Corpus of Environmental Knowledge, Focus on Bioculturality and its Relationship with Food Sovereignty and Security in the Municipality of Fómeque (Cundinamarca): A Perspective for Intercultural Scientific Education

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Abstracts

This study is part of the project "Inclusion and recognition of diversity and cultural difference in scientific education, through educational innovations that promote dialogue between Academic Scientific Knowledge (CCA) and Traditional-Local Knowledge (CTL) in and for rural communities. Case studies: Fosca and Fómeque", presented in the Call for the Strengthening of CTeI in Public Higher Education Institutions (IES) 2020 of Minciencias. The initiative has the participation of the research groups INTERCITEC, GEA-UD (Francisco José de Caldas District University), Disciplinary Research in Social Work and Contemporary Trends (College Mayor University of Cundinamarca) and GEA (Technological School Central Technical Institute).

The study analyses the relationship between environmental knowledge, bioculturality and food sovereignty and security in Fómeque, Cundinamarca. Agro-environmental practices in the region reflect a sustainable balance between the natural environment and traditional knowledge, although their incorporation into formal education remains a challenge. Through an intercultural scientific education approach, pedagogical strategies are identified to integrate local knowledge with academic knowledge.

A mixed methodological approach was used, including a documentary review (Álvarez, 2003; Molina-Andrade & Robles-Piñeros, 2022; Maffi, 2005; Toledo & Barrera-Bassols, 2008), focus groups with local experts, and ethnographic observations. In addition, Bibliographic Information Mapping (Molina et al., 2013) allowed for the analysis of trends in intercultural scientific education and food sovereignty.

The findings reveal that oral and community transmission of environmental knowledge contributes to local identity and food self-sufficiency. However, the integration of this knowledge into formal education is limited (Álvarez, 2003; Maffi, 2005; Toledo & Barrera-Bassols, 2008). It is concluded that including bioculturality in formal education would strengthen territorial sustainability and the conservation of biocultural heritage.

Keywords: environmental corpus, bioculturality , food sovereignty, food security, intercultural scientific education, sustainability, Fómeque.

1. Introduction

The research described is part of the project "Inclusion and recognition of diversity and cultural difference in scientific education, through educational innovations that promote dialogue between Academic Scientific Knowledge (CCA) and Traditional-Local (CTL) in and for rural communities. Case studies: Fosca and Fómeque", which was presented to the Call for the Strengthening of CTeI in Public Institutions of Higher Education (IES) 2020 of Minciencias , by the research groups: INTERCITEC, GEA-UD (Francisco José de Caldas District University), Disciplinary Research in Social Work and Contemporary Trends (College Mayor de Cundinamarca University) and GEA (Technological School Central Technical Institute), in Institutional alliance.

In recent years, environmental knowledge and bioculturality have acquired a prominent role in debates on sustainability and intercultural education. This growing relevance reflects the importance of understanding how the interrelation between biodiversity and cultural diversity contributes to the construction of a corpus of knowledge that not only protects ecosystems, but also strengthens local identities (Boege , 2021; Nemogá , 2016).

In this context, the municipality of Fómeque, Cundinamarca, stands out for preserving deeply rooted traditional knowledge. Practices linked to water management, sustainable agriculture and the use of medicinal plants are not only agroecological techniques, but also cultural expressions that sustain its community management of the environment (Bejarano, 2024). These practices, transmitted from generation to generation, weave a network of knowledge that demonstrates a harmonious relationship between the community and its natural environment.

However, despite the value of this knowledge, its inclusion in educational programs has been limited. The predominant methodologies privilege western approaches, relegating local worldviews and traditional practices of rural communities to the background. This fragmentation has affected the continuity in the transmission of knowledge, weakening the link between new generations and their territory and hindering the appropriation of their local knowledge (Maffi, 2005; Toledo & Barrera-Bassols, 2008).

From this perspective, intercultural scientific teaching is proposed as an effective way to foster dialogue between traditional and academic knowledge, promoting contextualized and meaningful learning (Aikenhead & Jegede, 1999; Molina et al., 2013). Considering this need, the present study analyzes how the corpus of environmental knowledge is built in Fómeque, exploring its implications in intercultural scientific teaching and proposing strategies for its strengthening (Álvarez, 2003; Molina-Andrade & Robles-Piñeros, 2022).

