Innovate or Perish: Food Policy Design in an Indigenous Context in a Post-Pandemic and Climate Adaptation Era

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Abstract: The objective of this study is to explore the strengths of indigenous food systems in Latin America within the framework of effective food policies. The analysis is based on the adaptive capacity of human beings, and, in this logic, it considers the food systems of Latin America to be relevant since in the face of challenges, such as climate change and the COVID-19 pandemic, indigenous peoples have been able to establish response strategies. However, beyond these responses, we find a region that has assumed a biopolitical stance with a tendency to design control policies in response to the pandemic. This situation has not improved the inequalities and vulnerabilities of a sector of the indigenous population in Latin America. The aforementioned challenges give a clear picture of the strengths of the region's indigenous people, and knowledge of this interactive dynamic can provide elements for the design of food policies. In this sense, an exhaustive literature review was carried out in order to approach the state of the art of the issue. The analysis was derived from three analytical categories that in synergy and from an open innovation perspective, make a proposal for the design and implementation of effective food policies that allow a region to learn from local indigenous experiences in a context of food insecurity.

Keywords: indigenous; biosociety; innovation; resilience; edible wild plants; COVID-19

1. Introduction

The COVID-19 pandemic has been an event of relevance for humanity [1], events of global magnitude have been experienced by mankind, overcoming each event that has occurred. The process of humanisation of the planet began in full in the Pleistocene approximately 350,000 years ago [2]. However, the complexity of organism–environment interactions already existed with the appearance of hominids in the Pliocene two million years ago [3]. This fact is of relevance because it marks the beginning of biotic and abiotic resource pressures.

We survived the Palaeolithic (stone age), Neolithic (agricultural age), the industrial age, and have culminated at the dawn of the 21st century with the information systems revolution, economic crises, and famines, and imposed them on nature in an anthropocentric way [4]. This way of living has undoubtedly been destructive not only for our species but also for our environment [5]. Among the implications of this imbalance is the rise in sea level, which has increased by 10–20 cm since 1900 [6]. Non-polar glaciers are retreating, and the extent and thickness of Arctic Sea ice are decreasing, losing 28 billion tonnes of ice between 1994 and 2017 [7]. In 1998, more than 45% of the world's people had to live on incomes of less than $2 a day. Meanwhile, the richest fifth of the world's population owns 85% of global GDP [8]. In 2002, the Food and Agriculture Organization of the United Nations estimated that 75% of the world's ocean fisheries were fished at capacity [9]. For example, fishing for North Atlantic cod has decimated its population and the species is on the verge of biological extinction [10]. Soil fertility has declined considerably due to modernisation of agricultural activity, and more than 35% of arable land has been degraded due to anthropogenic activities [11].

With the above, a question arises: what lessons do we learn as human beings? Only one; we have learned to adapt.

The ability of humans to cope with and even benefit from environmental, economic, and social stress has been the subject of a debate that has yet to reach its climax in academia, society, and governance at different scales [12]. According to [13], living through an adverse event can be traumatic for many people, but it is also an opportunity to become aware and to restructure the way of understanding the world, which translates into an ideal moment to build new value systems.

For today's society, the COVID-19 pandemic represents the beginning of an era of change [14], with an eye on experiences, such as those of indigenous societies, which have seen the health crisis as an opportunity to revalue their belief systems, values, and traditions [15]. The resilience of indigenous peoples is a condition that is activated in the face of an adverse situation of any nature and generates innovative dynamic responses, creating exceptional survival conditions, allowing the individual and their territory to deploy a high capacity to manage resources in accordance with the problems they face and to recover in multidimensional terms with little or no government intervention [16].

An example of the resilience that indigenous peoples have displayed is the Latin America region that owes its survival to natural resources [17]. In the years 2020 and 2021, in a biopolitical context, the countries of Latin America have had to design control and containment policies against COVID-19, but in a differentiated manner due to the structural conditions of the region's health systems. Despite the situation described above, many indigenous peoples in the region have survived the negative impacts of the pandemic [18]. In a prospective development framework, policies aimed at food and nutritional care must be designed [19], as the role of therapeutic foods will be essential for a healthy and nourished Latin America [20]. In this context, indigenous food systems from an open innovation perspective constitute an alternative to solve these dilemmas. An interesting example is the Qhapaq Ñan project in Peru that addresses the rights of indigenous peoples in a context of protection and management of their biocultural heritage, advancing a proposal for public policy; this proposal is born of a new indigenous activism in Latin America [21].

Open innovation is defined as an adaptive process that is shaped according to the context in which it emerges [22]. Pluri-participation and the dynamics of creating an open innovation ecosystem guarantee access to knowledge at differentiated scales, which facilitates interaction between formal and informal institutions, the latter being essential in the social organisation of indigenous peoples. Informal institutions are norms historically established by indigenous peoples, such as in the case of Ecuador and the various product exchange networks established by the Quichua indigenous group of the Ecuadorian Sierra [23]. These expressions and forms of understanding of indigenous populations are elements that have favoured them in the health crisis. Another example is the case of Brazil, where a multinational cosmetics company has a commercial interaction with rural communities, establishing a supply chain based on biodiversity [24]. These examples are important references in the region, but these initiatives need to be explored and improved to ensure the rights of the communities involved. In contrast, in urban areas the pandemic has had a negative impact on food systems due to reduced mobility, loss of employment and social alienation, and this pandemic scenario is compounded by climate change.

The results of predictions of the impact of climate change on crop yields vary from study to study [25–27], although most authors agree that climate change will most likely reduce agricultural yields of important crops in Latin America and the Caribbean. In terms of biodiversity, a clear trend with respect to future warming levels is that the greater the predicted increase in temperature, the greater the diversity of species affected [28]. Mountainous territories in the tropics are expected to be highly vulnerable due to the high number of endemic and highly specialized species that could face extinction in these ecosystems [29], particularly pollinator species. According to [30,31] almost 90% of all wild flowering plant species on the planet depend on pollinators for their reproduction

and evolution. These plants, in turn, are critical to ecosystem functioning as providers of food, habitat and other resources for many other species. On the other hand, we have ocean acidification and hypoxia, which are likely to become more pronounced under high emissions scenarios [32,33].

