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RESILIENT FOOD SECURITY POLICIES UNDER CLIMATE STRESS: COMPARATIVE EVIDENCE FROM LATIN AMERICA

气候压力下的弹性粮食安全政策：拉丁美洲的比较证据

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Abstract
The purpose of this article is to analyze food security policies implemented in communities experiencing extreme poverty due to environmental degradation, conceptualized as a form of gender-based violence driven by climate change. This article is based on a combination of quantitative impact assessment and qualitative text analysis, enabling a multidimensional understanding of how food security policies influence agricultural productivity and socioenvironmental resilience in Mexico, Cuba, and Colombia. Using statistical data from the last decade and qualitative document analysis, the authors demonstrate the relevance of production-oriented strategies, such as productive patios, in addressing both environmental challenges and the sustainable development of Afro-descendant and indigenous populations. We illustrate the proposed method by assessing regional variations in productivity gains and institutional policy effectiveness. Our approach reveals a modest but steady increase in agricultural productivity—despite regional disparities—showing an improvement of up to 5% in localized areas. The new method for evaluating food security effectiveness was confirmed through cross-national comparisons and regression-based validation. New research results can be used to design inclusive and environmentally just food systems. This paper is novel because it integrates socio-legal perspectives with empirical agricultural data to assess the gendered implications of climate-related food insecurity in Latin America.

Keywords: Food Insecurity, Agricultural Productivity, Productive Patios, Food Law, Public Policies on Food Security

摘要 本文旨在分析由于环境恶化而陷入极端贫困的社区所实施的粮食安全政策，这一现象被界定为由气候变化引发的性别暴力形式。文章基于定量影响评估与定性文本分析相结合的方法，从多维角度理解粮食安全政策如何影响墨西哥、古巴和哥伦比亚的农业生产力与社会-环境韧性。通过分析过去十年的统计数据和政策文件，作者证明了以生产为导向的战略（如"生产性庭院"）在应对环境挑战和促进非洲裔及原住民社区可持续发展方面的重要性。我们通过评估各地区生产率提升和政策效果的差异，展示了所提出的方法。尽管存在区域差异，该方法揭示了农业生产力的温和但稳定增长，在部分地区的提升幅度达到 5%。该粮食安全效果评估新方法已通过跨国比较和基于回归的验证得以确认。本研究成果可用于设计包容性、环境公正的粮食系统。本文的创新之处在于融合了社会法律视角与农业实证数据，以评估气候相关粮食不安全的性别影响，推动拉丁美洲相关研究发展

关键词: 粮食不安全、农业生产力、生产性庭院、粮食法、粮食安全公共政策

1. INTRODUCTION

Food security has emerged as a critical pillar of the global development agenda, particularly in the context of the 2030 Sustainable Development Goals (SDGs). Its importance is further magnified in regions where agriculture is the principal source of livelihood, sustenance, and employment—such as Mexico, Cuba, and Colombia in Latin America. These countries not only face persistent structural inequalities but are also increasingly vulnerable to the compounded effects of climate change, socio-political instability and environmental degradation, all of which directly undermine agricultural productivity and food system resilience. The foundational definition articulated by the Food and Agriculture Organization (FAO) during the 1996 World Food Summit remains widely accepted: food security exists "when all people, at all times, have physical and economic access to sufficient, safe, and nutritious food to meet their dietary needs and food preferences for an active and healthy life" [1]. This multidimensional concept encompasses availability, access, utilization, and stability—dimensions particularly precarious in Latin American contexts marked by extreme poverty, rural marginalization, and climate-exacerbated displacement.

The relevance of food security in the current global landscape cannot be overstated. In the Latin American context, it intersects with broader socio-ecological challenges, including deforestation, water scarcity, and the intensification of weather-related shocks such as droughts and floods. Ensuring food security in these countries is not only a matter of public health and economic development but also a prerequisite for social cohesion, environmental sustainability and climate resilience. Consequently, there is an urgent need to critically examine the role of state and community-level policies in reinforcing inclusive, adaptive, and environmentally just food systems. Agricultural productivity emerges as a determining factor for guaranteeing food security because an increase in productivity can result in a better supply of food and, consequently, in more affordable prices for consumers [2].

Recent studies [3], have indicated that initiatives such as subsidies, agricultural credits, and technology transfers have had heterogeneous impacts in different regions of the country. However, despite these efforts, the Colombian agricultural sector continues to face significant challenges in terms of productivity, which are intrinsically linked to socioeconomic, technological, and environmental factors [4].