To achieve these objectives, a mixed methodological approach was chosen that combines documentary review with participatory fieldwork in rural communities. Through focus groups with local experts, teachers and community leaders, the aim is to characterize the environmental setting of Fómeque and evaluate its integration into educational programs. In addition, the

barriers and opportunities for implementing pedagogical strategies that strengthen the appropriation of this knowledge in the school context are analyzed.

Ultimately, this study contributes to a deeper understanding of the relationship between bioculturality and local knowledge, providing empirical evidence that can guide the formulation of public policies and the design of educational programs focused on territorial sustainability and the recognition of cultural and ecological diversity in teaching-learning processes.

2. Aim

The main objective of this study is to analyze the relationship between environmental knowledge, bioculturality and food sovereignty and security in Fómeque, Cundinamarca, in order to provide inputs that strengthen intercultural scientific education and contribute to the design of contextualized pedagogical strategies. To this end, the following specific objectives are proposed:

To systematize the set of environmental knowledge in Fómeque, exploring its relationship with food sovereignty and security through the analysis of traditional agroecological practices.

Investigate bioculturality as an integrating axis between environmental knowledge and intercultural scientific education, evaluating its impact on territorial sustainability and the socio-environmental resilience of the community.

To analyze the perceptions and practices of teachers, students and community leaders regarding environmental knowledge, identifying barriers and opportunities for its inclusion in the school curriculum.

To review national and international educational experiences in biocultural territories, with the aim of identifying innovative pedagogical strategies that promote the dialogue of knowledge and the strengthening of intercultural scientific education.

Propose educational guidelines and public policies that promote the implementation of contextualized teaching strategies, fostering convergence between traditional and academic knowledge in the teaching of environmental sciences.

With these objectives, the study seeks to provide empirical evidence that helps build more inclusive and relevant educational models.

3. Method

This study used a mixed methodological approach, integrating documentary review, bibliographic information mapping, focus groups and field observations. This combination of methods facilitated data triangulation, allowing a more complete analysis of the relationship between bioculturality, environmental knowledge and intercultural scientific education in the municipality of Fómeque.

3.1 Study area

The municipality of Fómeque, located in the central-eastern sector of Colombia, belongs to the eastern region of Cundinamarca department and is under the jurisdiction of the Regional Autonomous Corporation of Guavio (CORPOGUAVIO, 2008). This territory covers mountainous areas that are part of the eastern mountain range of the Colombian Andes. Its geographic boundaries include Cáqueza and Ubaque to the west, Choachí, La Calera and Junín to the north, Quetame and the department of Meta to the south, and Gachalá to the east.

Fómeque is part of the Oriente Province of Cundinamarca, 56 km from Bogotá, and is characterized by a diverse relief with altitudes ranging between 800 and 3,200 meters above sea level, and an average temperature of 18ºC. The municipality covers an area of 55,565 ha, of which 49% belongs to the Chingaza National Natural Park, standing out for its abundant water wealth (Alcaldía de Fómeque, 2013; 2020).

The population of Fómeque resides mainly in rural areas and its economic activity is based on agriculture. The predominant crops include beans (Phaseolus lunatus), tomato (Solanum lycopersicum) and cucumber (Cyclanthera pedata), which are essential for the region's food sovereignty and security (Bayona & Muñoz, 2009). The socioeconomic structure of Fómeque shows a deep connection with the territory and its ecosystems, which has allowed the preservation of agroecological practices and the transmission of environmental knowledge from generation to generation.

In summary, Fómeque represents a territory of high biocultural diversity that strengthens the sovereignty and food security of its communities. Environmental knowledge has been developed over generations through sustainable agricultural practices, water management and ecosystem conservation. This set of knowledge provides a comprehensive approach to intercultural scientific education, promoting the integration of traditional and academic knowledge in a contextualized and relevant educational model for the region.