The Latin American region is currently facing a double risk of morbidity and mortality due to the COVID-19 pandemic and the variants of this virus that have emerged [34]. On the other hand, climatic events are affecting local food systems [35–37]. This dynamic of change not only affects the Latin American region but will spread throughout the world if our societies are not transformed [38]. The subjectivities with which indigenous peoples perceive their environment is a relevant element in the construction of their reproduction strategies [39], and in a globalized or delocalized world these subjectivities become more acute [40].

Mobilization towards a biosociety is urgent; we understand biosociety as the collective organization of individuals who generate processes of bio-knowledge with the natural resources of their territories. Biodiversity would be the starting point for these processes [41].

In the logic of the previous approach, it is proposed to explore the strengths of indigenous food systems in Latin America within a framework of effective food policies. To achieve this objective, a theoretical-conceptual framework was constructed that addresses resilience in the field of biosocieties, theorizes biosociety from the reality of indigenous populations, explores the biodiversity–food system relationship in a pandemic context and how this relationship leads to resilient indigenous food systems, and finally explores the design of food policies that enable the establishment and functioning of indigenous food systems.

2. Materials and Methods

Methodologically, the study was completed as theoretical research, with a qualitative analysis that was supported by an extensive literature review with the idea of approaching the state of the art of the object of study. The literature search was based on three categories of analysis: the impact of the COVID-19 pandemic at regional and global levels; the evolution of food systems in a pandemic context; and the dynamics of climate change and the impact on biodiversity. This made it possible to review 180 publications, mostly from indexed journals and official reports from international organizations, and a total of 91 publications were selected (Figure 1).
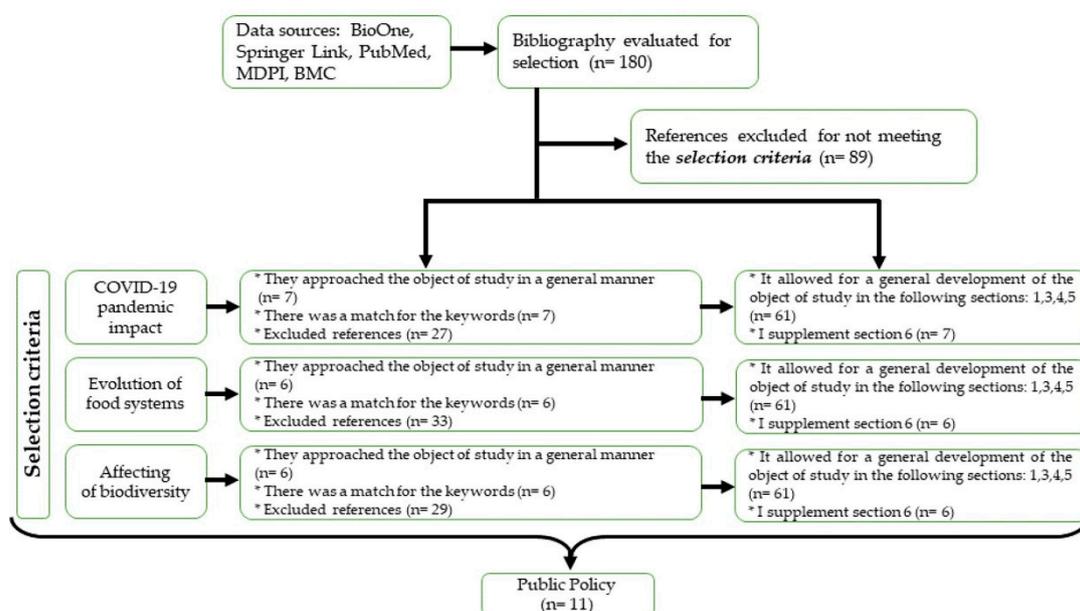
Figure 1. Consort diagram of the bibliographic analysis of the study and selection criteria.

A keyword search was conducted using the terms "covid-19", "climate change", "resilience", "biodiversity", "food system", "open innovation" and "public policies". Throughout the search the keywords were cross-cut by the word "indigenous peoples". This synergy made it possible to concretize the categories of analysis used in the study. The bibliographic databases consulted for the scientific articles were "BioOne", "Springer Link", "PubMed", "MDPI" and "BMC". In the case of official reports, the websites of international organizations related to some of the topics addressed were consulted directly. Figure 2 traces the trajectory of the study and why the above categories of analysis were considered.
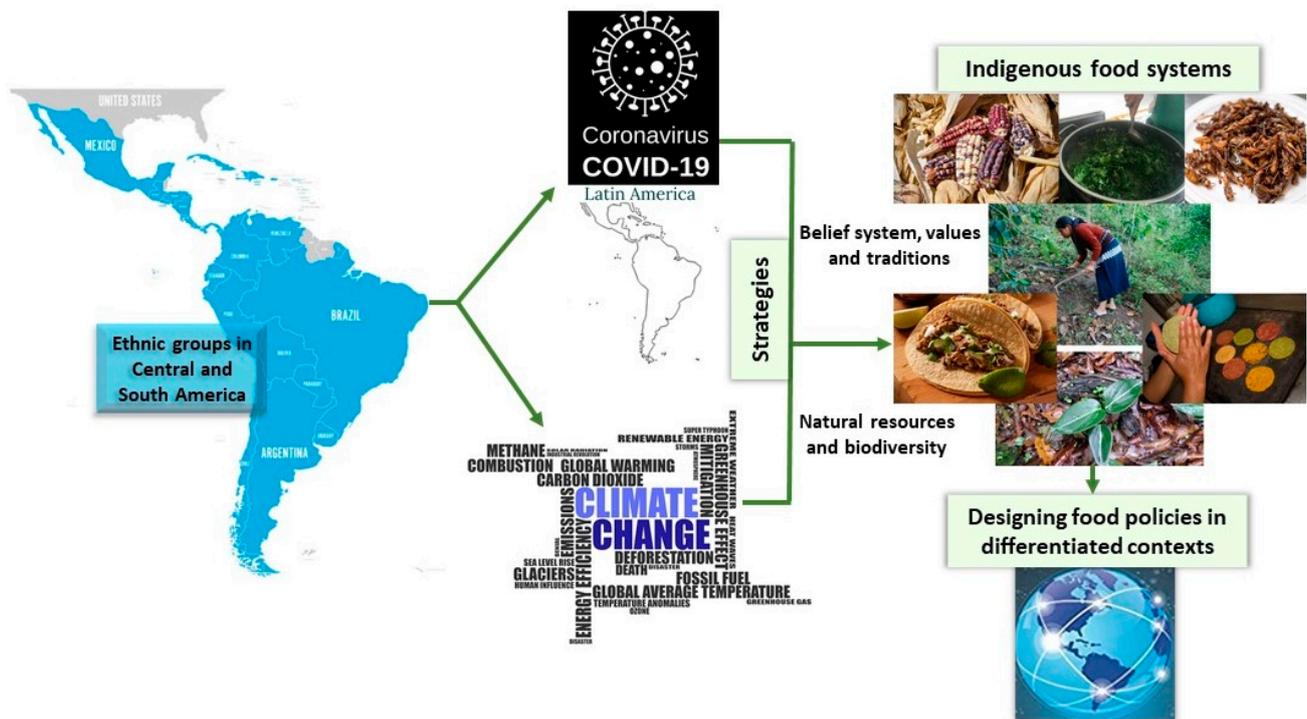
Figure 2. The trajectory of the study. It shows the location of indigenous groups who, due to the impact of COVID-19 and climate change in the region, have deployed response strategies based on their belief systems, values and traditions, and the natural resources and their associated biodiversity. These elements have not only allowed the historical continuity of their food systems but have also enabled their re-configuration in the face of current challenges. These food landscapes should be protected and placed in other indigenous territories or areas of food vulnerability.