Colombia has a land area of 114 million hectares, of which 39.2 million are potentially suitable for agricultural cultivation, representing 34% of the total area. In 2021, 5.3 million hectares were cultivated, equivalent to 13.5% of this potential. Despite this underutilization, agricultural crops, especially tropical crops, cereals, and fruit trees, occupy 70% of the total cultivated area [5]. In contrast, this sector contributes significantly to the country's GDP, despite not exploiting its productive potential. In the fourth quarter of 2023, agriculture, livestock, hunting, forestry, and fishing recorded an annual percentage change of 5.2% in their contribution to GDP [6]. This contradictory trend underscores the urgent need to understand and address the factors that influence the country's agricultural productivity by comparing it with those of Latin American countries such as Mexico and Cuba.

Despite progress in the implementation of food security policies, significant gaps persist in the knowledge regarding how these policies impact agricultural productivity differently in the various Colombian regions [7]. Likewise, according to the WFP, although progress has been made in collective action to address food insecurity, the assessment carried out at the end of 2023 reveals that half of Colombian households are in a situation of marginal food security [8]. This suggests that existing assessments may not fully capture the complexity of the situation; therefore, the statement of the problem is because food security and agricultural productivity are fundamental pillars for the sustainable development of Latin American countries such as Mexico, Cuba, and Colombia [9]. Since these are countries where agriculture plays a significant role in the economy, ensuring sufficient and high-quality agricultural production is essential to combat poverty and improve the quality of life of rural populations. According to the National Administrative Department of Statistics DANE, Colombia's total GDP was 1,002,922 billion pesos at current prices; agriculture represented approximately 5.2% of Colombian GDP, equivalent to approximately 52,151.9 billion pesos [6]. However, the product per worker in agriculture was equivalent to less than half (42%) of the national product per worker in 2019, and it is the third branch of activity that employs the most workers (16.6%) [9]. However, despite the relevance of the agricultural sector, Colombia faces significant challenges in terms of food security, which is why the Ministry of Agriculture and Rural Development points out that, despite the advances in food security in Colombia [11], significant challenges persist, since half of Colombian households are in a situation of marginal food security, these households could fall into food insecurity due to circumstantial factors such as climatic phenomena, the economic slowdown, instability in food prices and other causes, generating that the poorest population faces difficulties in accessing food, resulting in many households being forced to resort to survival strategies to cope with food insecurity [12].

Agricultural productivity is affected by various factors, including socioeconomic, technological and environmental aspects, and in this context, food security policies have been implemented with the aim of improving the availability, access and quality of food in the country [13]. However, the effectiveness of these policies in improving agricultural productivity and therefore food security continues to be a subject of debate. Over time, government policies have varied, adopting different approaches and achieving different levels of success [14].

Therefore, it is essential to analyze how these policies have influenced agricultural productivity and to identify the factors that have played a determining role in this relationship. In this sense, the present study aims to analyze the effect of

food security policies against gender violence due to climate action in Latin America, and to achieve this objective, it is proposed to describe the effect of food security policies against gender violence due to climate action in Mexico, Cuba, and Colombia.

The central question guiding this research is: How have food security policies against gender-based violence due to climate action in Colombia, compared with Mexico and Cuba? As a working hypothesis, it was proposed that food security policies implemented in Colombia have had a significant and positive impact on agricultural productivity, especially when accompanied by improvements in agricultural technology and socioeconomic support for farmers. However, it is anticipated that this impact will vary considerably among the different regions of the country due to existing socioeconomic and environmental disparities.

The relevance and timeliness of this reflection lies in the growing concern for food security in a context characterized by climate change and global economic fluctuations [15]. In this scenario, agricultural productivity in Colombia emerges as a key factor in food stability and rural development. Therefore, this research will not only contribute to academic debates but will also provide valuable insights for policymakers and agents in the agricultural sector [16] in Latin America.

2. Methods

This research was based on a quantitative-qualitative methodology [17] and a systematic analysis of statistical techniques and secondary data. This approach allowed an objective [18] and precise evaluation of the effect of food security policies against gender-based violence due to climate action in Latin American countries such as Mexico, Cuba, and Colombia [19].

The methodology was structured in sequential and interrelated phases that included quantitative analysis of data found in documents after an exhaustive review of academic databases, government reports, and specialized publications [20]. Subsequently, several historical data on food security policies was collected, which were examined against gender-based violence due to climate action in Latin America [21]

A comparative analysis of food security policies in Mexico, Cuba, and Colombia was conducted, considering socioeconomic, technological, and environmental factors that affect agricultural productivity and the implementation of food security policies [22] and [23]. The synthesis of the results enabled the development of solid conclusions on the impact of these policies on agricultural productivity, identifying significant patterns and trends [24]. This quantitative-qualitative methodology facilitated a systematic and objective exploration of the interrelationship between food security policies and agricultural productivity in the Colombian context, contributing to a deeper and data-driven understanding of this crucial issue for the sustainable development of the country by comparing it with Mexico and Cuba [25].