3.2 Research design

A qualitative exploratory-sequential design was used to analyze the corpus of environmental knowledge in Fómeque, its relationship with bioculturality and its influence on food sovereignty. The methodology was structured in three phases:

Document review and bibliographic information mapping (MIB): An exhaustive analysis of scientific literature and technical documents on bioculturality, intercultural scientific education and food sovereignty was carried out. Bibliographic information mapping (Molina et al., 2013) was used by analyzing 148 abstracts of articles in indexed journals in databases such as Ambientalex, Google Scholar, Open Access, Redalyc, ResearchGate and Scielo. The literature was classified into three thematic axes: (1) bioculturality and traditional knowledge, (2) intercultural scientific education and (3) food sovereignty and security in rural communities.

Fieldwork and qualitative data collection: Focus groups were held with local experts, teachers and community leaders to understand their perceptions of environmental knowledge and explore the mechanisms of intergenerational transmission of this knowledge.

Data analysis and triangulation: Methodological triangulation was used to combine information obtained from the documentary review, focus groups, and field observations. This approach strengthened the validity and reliability of the findings, offering a comprehensive perspective on the relationship between bioculturality, environmental knowledge, and intercultural scientific education in Fómeque.

3.3 Criteria of methodological rigor

To ensure the credibility and reliability of the results, various methodological strategies were employed, such as triangulation of sources and theoretical saturation in data collection. Participatory validation of the findings was also carried out with community members, ensuring that the results accurately reflected local perspectives. In terms of ethical principles, informed consent was obtained from all participants and the confidentiality of the information collected was guaranteed.

The methodological approach adopted in this research allowed us to obtain a comprehensive view of the corpus of environmental knowledge in Fómeque and its impact on food sovereignty. The results offer key elements for the formulation of contextualized educational and environmental policies, promoting the valorization and continuity of biocultural knowledge in rural communities.

The information presented is based on a bibliographic information mapping and a very serious review of scientific literature; artificial intelligence was used to organize ideas as an additional tool to improve the clarity of writing; its use does not affect the originality or rigor of the study.

4. Results

4.1. Corpus of environmental knowledge

The corpus of environmental knowledge is understood as the set of knowledge, practices and discourses that a community develops around its natural environment. In Fómeque, this corpus has emerged from the interaction between academic knowledge and local traditional knowledge, which has allowed the construction of an integrated vision of the territory (Elkana, 1983; Avella et al., 2017). This corpus not only generates local knowledge, but also directly influences territorial governance, strengthening the biocultural identity of the community.

Previous studies have shown that environmental knowledge corpus in Latin American contexts significantly impact sustainability and ecosystem services (Costanza et al., 1997; Daily, 1997). In Fómeque, the environmental knowledge corpus is closely linked to agroecological practices, community water management, and biodiversity conservation, which are essential for food security and sovereignty in the region (Nemogá, 2016; Toledo & Barrera-Bassols, 2008). These practices not only preserve the natural environment, also strengthen the social fabric and promote conservation strategies adapted to the particularities of the territory.

The transmission of this knowledge has historically occurred through oral tradition and community practices, keeping it alive through agricultural activities, collective rituals, and the use of medicinal plants (Maffi, 2005; Boege, 2021). However, in recent decades, formal

education has shown difficulties in integrating this knowledge into educational programs, causing a disconnection between academic and traditional knowledge (Molina et al., 2013). Despite these limitations, initiatives have emerged promoting intercultural education through school gardens, reforestation programs, and teaching ethnobotany in rural educational institutions (Molina-Andrade & Robles-Piñeros, 2022; Bejarano, 2024).

The results of this research show that the corpus of environmental knowledge in Fómeque plays a fundamental role in territorial sustainability and in the consolidation of intercultural scientific education. The need to design educational strategies that foster the dialogue of knowledge between western science and ancestral knowledge is highlighted, thus ensuring the preservation of bioculturality and strengthening food sovereignty in the region.

The corpus of environmental knowledge in Fómeque has been consolidated through sustainable agricultural practices that have guaranteed food self-sufficiency and ecological sustainability. Torres Guevara (2002) underlines the relevance of self-consumption and reciprocity in Andean peasant systems, emphasizing the role of bioculturality in food security. In this context, family farming with informal irrigation systems has been key to sustaining agroecological production in mountainous areas (Gutiérrez Malaxechebarría , 2014).

