereals and breads. The mechanisms by which cereals convey beneficial effects on health are multifactorial and are related to, among other indicators, the micronutrient and fiber content and their glycemic index.
Mwanamwenge and Harris	2017	No	No	No	No	No	Yes	Yes	No	No	It is theorized by increasing the diversity of crops.

Bertuccioli and Ninfali	2014	Yes	Yes	Yes	Yes	No	Yes	No	Alzheimer	The Mediterranean diet can contribute to the prevention of cardiovascular disease, cancer, metabolic syndrome, diabetes and alzheimers. This evidence comes from studies of basic sciences (mechanisms of different nutrients) and population level evidencing reduction in biomarkers and in Alzheimer's.
Otero et al.	2015	Yes	No	No	No	No	Yes	No	No	Hypothesis in terms of intervening inequity in nutrition, which would lead to a consumption of healthier foods and therefore better health.
Libman et al.	2015	Yes	No	No	No	No	No	No	No	A recent report shows that more than 10% of the global burden of disease can be attributed to dietary factors and physical inactivity, making these the single most significant risk factors for premature mortality, disability and preventable illnesses. Recently, several expert groups have recognized the importance of diet in the aetiology of major non-communicable diseases (NCDs) and recommended various policies to change the food environments that contribute to these risks. Such interventions seek to lower the burden of diet-related NCDs by encouraging reductions in consumption of products high in saturated or trans fats, refined grains, added sugar, and salt products and increases in intake of fresh fruit, vegetables and whole grains.
Poms	2017	Yes	No	No	Yes	No	Yes	Yes	No	It is theorized by increasing the availability of nutritious foods.

Appendix 5. Information on Ecohealth principles							
		Ecohealth principles identified					
Authors	Year	System thinking	Transdisciplinarity	Participation	Sustainability	Equity (social and gender)	Knowledge for action
Achadi et al.	2016	Yes	Yes	No	No	Yes	No
Banwell et al.	2015	No	No	No	Yes	No	No
Bertuccioli and Ninfali	2014	No	No	No	No	No	No
Cabada and Calvillo	2014	Yes	No	No	No	No	No
Cogill	2015	Yes	No	No	No	No	No
Combs	2000	No	No	No	No	No	No
Donini et al.	2016	Yes	No	No	Yes	No	No
Dube et al.	2012	Yes	Yes	Yes	No	Yes	No
Friel et al.	2015	No	Yes	No	No	Yes	No
Galli et al.	2017	Yes	Yes	No	No	No	Yes
Ganry et al.	2011	No	No	No	No	No	No
Haddad et al.	2015	Yes	Yes	No	Yes	Yes	No
Hallström et al.	2017	Yes	No	No	Yes	No	No
Hammond and Dube	2012	Yes	Yes	No	No	No	No
Hawkes	2006	No	No	No	No	No	No
Hawkes and Popkin	2015	Yes	No	No	No	No	No
Hawkes et al.	2013	Yes	No	No	No	No	No

Hayashi and Takemi	2015	Yes	Yes	No	No	No	No
Horrigan et al.	2002	No	No	No	No	No	No
Ishikawa et al.	2015	No	Yes	Yes	Yes	No	No
Jackson et al.	2009	Yes	No	No	Yes	No	Yes
Johns and Sthapit	2004	No	No	Yes	No	No	No
Keane et al.	2015	Yes	No	Yes	No	No	No
Kraak et al.	2016	No	No	No	No	No	No
Kuhnlein	2004	No	No	No	No	No	No
Lang	2007	No	No	No	No	No	No
Larson and Story	2015	Yes	No	No	No	Yes	No
Libman et al.	2015	Yes	No	No	No	No	No
Lobstein	2015	Yes	Yes	Yes	Yes	No	No
McCarthy et al.	2011	Yes	Yes	Yes	Yes	Yes	No
Migliozzi et al.	2015	No	No	No	Yes	No	No
Moreira et al.	2015	No	No	No	No	No	No
Morgan and Fitzgerald	2014	Yes	Yes	Yes	Yes	Yes	No
Mwanamwenge and Harris	2017	Yes	No	No	No	No	No
O'Kane	2012	Yes	Yes	No	Yes	No	Yes

Otero et al.	2015	Yes	No	Yes	No	Yes	No
Poms	2017	No	Yes	No	No	Yes	No
Popkin	2017	Yes	No	No	No	No	No
Ridoutt et al.	2017	Yes	No	No	No	No	No
Smith	2015	Yes	Yes	No	No	Yes	No
Solomons	2000	No	No	No	No	No	No
Springman et al.	2016	No	No	No	Yes	No	No
van Zanten et al.	2017	Yes	No	No	Yes	No	No
Vanamala	2017	Yes	No	No	No	No	No
Welch et al.	2005	No	No	No	No	No	No
Yach	2014	No	No	No	No	No	No