The information obtained was analysed and interpreted on the basis of the three categories of analysis mentioned above. The analysis allowed for the definition of a common thread that identified strategies that would guide the design of food policies to ensure the sustainability of indigenous food systems in differentiated contexts.

3. Resilience and Biosociety

These definitions have three analytical orientations in common: (i) resilience as a process and not as something finished [42]; (ii) resilience as a product of the interaction between person and environment [43,44]; and (iii) resilience as abilities or capacities to face or resolve adverse situations [45–47]. An individual is resilient when living or having lived through a situation of risk, exclusion, or trauma for some reason, he/she is able to adapt and recover. This adaptive process occurs through the interaction between internal and external factors. According to [48] these factors must necessarily interact in order to be able to speak of resilience.

In this study we will address the concept of resilience in synergy with the concept of biosociety which will be understood as the capacity of an individual or group to maintain their physical and psychological functions in dynamic environments associated with natural

resources and their biodiversity. In our analysis, we will consider indigenous societies as biosocieties because of their extensive management of natural resources and biodiversity. In biosocieties, the capacity for adaptation and transformations in space and time has been fundamental, and it is no coincidence that the areas known as "biodiversity hotspots" are mostly located in territories with an indigenous presence [49].

On the one hand, transformations in biosocieties follow a historical trajectory, marked by migratory dynamics and later by settlement, and these events probably explain the shaping of indigenous food systems because their configurations arise from the needs and challenges that the original populations had to face in their territories.

On the adaptive capacity side, Lamarck [50] highlights two adaptive mechanisms: (i) law of use/disuse: if some parts of the body or organs are used more, they will strengthen, enlarge and improve; on the other hand, what is not used will weaken, atrophy and reduce in size; and (ii) law of inheritance of acquired characters: assumes that the result of the use or disuse of parts, i.e., improvement or reduction, respectively, is inherited and if this tendency is maintained for several generations, then new structures will be generated, perhaps with new functions and others will be definitively lost.

Both transformations and adaptive capacity weave a loop that in the case of food systems gives rise to persistence; these systems interrelate the worldviews of indigenous groups, the bio-knowledge of natural resources and the biodiversity of their territories. The study by Mukhopadhyay et al. [51] highlights this loop and the production of knowledge.

A biosociety is defined as an organized set of individuals who base their lives on learning, managing, and experimenting with the biotic resources of a territory. Nature is perceived as a "somebody", so the relationships that are established are ones of respect [52]. As part of the social structure, rules, and behaviours, a biosociety does not differ from a society based on an anthropocentric approach, but it does have the particularity that needs are satisfied based on the knowledge obtained from its interaction with the biodiversity existing in the territory.

In today's society individuals live in a permanent conquest of status; in a biosocial society the beliefs system, values, and traditions, mean that individualism is not imposed as a social value. The result is the emergence of a society where collective values prevail, without ignoring individual action, the atmosphere of well-being is perceived in the context of production and consumption processes.

The bio-knowledge gained from balanced collection, production, and consumption provides a sustainable food system. An excellent example is the use of wild edible plants in Central India, using 172 species comprising 60 vegetables, 70 fruits, seeds, and nuts, 23 tubers, and 19 mushrooms [53]. The study showed that indigenous communities in Central India possess extensive bio-knowledge, but the absence of locally adapted marketing models is a barrier to the full development of their food system.

In Latin America, the bio-knowledge acquired in collection, production and consumption is extensive in indigenous populations, the wealth of edible and cultivated wild plants with a variety of centres of origin has been documented by Casas [54] and is estimated at more than 5000 species. Some specific examples for indigenous populations in Central America include the production and consumption of roots and tubers (*Ipomea batatas*, *Colocasia esculenta*) for the Mopan (Belize), Garifuna (Guatemala), Miskitu (Nicaragua), Totonac (Mexico), and Naso (Panama) ethnic groups. Leguminous plants (*Prosopis alba*, *Mucuna pruriens*) for the Wichí (Argentina), Weenhayek (Bolivia), and Totonac (Mexico) ethnic groups. For South American ethnic groups, the production and consumption of Musaceae is relevant, including Hoti (Venezuela), Putumayo (Colombia), and Yanomami (Brazil). The Andean territories have an extensive variety of potatoes where the Aimara (Bolivia) and Quechua (Peru) ethnic groups have an important role in production and consumption. According to Jacobsen et al. [55], the agrobiodiversity of the Andean territories stands out in the region, an example being the grains quinoa (*Chenopodium quinoa*), cañihua (*Chenopodium pallidicaule*), kiwicha (*Amaranthus caudatus*), and tarwi (*Lupinus mutabilis*), which possess prodigious nutritional characteristics to solve problems of human malnutrition.