3. Results

The theoretical analysis of this research is based on four complementary perspectives that allow a comprehensive examination of food security policies and their impact on Colombian agricultural productivity and then compare them with Mexico and Cuba, understanding processes ranging from institutional change to agricultural economics, through food sovereignty and agri-food systems, since these theories offer a multidimensional overview of the phenomenon studied [26], and their joint application allows examining not only the economic and productive aspects, but also the social, cultural and systemic dimensions of food security in Colombia and then comparing them with Mexico and Cuba [27].

National Studies in Colombia. Examining the literature on food security in Colombia, we found the article entitled "Food security assessment for the Colombian population, Colombia - May 2023", prepared by the World Food Program [28], in which a quantitative methodology is used to assess food security in 29 departments and 118 municipalities of Colombia.

The information was collected between October and November 2022. The results reveal that 30% of the Colombian population, equivalent to 15.5 million people, is food insecure, 2.1 million are in a severe situation, and 13.4 million are in a moderate situation. Households in severe situations face extreme gaps in food consumption and the exhaustion of livelihood options. Food insecurity in Colombia is closely related to economic access because of the high informality of the labor market and income inequality. Almost half of households (46%) had expenses below the national poverty line. In addition, the assessment shows that half of the households are in a situation of marginal food insecurity, meaning that their situation could deteriorate if adverse conditions persist [29]. On the other hand, the article "Colombia improves its food security, but half of the population remains vulnerable due to economic and climatic risks", also from the World

Food Program [30], uses a quantitative methodology to assess food security in 29 departments and 133 municipalities. The information was collected at the end of 2023. The study observes an improvement in food security; however, half of Colombian households are in a situation of marginal food security and could fall into food insecurity due to factors such as the El Niño and La Niña phenomena, as well as the economic slowdown. Despite this progress, many households resort to survival strategies to access food. Rural areas have greater food insecurity (31%) than urban areas (24%). The assessment provides updated data for the government and its allies to strengthen actions aimed at achieving the goal of zero hunger [31]. Considering the above results, the various economic theories that have been established to shape the economic and social behavior that allow us to understand the economic performance and social development that the country has had considering the policies that allow safeguarding food security in Colombia are analyzed [32].

The Theory of Institutional Change [33], developed by Douglass North in the 1990s, explores how transformations in rules, norms, and organizational structures shape economic and social behavior. North argued that both formal and informal institutions are key to understanding economic performance and social development [34]. Applying this perspective to food security policies in Colombia, one can examine how political changes have redefined the agricultural institutional framework [35], influencing its productivity and organization. This approach illuminates the evolution of institutions in response to these policies and their impact on Colombian agricultural productivity [36].

Theory of Food Sovereignty proposed by La Via Campesina in 1996, the Theory of Food Sovereignty defends the right of peoples to define their own food and agricultural systems. Authors such as Patel and Wittman have expanded this concept beyond mere food security, advocating community autonomy in production and consumption [37]. In the Colombian context, this theory is valuable for evaluating the impact of policies on the country's ability to produce food in a sustainable [38] and culturally appropriate manner [39]. Its application considers crucial aspects such as productive autonomy, access to resources, preservation of native seeds, and protection of traditional agricultural knowledge [40].

Agri-Food Systems Theory. The Agri-Food Systems Theory, developed by Sobal, Khan and Bisogni in 1998, analyses the complex interrelations between the production, distribution and consumption of food [41]. This approach views the food system as an integrated whole, from production to final consumption. In the Colombian context, it allows us to examine how food security policies have transformed these systems, influencing agricultural productivity and the structure of the sector [42]. The study also considers the impact of these policies on the resilience of the system in the face of challenges such as climate change and economic crises, offering a comprehensive view of the changes in the Colombian food system.

Agricultural Economics Theories rooted in the work of Smith and Ricardo and developed by authors such as Schultz, Hayami, and Ruttan examine how economic factors affect food production and distribution [44]. The variables range from the microeconomics of farmers' decisions to the macroeconomics of global agricultural markets. In the Colombian case, these theories help understand how food security policies have influenced farmers' incentives, resource allocation, and productive efficiency. This framework offers valuable tools for analyzing the economic impact of such policies on the country's agricultural productivity [45].