The relationship between society and nature is a central axis in the territorial configuration of Fómeque. Robayo (2018) analyses the territorial dynamics between the Chingaza National Natural Park and Fómeque, highlighting the challenges in the sustainable management of the ecosystem. Galindo Limas and Báez Ardila (2019) recognise the ecosystem services that Chingaza offers to the Río Negro basin, highlighting its relevance for water security and biodiversity conservation.

Food sovereignty and security in Fómeque depend on the intergenerational transmission of agroecological knowledge and the use of local resources. Neusa Vargas (2020) analyzes the impact of Environmental Educational Projects (PRAE) in the rural context of Fómeque, finding that the integration of this knowledge into formal education has been limited. Furthermore, Villalobos González and Guevara Rodríguez (2019) warn that school disengagement constitutes an obstacle to the continuity of traditional knowledge, since new generations have fewer opportunities to participate in inherited agricultural practices.

In conclusion, the corpus of environmental knowledge in Fómeque constitutes a fundamental pillar for intercultural education and sustainable management of the territory. The integration of biocultural knowledge in formal and community educational processes can contribute significantly to food sovereignty, self-sufficiency and the preservation of the ecological heritage of the region.

4.2. Bioculturality and its relationship with environmental knowledge

Bioculturality represents the interconnection between biodiversity and cultural practices, reflecting how ecosystems and sociocultural values are intertwined in the construction of the corpus of environmental knowledge (Maffi, 2005; Toledo & Barrera -Bassols, 2008). This intrinsic relationship is fundamental for the conservation of the natural environment and the

resilience of rural communities, since ancestral knowledge fosters sustainable practices and adaptive strategies in the face of socio-environmental changes (Mora Penagos, 2020).

Previous studies have highlighted the relevance of bioculturality in Andean regions, underlining its role in preserving the ecological and cultural heritage of local communities (Berkes, 2012; Pilgrim & Pretty, 2010). In Fómeque, bioculturality is reflected in the community's daily interaction with its natural environment, evidenced in agroecological practices, use of medicinal plants, and traditional narratives about water management and ecosystem conservation (Nemogá, 2016). These practices not only preserve the environment, also strengthen cultural identity and promote territorial sustainability.

Bioculturality is closely linked to food sovereignty and security, since traditional knowledge about crops and soil management promotes sustainable food production (Gómez-Galindo, González Galli & García Franco, 2019). The intergenerational transmission of this knowledge has allowed communities to manage their natural resources efficiently, ensuring their resilience in the face of climatic and environmental challenges (Boege , 2021). Furthermore, bioculturality has been recognized as a fundamental axis for developing intercultural educational models that facilitate dialogue between traditional and academic knowledge in science teaching (Molina et al., 2013; Molina-Andrade & Robles-Piñeros, 2022).

In Fómeque, intercultural science education has played a key role in the conservation of bioculturality, promoting pedagogical methodologies that integrate traditional ecological knowledge into the teaching processes. The implementation of initiatives such as educational gardens, ethnobotany projects, and participatory methodologies has enriched science teaching, contextualizing learning and reinforcing the appropriation of ecological and cultural knowledge (Bejarano, 2024). Likewise, the use of case studies in the teaching of bioculturality has proven to be an effective tool to contextualize learning and strengthen cultural identity in rural communities (Nemogá , 2016; Molina et al., 2013).

Recent research has highlighted the need to apply participatory methodologies in science teaching, where local actors assume an active role in the production of knowledge (Boege, 2021). In this context, it is essential that educational and environmental policies recognize bioculturality as a key element for territorial sustainability and the well-being of communities. Strengthening community networks aimed at the recovery and systematization of biocultural knowledge is presented as a fundamental strategy to guarantee the continuity of this knowledge in an environment of accelerated environmental and sociocultural changes (Toledo & Barrera-Bassols, 2008).

In conclusion, bioculturality in Fómeque constitutes an essential pillar for strengthening the corpus of environmental knowledge and sustainable management of the territory. The integration of biocultural knowledge in educational processes can significantly contribute to food sovereignty, self-sufficiency and the conservation of the ecological heritage of the region.