Integration with wider marketing models (e.g., regional, national, and global markets) is perfectly possible in biosocieties, as external elements reshape adaptive processes, so that in situ conservation of biodiversity is constant. The particularities of the generation of new bio-knowledge by indigenous populations constitutes a commercial opportunity; the food industry could articulate an open innovation system for a chained exploitation of primary and secondary metabolites of a variety of edible wild plants that Latin America possesses, a good guiding example of the design of this exploitation is the study of Chez Panisse: Building an open innovation ecosystem by Chesbrough et al. [56]. However, the viability of an open innovation ecosystem with these specificities will depend on the accompaniment of effective food policies [57].

4. Biodiversity-Food System Loop in the Context of the COVID-19 Pandemic

The COVID-19 pandemic has highlighted the food vulnerability of global society; the slowdown of the global food system due health measures (e.g., social distancing, confinement, restrictions on spatial mobility) put in place by national governments around the world has been unexpected. Currently, the COVID-19 pandemic has had a significant negative global impact, with the level of infection reaching 364 million infected people with 5.6 million deaths by January 2022 [58]. This scenario in the context of food security has raised concerns around the world, particularly in regions such as Africa, Asia, and much of Latin America.

World hunger increased in 2020 in the shadow of the COVID-19 pandemic. After five years of little change, the prevalence of undernourishment grew in just one year from 8.4% to almost 10% [59]. More than half of the world's undernourished population is concentrated in Asia and Africa, affecting 700 million people. Compared to 2019, in 2020 this figure increased by 100 million more people for both continents [59]. In Latin America, agricultural and food systems tend to be resilient due to the attributes of their territories; the complexity of socioecological systems has been a resilience factor in the face of the territories of the region in the midst of health crises (e.g., climate change, lack of funding, poor infrastructure, deforestation, lack of public policies) which generate scenarios of food uncertainty. According to FAO [60], in 2020, despite policies to support income and access to food, the incidence of moderate or severe food insecurity is estimated to have reached 40% of the population, i.e., 44 million more people in Latin America.

According to Tendall et al. [61], the food system resilience action cycle consists not only of reactive actions (absorb, react, restore, learn), but also preventive actions (build resilience). Preventive actions can also address stressors, which affect the reactive capacities of the food system in response to a perturbation. The precarious conditions of the territory and the absence of public policies, far from being disturbances, can represent a scenario of opportunity to promote the establishment of resilient food systems [61]. If we look at the rural landscape of Central and South America, more than 80% are small family farms (16 million people) that bring together a population of 60 million people [62], which represents a high potential for transforming local food systems.

In the context of globalization, the FAO [62] stresses the need to develop an institutional framework that promotes access to public goods (e.g., technologies, irrigation infrastructure, roads, transport, etc.), sources of financing, and productive resources. This is compounded by the effects of macroeconomic policies implemented in most countries in the region. The territorial approach provides a physical space that makes it possible to understand the productive and social reality of the smallholder farmer, enabling the design of development strategies adapted to the territorial resources, infrastructure, and socioeconomic characteristics of the sector to be intervened. The territory, therefore, recognizes the heterogeneity of family farmers, allowing the design of differentiated policies according to the diversity of situations of each segment of farmers [62].

In this institutional context, in recent years governmental bodies have been promoting the establishment of ethnobotanical gardens with the main objective of conserving species. This conservation strategy is associated with indigenous territories; experiences in Mexico

are known, as well as the proposal for an ethnobotanical garden in the Ecuadorian Amazon [63,64]. The development of this regional or local biodiversity conservation strategy can serve as spaces for dissemination in the context of indigenous food systems [65].

At the same time, indigenous food systems, which are associated with the biodiversity of territories in Latin America, must be considered. Central and South America are home to significant indigenous populations, in addition to the fact that the region possesses 60% of the world's biodiversity and is home to one third of the world's freshwater [66]. These attributes of the region represent an opportunity to learn from indigenous food systems from a sustainability perspective, to explore their adaptability to the heterogeneous reality of Latin American territories, and to provide support in a public policy context are the first steps to be taken.

5. Indigenous Food Systems, Challenges and Foresight

Indigenous peoples have mediated relationships with nature through their belief systems, values, and traditions, resulting in knowledge of agricultural and management practices that has endured through the ages [67]. This continuous accumulation of indigenous local knowledge is what we can call "biocultural food heritage". The threat of modernity has always lurked, and indigenous peoples and their food systems have in most cases adopted external cultural elements that enable their survival in order not to perish. According to [68], indigenous peoples have been affected by economic and agricultural development and related policies, including the industrialization of production, combined with trade agreements that undetermined local competitiveness. This makes biocultural food heritage part of an open innovation ecosystem due to its historical persistence and socio-ecological attributes that allow a configuration of indigenous territories.

Local and global initiatives, such as the one launched by the International Network of Mountain Indigenous Peoples (https://inmip.net/, accessed on 10 November 2021), have confronted these adverse scenarios as a collective. This collective brings together communities and organizations from China, Ethiopia, Guatemala, India, Kenya, Mexico, Papua New Guinea, Peru, Kyrgyzstan, Philippines, Thailand, Taiwan, and Tajikistan. This network offers opportunities for substantive positive change in key diversity regions by providing a focus for initial integrated efforts to conserve and utilize biocultural food heritage. This initiative is an example of the activism that is taking shape in Latin America, where indigenous peoples have adopted this movement as a strategy to protect their freedom, autonomy, and the natural resources under their protection.

The traditional foods of indigenous peoples in Latin America are derived from food systems based on a diversity of edible plants of wild or cultivated origin [67]. Promotion and learning based on these food systems should consider the build of diverse food landscapes. Forests would be the primary sources of such landscapes, the biodiversity contained in them is sufficient to drive this strategy.