Related Studies at the Latin American Level. The study entitled "Food and nutritional insecurity in Latin America and the Caribbean", carried out by the World Food Program [46], is based on the collection and analysis of data from various countries in the region, using household surveys, food consumption analysis, and public policy evaluation. The results reveal that despite advances in food production, large population groups still live in a situation of food insecurity and chronic malnutrition. Although food production has grown by more than 40%, 45 million people do not have sufficient access to food and 4 million children under 5 years old are underweight for their age. In conclusion, food insecurity in Latin America is due to persistent inequalities in income distribution and access to food systems. The implementation of comprehensive and long-term social policies to reduce malnutrition and hunger is recommended, as well as interventions with a short-term impact to mitigate the nutritional and food effects of recent crises.

A previous study revealed that agricultural productivity must increase by 1.75% each year to feed the world in 2050," prepared by the Global Harvest Initiative [47], and used global and regional data to assess the rate of agricultural productivity growth needed to meet future food needs. The model employs agricultural

productivity indicators and policy analysis. The results indicate that the global agricultural productivity growth rate is 1.73%, which is insufficient to meet the target of 1.75% per year needed to feed a projected world population of 9.7 billion in 2050. Latin America, especially countries such as Mexico and Cuba, has significant potential to increase its agricultural productivity. In conclusion, to improve agricultural productivity, it is recommended to invest in agricultural research, development and extension, to adopt science-based technologies and to foster collaboration between the public and private sector. Policies should focus on maximizing the use of natural resources in a sustainable manner and reducing environmental impact [48].

4. Discussion

The analysis focuses on the analysis of food security policies in the face of gender violence due to climate action in Latin America and also reviews the complex interaction between socioeconomic, technological and environmental factors that ensure food security. We begin with the analysis of the Key Agricultural Productivity Policies in Colombia in the Context of Food Security; among these we find:

The National Food and Nutrition Plan (PNAN) established on May 29, 1996, through Conpes 2847, its objective was to contribute to the improvement of the nutritional and food situation of the Colombian population, especially the poorest and most vulnerable, through multisectoral actions in health, nutrition, food, agriculture, education, communication, and the environment. The PNAN strategy integrated these areas through eight lines of action, based on intersectoral work and coordination at the municipal, departmental, and national levels, and the implementation of this policy was carried out with a focus on constitutional rights and comprehensive nutritional and food issues, being a key tool to comprehensively address these issues. Valid until 2005, the PNAN promoted the collaboration of different sectors and levels of government, with significant results in improving the country's food and nutritional security [49].

The National Food and Nutrition Security Policy (PSAN), established by Conpes 113 of 2008, has been one of the most important policies in Colombia in the last two decades. This policy aims to ensure that the entire Colombian population, especially the most vulnerable groups, has adequate access to an adequate quantity, variety, and quality of food. Furthermore, the PSAN seeks to reduce social and economic inequalities associated with food and nutritional insecurity through intersectoral actions that include health, nutrition, agriculture, education, communication, and the environment [50].

The PSAN aims to ensure that the entire Colombian population, especially the most vulnerable groups, has adequate access to adequate quantity, variety, and quality food. The PSAN strategy focuses on reducing social and economic inequalities associated with food and nutritional insecurity through intersectoral actions in health, nutrition, agriculture, education, communication, and the environment. The implementation of this policy is carried out through the National Plan for Food and Nutritional Security (PNSAN) and the Intersectoral Commission for Food and Nutritional Security (CISAN), strengthening governance and coordination mechanisms. This policy has been fundamental to improving the food and nutritional situation in Colombia, with significant progress in reducing chronic malnutrition and food insecurity. [51].

The National Agricultural Development Plan is another key policy influencing agricultural productivity in Colombia. This plan, implemented in 2018, focuses on transforming and organizing agricultural production and promoting knowledge management in research, technological development, and innovation (R&D) [52]. In collaboration with AGROSAVIA, the Ministry of Agriculture and Rural Development (MADR) has promoted productive models that improve the competitiveness and quality of agricultural products. Implemented since 2018, the National Agricultural Development Plan aims to transform and organize agricultural production and promote knowledge management in research, technological development, and innovation (R&D). The plan's strategy promotes productive models that improve the competitiveness and quality of agricultural products through collaboration between MADR and AGROSAVIA [53]. This plan has been key to improving agricultural productivity in Colombia and contributing to economic growth and food security.

The Food and Nutrition Security Program (PSAN) has been fundamental in strengthening the agricultural sector. This program seeks to promote peace and considers the agricultural and rural sectors as strategic and a national priority. It also encourages the participation of the private sector with the public sector to improve food security [54].

In 2023-2025 years, productive management strategies have been essential to improve agricultural productivity. These strategies include

the adoption of new technologies, sustainable management practices, and the reduction of production costs. As a result, greater competitiveness is allowed in the productive chains of the agricultural and livestock sector. Implemented between 2018 and 2022, these strategies aim to improve agricultural productivity through the adoption of new technologies, sustainable management practices, and reductions in production costs. The strategy seeks to increase competitiveness in the production chains of the agricultural and livestock sector, focusing its efforts on the adoption of innovative technologies and sustainable practices to improve the efficiency and quality of agricultural production. These strategies have enabled greater competitiveness and sustainability in the agricultural sector, contributing to food security and rural development [55].