On the other hand, support for the design and implementation of public policies is essential. These policies would primarily guide the adaptive management of local communities in learning and acquiring new food systems. Secondly, local financing of community initiatives must be ensured, including road infrastructure improvement policies and local impact marketing models.

This institutionalization based on adaptive processes is not new, and a similar initiative has been proposed at the global level for the transformation of food systems [69]; the theoretical framework of this proposal is important but solving the "how to do it" at the local level is also fundamental and is a task to be accomplished.

The Current Situation of Indigenous People in Latin America

The current situation of indigenous peoples in Latin America can only be understood as the historical result of the European conquest more than five centuries ago, by which they were dispossessed of the territories they inhabited, and of their spaces of social and cultural reproduction [70]. The recognition of their rights has been persistent throughout

history, and two fundamental legal instruments support their rights: (i) ILO Convention No. 169 on Indigenous and Tribal Peoples (1989), which recognises their collective rights [71], and (ii) the United Nations Declaration on the Rights of Indigenous Peoples (2007) [72], which establishes the right of indigenous peoples to self-determination. In Latin America, indigenous peoples have gained political space in countries such as Bolivia, Ecuador, Guatemala, Nicaragua, Panama, Peru, and Venezuela, and with this have strengthened their freedom and autonomy [73].

Territorial inequalities reflect the limitations suffered by indigenous populations in the exercise of their rights. Modernity in the region and the growth of the agricultural frontier have led to displacement, but international pressure has halted these processes [74]. A decade ago, more than 50% of the indigenous population of Brazil and Colombia experienced forced migration processes, and these peoples had an important interrelationship with urban areas [70]. The regional economy in the context of raw material commodities has caused strong pressures on indigenous territories and triggered numerous unresolved socio-environmental conflicts. One of the greatest challenges facing the region in its quest for equality is the inclusion of indigenous peoples' rights among policy priorities [75]. In Latin America, there are 826 indigenous peoples, with a population of 45 million, characterised by a wide demographic, and social, territorial, and political diversity, ranging from peoples in voluntary isolation to their presence in large urban settlements [70].

In the area of social policy, 29 Latin American countries have adopted 285 social protection measures to help households suffering from the greatest poverty, vulnerability, and insecurity. The most frequent measures have been cash transfers and the provision of food (41.8% and 19.3% of the total, respectively), but it is not possible to know what the impact of these measures has been on indigenous peoples due to the lack of available information [74]. Despite the evidence of the vulnerability of indigenous peoples to the pandemic, and the widespread recognition in the countries of the region of their individual and collective rights, including the rights to health and life, the reality is that, to date, state responses have been insufficient [75].

Indigenous peoples have taken important steps to resist the pandemic. In general, these initiatives involve generating data on infections and deaths in their communities; conducting information and awareness campaigns on virus prevention; adopting containment and mitigation measures information and awareness campaigns on virus prevention; adopting containment and mitigation measures, such as cordon sanitaires, prohibition of access to communities, surveillance, community supervision, establishment of circulation and isolation protocols, use and promotion of traditional medicine, and adoption of measures to ensure food security [74]. According to Lugo-Morin [15], in the context of the COVID-19 pandemic, indigenous peoples in Latin America have deployed strategies for food security and health, including the management of their food systems and the revaluation of wild plants for medicinal use.

The handling of information provided by institutions that generate statistical data related to indigenous peoples should be treated with caution, remembering that 25% of the indigenous population in Latin America live in inhospitable territories in voluntary isolation and nothing is known about them, and the remaining 75% live in semi-isolation, safeguarding their belief systems, values and traditions, and those peoples who live linked to large cities with a continuous migratory flow.

6. Discussion of Results

The findings are analysed based on the categories of analysis generated from the bibliographical review, and each category is developed and argued with the similarities and oppositions of the references included in the constructed theoretical framework.

6.1. Impact of the COVID-19 Pandemic at Regional and Global Levels

The results derived from the analysis show that the COVID-19 pandemic has had a negative impact on society. Official figures show a progressive increase in infections and

deaths due to the pandemic [58]. In Latin America, the number of people infected to date (January 2022) has reached 132 million people, with more than 2.4 million people dead due to the pandemic [58].

The region accounts for one-fifth of confirmed cases of COVID-19 and about 30% of deaths worldwide, despite having only 8.4% of the world's population. In 2020, due to the health emergency, Latin America experienced the largest economic contraction in 120 years and was the worst performing of all developing regions. Prior to the pandemic, the region was already suffering from low growth. The COVID-19 pandemic has made clear the need to implement comprehensive policies and to recognise the interdependence between health, the economy, social development, and the environment [76].

Against this backdrop of health crisis, the measures implemented to contain the pandemic have generated scenarios of food insecurity. The incidence of moderate–severe food insecurity reached 40.4% of the population, up from 33.8% in 2019 [77]. According to FAO [60], the prevalence of undernourishment in Latin America has increased by 40% since the pandemic officially began in March 2020.

According to the report in [78], the COVID-19 pandemic and associated containment measures are expected to continue to exacerbate economic crises and acute food insecurity, especially in fragile economies in parts of Latin America (e.g., El Salvador, Guatemala, Honduras, Paraguay, and Haiti, among others). Even if COVID-19 can be contained in some parts of the world, slow implementation of vaccines in countries with weak health systems could prolong constraints, dimming prospects for rapid economic recovery [79]. According to [76] there is a need to incorporate sectoral policies in the region that promote a transformative recovery that values and recognises the interdependence that exists between the health, social, economic and environmental dimensions, articulating a strategy for structural change focused on promoting investments for economic, social and environmental sustainability.

6.2. Evolution of Food Systems in a Pandemic Context and Climate Change Dynamics

The population affected by food insecurity has continued to increase in Latin America over the past 5 years. In 2019, almost one third of the population, or 191 million people, were affected by moderate or severe food insecurity. Of these, 57.7 million, approximately 10% of the region's population, were severely food insecure, i.e., they went without food, went hungry or went more than a day without food. Against this backdrop we must add 44 million more people who are being affected by the COVID-19 pandemic [59].

In terms of prevalence, the populations of Central and South American countries are located in phases 2 and 3 of the Integrated Food Security Phase Classification provided by [78], indicating the need to implement actions to reduce disaster risk and protect livelihoods.

The analysis shows that the impact of health measures (e.g., social distancing, confinement, restrictions on spatial mobility) have slowed down food systems in the region. The picture described above is not encouraging as, even after the COVID-19 pandemic is over, the consequences of the pandemic will be present for some time to come. The opportunity to look towards resilient food systems is likely in a post-pandemic scenario. A resilient food system involves identifying aspects of adaptation, learning, and persistence in the components of the system. In rural areas of Latin America, local food systems meet these attributes; however, the precarious conditions of social actors and the lack of public policies are elements that sometimes impede their development.

The COVID-19 pandemic is a scenario for change, and a look at the experiences of indigenous societies in the context of their food systems can be an opportunity to transform the way we feed ourselves [15]. In addition to this pandemic dynamic that has put the region's capacities to the test, Latin America has been suffering from the impacts of climate change. Several studies maintain that the impact of climate change has had a negative and differentiated effect on agricultural yields [25–27].

6.3. Affecting Biodiversity

The impact of the COVID-19 pandemic on biodiversity has yet to be quantified. The central element in the impact on biodiversity is climate change. A clear trend with respect to future warming levels is that the greater the predicted increase in temperature, the greater the diversity of species affected [28]. Ecosystems in the Latin American tropics will be vulnerable to a possible increase in temperature due to the high number of endemic and highly specialized species. According to [30,31], almost 90% of all wild flowering plant species on the Earth depend on pollinators for their reproduction and evolution.

In the face of this landscape of biodiversity affectation, the region has the advantage of having 60% of the world's biodiversity with important freshwater reservoirs [66]. A significant number of indigenous peoples have settled in Latin America and have used the region's biotic resources in a sustainable manner since ancient times [15].

The above supports the fact that food security in indigenous territories is associated with their biodiversity and their belief systems, values, and traditions. Indigenous food systems, by definition, are resilient; they have persisted historically and their custodians, the indigenous groups, safeguard the ancestral knowledge that has enabled their permanence since ancient times. One example is the pandemic response strategies of some indigenous groups in Central and South America (Table 1).

Table 1. Ethnic groups in Central and South America and the use of some wild and cultivated edible plants. The food systems of these indigenous groups have historically used edible plants and insects in their diet, their intensity of use has changed due to cultural, environmental, or economic elements, but they have never ceased to be part of the indigenous food system.

Country	Ethnic Group (Example)	Indigenous Strategy for COVID-19	Forgotten and Recovered Plants (Ethnic or Common and Scientific Name)	Underutilized Plants (Ethnic or Common and Scientific Name)
Argentina	Wichí	Food system and system of beliefs, values and traditions	Fwalhawuk (Morrenia adorata)	Fwa´ay (Prosopis alba)
Belize	Mopan	Food system	Sweet potato (Ipomoea batatas)	
Bolivia	Weenhayek	Food system and knowledge of ancestral medicine		Fwa´ay (Prosopis alba)
Brazil	Yanomami	Food system	Naönaö amo (Lentnula raphanica)	
Chile	Mapuche	System of beliefs, values and traditions	Pisku (Pinus pinea)	
Colombia	Putumayo	Food system and knowledge of ancestral medicine	Tacacho (Musa paradisiaca)	
Costa Rica	Maleku	Knowledge of ancestral medicine		Pejibaye (Bactris gasipaes) * Worm: chontacuro (Rhynchophorus palmarum)
Ecuador	Shuar	Food system		
Guatemala	Garifuna	System of beliefs, values and traditions	Malanga (Colocasia esculenta)	
Honduras	Lenca	Food system		Guamo (Inga feuillei)
Nicaragua	Miskitu	System of beliefs, values and traditions		Malanga (Colocasia esculenta)
Panama	Naso	System of beliefs, values and traditions		Otoe (Colocasia esculenta)
Paraguay	Mbya-Guarani	Knowledge of ancestral medicine		Kambara (Buddleja madagascariensis)
Peru	Quechua	Knowledge of ancestral medicine		Ayrampu (Opuntia apurimacensis)
Uruguay	Charrua	Knowledge of ancestral medicine	Ceibo flower bud (Erythrina cristagalli)	
Venezuela	Hoti	Food system and knowledge of ancestral medicine		Asai (Euterpe precatoria)

Source: Based on data from [15]. Note: * Worm of importance to the ethnic group for its nutritional value, collected during a specific period of the year.

7. Food Policy Design

A public policy is defined as a plan of action, it represents the concrete realization of the state's decisions in its desire to modify behaviour by changing the rules of the game operating in society [80].

This author also points out that there are at least three meanings that are covered by the word politics and that the English language does distinguish [80]. First, *politics* conceived as the sphere of government of human societies, *polity* in English. Second, *politics* as the activity of organising and struggling for the control of power, *politics*. Finally, *politics* as the designation of the purposes and programmes of public authorities, *policy*, and this analysis will be aligned with the latter meaning.

The analysis of public policies offers a renewal of studies for understanding the state and its actions. These studies have often brought to light the sometimes significant gap between the state's or legislator's initial intentions and concrete realizations. In this way, public policy analysis has contributed to viewing the state with less consecration or reverence [80].

Following Muller and Surel [81], it should be noted that public policy does not exist "naturally" in reality but is a social construct. The implies difficulties in identifying its exact contours. A simple observation of the actions of the authorities and their effects shows that delimiting whether they belong to one or the other public policy is a much more complex exercise than one might initially imagine. Where is the boundary between food security policy and food resilience policy? The very definition of policy is already a matter of controversy, debate, and political struggle for political actors. Here, the food industry would have a role to play in driving the open innovation ecosystem. This is a difficult process and will require as a first step that the industry learns from the belief systems, values, and traditions of indigenous groups.

The participation of urban societies will include having to learn from indigenous values, and the promotion of food health in the region's indigenous values will have to reconcile with the social metabolism of the current society. The prolongation of the health crisis will allow the integration of indigenous values into a renewed sustainable food system in the region [73].