Regarding the socioeconomic, technological, and environmental factors that have influenced agricultural productivity in Colombia (2003-2023), we find the following:

The concentration of land ownership in Colombia is a critical socioeconomic factor that has significantly affected the country's agricultural productivity. According to the Third National Agricultural Census conducted by DANE in 2015, 69.9% of Agricultural Production Units (UPA) have less than 5 hectares and correspond to less than 5% of the censused area, while 0.4% of the UPA have 500 hectares or more and occupy 41.1% of the censused area. This unequal distribution limits access to productive land for small and medium-sized farmers, negatively affecting productivity in various regions of the country [56].

Poor infrastructure and limited access to financial and technological services have been significant obstacles to agricultural productivity in Colombia. According to the Ministry of Agriculture and Rural Development, low investments in transport infrastructure, agricultural production, transformation, and value addition have restricted the development of the sector. In addition, the low use of productive planning instruments and the incipient mitigation of agro-climatic risks have contributed to low agricultural productivity. A study by Fedesarrollo [57] indicates that agricultural production involves factors such as human capital, land, social capital, and public services, whose insufficient development has limited the growth of the sector.

The armed conflict in Colombia, lasting more than 50 years, has had a considerable impact on agricultural productivity. Violence and insecurity have limited the development of the agricultural sector in many regions. However, the signing of the peace agreement in 2016 has opened new opportunities for agricultural expansion and rural development, as Colombia only employs 24% of its 22 million hectares suitable for agriculture, suggesting significant potential for agribusiness growth and restructuring of agriculture in areas previously controlled by guerrilla groups [58].

The promotion of innovation and technological development has been identified as a key strategy to improve agricultural sector competitiveness. Agricultural production management policies have sought to generate conditions and incentives for production with less risk and uncertainty, thus improving the quality and profitability of agricultural activities (MADR). These policies include production planning, cost reduction, and searching for lower price volatility [59].

According to the Ministry of Agriculture, the occurrence of the El Niño phenomenon reduces Colombia's agricultural yield due to the adverse conditions it generates, such as prolonged droughts and extreme temperatures, negatively impacting production in several regions of the country.

Reviewing the Key Agricultural Productivity Policies in Colombia in the Context of Food Security, we examine gender violence due to climate action in Colombia and Latin American countries such as Mexico and Cuba and how they relate to Agricultural Productivity programs, finding that in Colombia, the Ministry of Environment and Sustainable Development (Minambiente) through the Directorate of Climate Change and Risk Management (DCCGR) has promoted at the national, regional, and local levels the understanding of a key principle for climate change management: that climate change is not gender neutral. That is, women and men have different needs, roles, skills, and expectations regarding impacts, as well as adaptation and mitigation of climate change.

Climate change has a greater negative impact on the most vulnerable communities in Colombia, and within these, historical and current inequalities make women and girls the ones who bear the brunt. At the same time, in the tour of the various territories of Colombia, the determining role that rural peasant, indigenous, and Afro-Colombian women play in climate action is highlighted. Their traditional and ancestral knowledge about biodiversity, crop management, community leadership and their fight to defend the environment are decisive in achieving socio-ecological resilience, since Colombia understands

that historical and current inequalities make women more vulnerable to the effects of climate change, while recognizing how their roles and skills configure them as vital agents in Climate Action. Under this understanding, the country has taken important steps to integrate the gender approach in a transversal way at all levels of climate change management and, in this way, ensure that Climate Action promotes progress toward equality and gender equity [60-61].

In Cartagena, Colombia, the Granito de Paz Foundation has initiated an innovative climate-resilient intervention aimed at dismantling structural barriers to social and environmental vulnerability. Specifically, the Foundation has facilitated the development of "productive patios" among Afro-descendant women residing in the Rafael Núñez sector of the Olaya Herrera neighborhood, located in Locality No. 2, La Virgen y Turística. These micro-agricultural plots serve as transformative spaces for advancing household-level food security and promoting gender-equitable social relations within families. The initiative currently involves 36 families, enabling them to cultivate organic crops for subsistence and market purposes while promoting ecological stewardship and sustainable land use.

A key condition for participation in the program was the availability of a backyard space for establishing the gardens. However, local perceptions of patios were predominantly negative; many residents traditionally used them as informal waste disposal sites. Additionally, the proximity of these households to the Virgin's Swamp—a flood-prone zone intensified by climate anomalies associated with the El Niño phenomenon—compounded the challenges. In response, participants adapted by constructing one-square-meter elevated garden beds to grow vegetables and herbs, some of which are commercialized through local restaurants. This not only strengthens household food autonomy and provides supplementary income for participating families, effectively integrating environmental, economic, and social dimensions of sustainability.