In this logic, it is necessary to design flexible public policies that allow them to be readjusted according to the effects they have on the final beneficiaries. The following food policy instruments are proposed: (i) food control instruments, (ii) food promotion instruments, (iii) food taxes, and (iv) feedback tools.

Food control instruments: a first approach to indigenous food systems must consider the safeguarding of ancestral knowledge derived from the indigenous food systems involved. The food policies implemented will be determined by several factors: the main economic sectors, the level of development of each region, national interests, or the lobbying power of the various stakeholders. Control instruments must be based on theoretical certainty and incorporate the institutional resilience of the indigenous groups that share their food systems.

Food promotion instruments: recognition of indigenous groups that share their food systems is fundamental and must be accompanied by incentives in agreement with indigenous groups, which will allow the scope of collaboration and transferable permits to be analysed.

Food taxes: in the context of biodiversity impacts, a levy per food system should be defined. These taxes will generate balance in the uses of wild species that are part of the food system, and the bio-knowledge derived from food systems should be managed in a tripartite manner (e.g., local authority, indigenous group, and entrepreneur or interest group) is a positive aspect of this instrument. An optimal design of such taxes would require information on the marginal damage curve, which in turn would require data on the status of the species.

Feedback tools: the monitoring of food policies must be constant, and the development of tools for collecting, organising, interpreting, and explaining food policies will make it possible to observe the effectiveness of the policies implemented.

7.1. The Role of Indigenous Peoples and Their Incorporation into the Design of Food Policy

Policies are deeply implicated in the way we construct ourselves as individuals. To put it another way, one of the most important aspects of public policymaking is the way in which policies construct new categories of subjectivity and new types of political subjects, particularly modern concepts of the individual [80,82].

From birth to death, individuals are categorized, classified, and regulated by public policy processes over which they have little control. Policies do not simply assign particular identities to specific individuals and groups; they actively construct those identities [82]. Indigenous peoples, at least all of those who have not been in voluntary isolation, do not escape this reality. According to Shore [82] the rise of politics and its penetration into increasingly diffuse areas of our daily lives is one of the defining characteristics of our age.

Policies are called upon when rules must be made visible, when relationships must be formalized, or when decisions require the stamp of legitimate authority [82]. Based on the previous position, a question arises as to how we should make a food policy based on food systems without affecting indigenous peoples. Designing a public policy from a biocultural perspective imposes a permanent contact with the final recipients of such a policy. The beginning of the formulation of a public policy must start by carrying out a diagnosis of the territory, following these steps:

I.　Identify the indigenous group.
II.　After point I has been fulfilled, the internal and external factors that enable individuals' actions, as well as their food systems, are identified, described and analysed.
III.　The identification, description, and analysis outlined in point II will reveal the relational dynamics.
IV.　Once the relational dynamics between the social actors have been exposed, it is possible to study the position of each of them.
V.　At the territorial level, it is important to assess the local context at the institutional and socio-cultural level and to see how the social actors are inserted.
VI.　Knowing points I to V will allow a first draft of how public policy should be designed, which involves three phases:

The first step is to perceive the problematic situation, in our case the resilience of food systems (e.g., strengthening or building). In Latin America, there are no programmes, norms, or regulations on the issue of food systems resilience. In this case, legislation on the subject is scarce, but the legal framework for indigenous groups is a start. It is important to make a synthesis of this scaffolding and how resilience of food systems can be part of a national agenda.

Secondly, articulation of the local-regional agenda with a national one, understanding the problem of food insecurity in the public sphere, i.e., how the problem affects the region's citizens and whether it is possible to quantify it and propose solutions. The objectives and potential population should also be established.

Thirdly, to conduct a dialogue with policymakers and the possibility of its implementation. In the dialogue, it is important to identify the points previously mentioned, as well as the attributes of the individual receiving the policy. The generated document should be socialized with regional political actors and governmental institutions, and if another mechanism exists, it should be put to the target population for consideration. A theoretical model for the design of a food policy is shown in Figure 3.
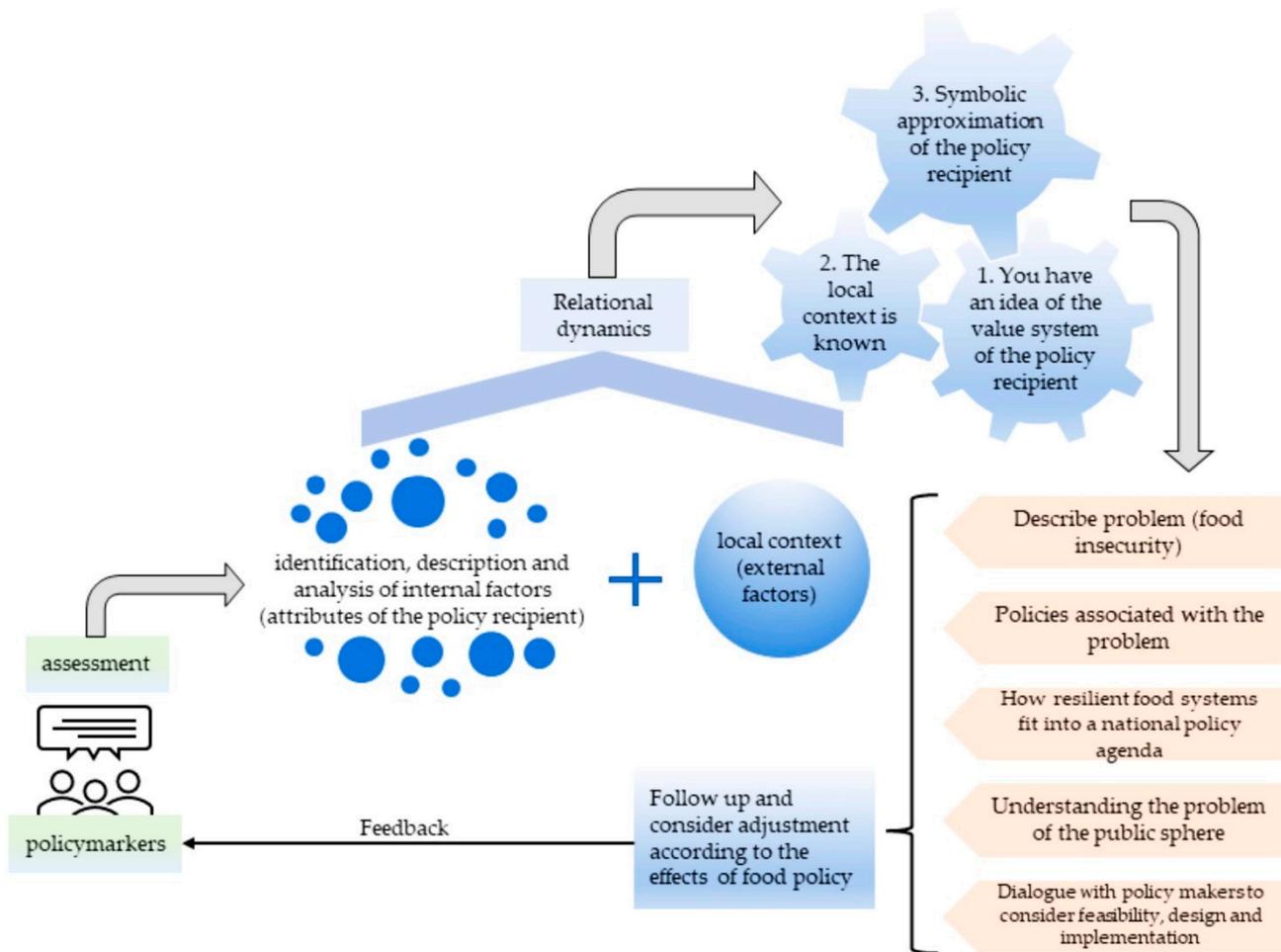
Figure 3. Theoretical model for food policy design.

7.2. Open Innovation in Food Policy

Open innovation emphasizes that an organization that generates its own ideas, develops, and implements them has a wider range of possibilities in the face of external scenarios [83]. Such organizations learn and adapt in such environments and become competitive [84,85]. Public policy and food systems are not far from the application of the open innovation approach; in the face of a reality of food insecurity, alternatives based on indigenous food systems are a real possibility.

Open innovation is a concept that has been in widespread use in recent years [86]. Considering open innovation in food policy design seeks to make food systems more inclusive. The recognition of indigenous food systems is a step forward in valuing these systems in differentiated contexts, and the application of open innovation is a relevant element for the design of effective food policies at both local and regional levels [87–91].

For the case of this study, the protocol of an open innovation strategy should consider indicators that project the sustainability of the designed food policies. Two types of indicators will be needed, the first one oriented to identify and monitor the effects of public policies on the final recipients and the second one to identify changes in the environment as a result of the implementation of public policy. Indicators will be useful not only to demonstrate changes in terms of temporality, but also to monitor the effects of the implemented food policy (Table 2).

Table 2. Indicators in food policy.

	Indicators	Observations
First case	Local economic dynamics	This aspect is fundamental, as it allows the development of well-being in the communities and, in times of crisis, if they have the financial strength to recover. A public policy focused on this objective should be one of incentive, seeking the use of territorial resources in a sustainable manner.
	Biocultural insurance	This type of insurance will allow indigenous peoples to have monetary support and should be included in the design of the food policy
Second case	Biodiversity insurance	This insurance is strategic for indigenous groups that share knowledge of their food systems and have a strong component of wild edible plants
	Capacity to learn and innovate	In this aspect it is important for the formation of social technologies, social technology being understood as the mechanism that influences people's behaviour and ways of live. An example would be the establishment of centres of ancestral knowledge, with which knowledge fairs could be promoted, where the elders could have discussions on indigenous food systems and their logics.

From a global perspective, open innovation is an element that has been present in the health crisis generated by the COVID-19 pandemic and its globally implemented health measures, which has led society, particularly indigenous societies, to put into practice food strategies derived from their ancestral knowledge that has been historically guarded, knowledge that can be shared in a context of respect for their belief systems, values, and traditions. This approach is a relevant aspect in the design of food policies; the biodiversity-food system loop not only allows for a flow of food knowledge, but also provides information on the recipients of food policies.

8. Conclusions

The methodology employed allowed us to explore the strengths of indigenous food systems in Latin America within a framework of policy design. The design was based on an open innovation perspective, using three categories of analysis derived from a robust literature review as an analytical tool. These categories were: (i) the impact of the COVID-19 pandemic at the regional-global level, (ii) the evolution of food systems in the context of pandemic and climate change, and (iii) the impact on biodiversity.

It was found that the potential of indigenous food systems can constitute a solid basis for the design of food policies in the face of the region's challenges. In a context of challenges, the region faces little assistance to vulnerable populations, including indigenous peoples. The adjustments made constitute a biopolitics aimed at taking advantage of the pandemic scenario; control measures are a clear example of this trend. However, more importantly, indigenous peoples have been able to cope not only with a health crisis, but also with the climate variability that threatens the region's biodiversity, and even the indigenous people's actions are better strategies than the deficient strategies implemented by Western hegemony.

The position of equating indigenous peoples with biosocieties in the region with the largest indigenous presence is established for two reasons: the impact of the COVID-19 pandemic and climate change. A relevant fact recognised by ECLAC is that the region has an incidence of food insecurity.

The coupling of the aforementioned elements implies the realization of socioecological systems that emerge as a response to food vulnerability in Latin America. At present, public policies with a local impact are far from being inclusive and much less are they conceived with an anthropological approach. It is necessary for indigenous territories to have sufficient autonomy in the management of their food systems from informal institutions, so that schemes can emerge that value the socialization of biocultural food heritage.

The results set the stage for advancing a research agenda for the reconfiguration of food policies in the region; although the proposal focuses on indigenous populations,

urban areas may benefit if the initiative to build an open innovation ecosystem in the context of indigenous food systems takes a first step. The potential of therapeutic foods and other foods derived from these systems can form the basis for mitigating malnutrition and bringing food insecurity to manageable levels for local and regional authorities.

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