In Mexico, the government has committed to reducing greenhouse gas emissions by 25% by 2030. This target is embedded within a broader policy framework that incorporates gender-responsive and human rights-based approaches to climate governance. The recognition of women as critical stakeholders in decisions related to energy consumption and resource management is central to this framework. The policy discourse emphasizes that climate adaptation and mitigation measures must not worsen pre-existing gender disparities or reinforce socioeconomic inequalities. Rather, these measures must ensure that the adverse effects of climate change—already disproportionately borne by women—are addressed through inclusive, equitable policy instruments.

In the Cuban context, the intersection between the climate crisis and gendered violence experiences is both direct and multifaceted. Women are increasingly exposed to various forms of violence—physical, psychological, and economic—exacerbated by environmental stressors and structural marginalization. For instance, climate displacement, disproportionate burdens of unpaid care work, devaluation of women's contributions to ecological sustainability, stigmatization, threats, and even physical assaults are recurrent phenomena. As climate disruption intensifies, so too does the vulnerability of women, particularly those engaged in environmental and territorial defense. In Latin America and the Caribbean, female environmental defenders face heightened risks, making the climate crisis not only a matter of ecological urgency but also one of deepening social injustice and human security.

5. Conclusion

The analysis of food security policies in Colombia reveals several significant findings that underscore both progress and persistent challenges in the agricultural sector. Agricultural productivity has shown modest but steady growth, driven in part by public policies that have promoted the adoption of improved agricultural practices and technologies. However, the underutilization of arable land, with only 13.5% of the agricultural potential exploited, indicates that there is still considerable scope for the expansion and optimization of agricultural production in Colombia.

Despite efforts to improve food security, half of Colombian households are still in a situation of marginal food security, according to the WFP. The regional disparity in terms of agricultural productivity and food security also highlights the need for policies that are more adapted to the specific conditions of each region.

The interaction between socioeconomic, technological, and environmental factors is crucial for understanding the effectiveness of food security policies. The adoption of new agricultural technologies not only by their availability but also by access to credit and the training of farmers. In addition, climate change and global economic fluctuations present additional challenges that

complicate the implementation of effective policies.

To address the challenges identified in food security and agricultural productivity in Colombia, a multidimensional approach that can be adapted to regional realities is crucial. First, developing food security policies that consider the specificity of each region, considering socioeconomic, environmental, and technological conditions is recommended. This should be accompanied by increased investment in research and development of agricultural technologies specifically adapted to the environmental and socio-economic conditions of Colombia, in order to ensure their effective adoption by local farmers. Furthermore, it is essential to implement comprehensive strategies aimed at enhancing the resilience of the agricultural sector to climate change. These strategies should include the promotion of drought-resistant crop varieties and the development and dissemination of efficient irrigation systems.

Second, improving access to finance for small and medium-sized farmers should be prioritized by developing innovative financial mechanisms such as microfinance schemes and state guarantees. In parallel, it is essential to promote sustainable agricultural practices that not only increase productivity but also conserve natural resources and biodiversity. Strengthening agricultural value chains is recommended to improve the integration of small producers and their access to broader markets. Finally, it is crucial to establish robust monitoring and evaluation systems for food security policies, implement nutritional education programs at the national level, and foster greater collaboration between the public, private, and academic sectors to comprehensively address the challenges of food security and agricultural productivity in Colombia.

In response to the problematizing question, it can be concluded that food security policies have had a positive impact on agricultural productivity in Colombia, but this impact has been moderate and uneven. The main factors determining this relationship include access to technology, financial support, farmer training and adaptability to changing environmental conditions. The proposed hypothesis is partially confirmed. Although food security policies have had a positive impact on agricultural productivity, especially when combined with technological improvements and socioeconomic support, this impact has not been as significant as initially expected. Regional disparities remain a major challenge.

Overall, Colombia has made progress in improving agricultural productivity and food security, but there is still a long way to go, as it requires the design of more comprehensive public policies adapted to regional realities, greater investment in agricultural technology and infrastructure, and a more determined focus on environmental sustainability and climate resilience. Only through these coordinated efforts will it be possible to fully exploit Colombia's agricultural potential and ensure food security for its entire population. Regarding food security policies in the face of gender-based violence due to climate action in Colombia and Latin American countries such as Mexico and Colombia, we find that mechanisms must be created so that women can advance in the integration of the gender perspective in public policy instruments, as well as in implementation actions to address climate change, so that, as governing bodies and/or managers of the implementation of public policies in favor of gender equality and women’s autonomy, they can become more actively involved and exercise a transformative leadership role in response processes related to climate change both at the national and international level.

Public policies on food security in the face of gender-based violence due to climate action must aim to ensure that gender equality and the autonomy of all women and girls, in their diversity, are prioritized and addressed in a comprehensive manner in the context of climate change actions carried out at the national and regional level; and ensure the full participation of women as climate actors, developing their resilience and that of their communities to achieve the 2030 Agenda and the goals of the Paris Agreement.

This study explored the complex relationship between food security policies and gender-based violence resulting from climate-induced vulnerabilities in Latin America, focusing on Colombia, Mexico, and Cuba. By combining quantitative impact assessment with qualitative text analysis, the research offered an interdisciplinary understanding of how state policies not only influence agricultural productivity and serve as instruments of social transformation, particularly in historically marginalized communities such as Afro-descendant and indigenous populations.

The findings revealed that food security initiatives, especially those tied to productive strategies such as “productive patios,” have contributed to modest but measurable gains in agricultural output—up to 5% in certain regions—despite structural inequalities and environmental instability. Importantly, these gains cannot be

dissociated from the gender dimension of climate change because women in vulnerable rural areas often serve as custodians of biodiversity, traditional ecological knowledge, and food sovereignty. In this sense, the productive patios program in Colombia emerges as an effective grassroots model that intertwins environmental justice with gender equality.

By situating our analysis within the broader theoretical frameworks of institutional change, food sovereignty, agri-food systems theory and agricultural economics, the study demonstrates that food security policies cannot be treated as isolated technical solutions. Instead, they are embedded within deeply sociopolitical and ecological processes. Thus, this paper argues for integrating gender-sensitive climate policies into national food security agendas. Examples from Cartagena, where Afro-Colombian women co-lead community agricultural resilience projects, show that when women are empowered as agents of change, both food security and community adaptation outcomes improve significantly.

In comparing the three countries, the study found that while Cuba and Mexico also have policy initiatives acknowledging the gender impacts of climate change, Colombia has taken more concrete steps to integrate a transversal gender perspective within climate governance structures. Yet, in all contexts, institutional fragmentation, uneven policy implementation, and persistent inequalities in land access and infrastructure hinder the scalability of successful interventions.

Another key conclusion is that climate change disproportionately intensifies existing gender-based violence and food insecurity, particularly through mechanisms such as forced displacement, labor exploitation, and economic exclusion. Therefore, policies that address food security in a siloed or technocratic manner are insufficient. A feminist, decolonial, and environmental justice framework is necessary to confront these interconnected crises holistically.

This research contributes to both theoretical debates on climate justice and practical evaluations of policy effectiveness in developing nations. This highlights the need to move beyond productivity metrics and focus on community resilience, sustainability, and equity. Moreover, this paper makes a methodological contribution by bridging legal and empirical agricultural analysis—an approach that can be replicated in other Global South contexts.

In closing, the study recommends the continued development of community-led agricultural initiatives, increased investment in gender-responsive climate adaptation programs, and the establishment of intersectoral governance mechanisms to harmonize food, gender, and climate policies. These measures are essential for reducing food insecurity while empowering women and communities most affected by the dual burdens of environmental degradation and social inequality.

6. Research Limitations

Despite offering novel insights into the nexus of food security, climate change and gender-based violence, this research acknowledges several limitations that may constrain the generalizability and depth of its findings.

First, the quantitative analysis was based on secondary data from national databases and international organizations such as the FAO and the World Food Programme. While these data sources are authoritative, they present aggregated or regionally generalized statistics that may obscure micro-level variations. For instance, localized practices and experiences in smaller rural municipalities may be underrepresented, particularly those that lack institutional visibility or government support.

Second, although the mixed-methods approach provided a holistic lens, the qualitative component relied heavily on content analysis of official policy documents and a limited number of case studies. More direct engagement with affected communities through fieldwork, interviews or participatory research methods would have enriched the study's understanding of the lived realities of those impacted by climate-related food insecurity and gendered violence. Future studies could incorporate ethnographic or survey-based methodologies to address this gap.

Third, while the study emphasized Colombia's agricultural and gender policies, comparisons with Mexico and Cuba were necessarily constrained by differing data availability, political systems, and degrees of policy transparency. The Cuban context, in particular, posed challenges due to limited access to up-to-date governmental sources, and in Mexico, variations among federal and state policies made cross-country standardization difficult. As such, the comparative dimension should be interpreted with caution.

Fourth, the evaluation of gender-based violence due to climate change remains an evolving and under-theorized field, especially in the Latin American context. The conceptual framework linking climate action to gendered structural violence—though compelling—requires further empirical substantiation. In the absence of disaggregated data on gender, climate impacts and food insecurity, some of the correlations identified

in this study may rely on inferential rather than causal logic.

Fifth, the use of the term "productive patios" as a central strategy could benefit from deeper theoretical elaboration and broader empirical testing. Although promising as a localized intervention, its scalability, long-term sustainability and adaptability across different agroecological zones remain untested. Furthermore, the socio-political acceptability of such programs in areas with entrenched gender norms or patriarchal land ownership practices must be critically examined.

Sixth, the political economy of agricultural subsidies, international trade dynamics, and donor-driven policy priorities—particularly the influence of organizations like the World Bank and IMF—were not fully addressed in this study. These factors can significantly shape national food security policies, often imposing structural constraints on local innovation and gender-sensitive planning.

Finally, language and translation constraints may have influenced both the interpretation of the document and the keyword classification. Key policy terms in Spanish (e.g., "soberanía alimentaria" vs. "seguridad alimentaria") carry distinct connotations and policy implications that may not translate seamlessly into English or Chinese, potentially affecting the analytical precision of international comparative work.

In conclusion, while this research makes valuable contributions, it remains exploratory in certain aspects.

Addressing these limitations in future studies could enhance the robustness and applicability of the findings, especially in policymaking, advocacy, and community development contexts.

7. Theoretical Contribution

This study makes a significant theoretical contribution by integrating agri-environmental perspectives into the analysis of food security policy within the Latin American context. While food security has traditionally been examined through economic or agricultural efficiency lenses, this research advances a more intersectional and justice-oriented framework. Specifically, it conceptualizes climate-induced food insecurity as a form of structural gender-based violence, thus bridging theories of climate justice, ecology, and institutional change.

By grounding the analysis in the Theory of Institutional Change, this study underscores how policy frameworks and governance structures influence agricultural productivity and food access, particularly for marginalized populations. This theory extends this theory by incorporating a gender-sensitive lens, showing how formal institutions—when designed with awareness of gendered vulnerabilities—can catalyze not only productivity gains but also equitable social transformation.

The study also enriches the Theory of Food Sovereignty by demonstrating how community-based practices like productive patios serve as mechanisms of resistance and resilience. These initiatives are not merely subsistence activities; they are political acts of reclaiming agency, land, and ecological knowledge. Thus, this research supports a growing body of literature that positions localized agroecological practices as essential for democratic food systems.

Additionally, the study contributes to Agri-Food Systems Theory by illustrating the multidimensional nature of food security, which involves not only input-output models of productivity but also sociocultural, environmental and gendered determinants of food access and control. The inclusion of feminist insights further expands the epistemological scope of this theory.

In sum, this paper provides a novel theoretical synthesis that connects environmental degradation, gender inequality and agricultural policy in a way that deepens our understanding of systemic vulnerabilities and potential pathways for transformation in food-insecure regions.

8. Practical Contribution

This study makes concrete practical contributions for policymakers, development agencies, and community organizations operating in contexts of food insecurity intensified by climate change and social inequality. One of the most actionable insights is the identification and validation of productive patios as a low-cost, scalable intervention that simultaneously addresses food insecurity, gender inequality, and environmental degradation. This model empowers women in vulnerable communities by converting underutilized household spaces into productive assets, promoting both nutritional autonomy and income generation.

By applying mixed-methods evaluation to agricultural productivity data, the research also introduces a practical tool for assessing the effectiveness of food security policies across heterogeneous regions, considering not only yield outputs but also social and ecological co-benefits. Policymakers can adapt this approach to design localized, gender-sensitive policy frameworks that

respond to region-specific challenges while enhancing national food security strategies.

In addition, the comparative perspective between Colombia, Mexico, and Cuba allows for the transfer of best practices among Latin American nations, thus encouraging horizontal learning in the region. This will support regional cooperation on shared vulnerabilities and the co-development of climate-resilient, socially inclusive food systems.

Ultimately, the study equips stakeholders with both empirical evidence and conceptual clarity to promote just and sustainable agricultural development in the face of growing climate challenges.

DECLARATIONS

Author Contributions

Conceptualization: Carlos Gregorio Diaz; Methodology: Marisol Maestre Delgado; Validation: Bleidis Vanessa Quintana Perez; Formal analysis: Maria de la Encarnacion Reyes; Research: Jorge Olver Mondelo Tamayo, Octavio Martinez Cazarez, and Elizabeth Ramirez Llerena; writing: preparation of the original draft; Writing: review and editing: Elizabeth Ramirez Llerena. All authors have read and approved the published version of the manuscript.

Conflicts of Interest

The authors declare no conflict of interest.

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