4.3 Intercultural scientific education

Intercultural science education seeks to create learning spaces where scientific knowledge and traditional knowledge are harmoniously integrated, allowing the construction of a corpus of

integrative and contextualized environmental knowledge (Aikenhead & Jegede , 1999). This approach fosters a dialogue between different forms of knowledge, recognizing and valuing the biocultural knowledge of communities. In doing so, it strengthens cultural identity and promotes a holistic understanding of natural processes, broadening the perspective on the relationship between society and nature (Boege , 2021).

From a pluralistic perspective, intercultural science education is based on three fundamental principles: (i) the integration of diverse forms of knowledge in science teaching, (ii) the recognition of the sociocultural context in the learning processes, and (iii) the application of participatory methodologies that facilitate the co-construction of knowledge (Valladares, 2010). Based on these principles, pedagogical strategies such as the use of case studies, situated learning and popular education have been developed, which have proven to be effective in teaching science in rural and indigenous communities (Bang et al., 2007).

Recent studies have shown that teaching biology in culturally diverse contexts requires teachers who recognize and value traditional knowledge in the classroom (Robles-Piñeros, Molina-Andrade & Baptista, 2021). This teaching profile implies a deep commitment to epistemological, ontological and ethical aspects, guaranteeing equity in scientific education and promoting a genuine exchange between local knowledge and academic knowledge (Robles-Piñeros, Barboza & Baptista, 2017). In this context, experiences in Brazil and Colombia have documented the implementation of teaching strategies based on ethnoecology, ecological literacy and the teaching of biology with an intercultural approach.

Intercultural science education plays a crucial role in strengthening the corpus of environmental knowledge, as it enhances the capacities of indigenous and rural communities to face the environmental and social challenges of the contemporary world (Boege, 2021; Robles-Piñeros, Molina-Andrade & Baptista, 2021). To achieve this goal, it is essential to implement educational programs that facilitate intercultural dialogue and promote community participation in the co-creation of knowledge, establishing long-term strategies that contribute to community well-being (Valderrama-Pérez, El- Hani & Molina-Andrade, 2020).

4.4 Sustainability and environmental governance in biocultural territories

The relationship between sustainability and bioculturality is essential for natural resource management and territorial decision-making. In rural communities, participatory environmental governance has proven to be key to strengthening socio-ecological resilience and consolidating community structures that support environmental management (Berkes & Folke, 2000; Toledo & Barrera-Bassols, 2008). This approach not only fosters sustainability, also reinforces the corpus of environmental knowledge, allowing for adaptive and contextualized management.

From this integrative perspective, bioculturality functions as a bridge that connects traditional ecological knowledge with contemporary environmental management strategies, fostering adaptive approaches that promote territorial sustainability. Communities that have preserved and strengthened their biocultural practices have demonstrated a greater capacity to respond to climate change and a more efficient management of their natural resources, minimizing the negative impacts on biodiversity (Maffi , 2005; Berkes , 2012).

One of the fundamental challenges in environmental governance lies in integrating local knowledge into decision-making. Recent studies have emphasized the need for public policies that include community participation mechanisms, recognizing bioculturality as an essential component for sustainable land management (Robles-Piñeros, Molina-Andrade & Baptista, 2021). The implementation of co-management models has allowed the active participation of communities in land use planning, water management and the conservation of strategic ecosystems, especially in territories with high biocultural diversity (Gómez-Galindo, González Galli & García Franco, 2019).

Previous research has shown that the integration of traditional knowledge into territorial sustainability plans increases the effectiveness of environmental policies and strengthens community commitment to conservation processes (Boege , 2021; Nemogá , 2016). This collaboration between scientific knowledge and traditional knowledge facilitates the implementation of adaptive strategies, reducing vulnerability to environmental risks and strengthening food sovereignty and security in biocultural territories (Alcaldía de Fómeque, 2020; Bayona & Muñoz, 2009).

Bioculturality is also closely linked to the adoption of agroecological approaches in sustainable rural development. Traditional practices such as ancestral agriculture, the use of medicinal plants and soil regeneration through indigenous knowledge have been fundamental in the protection of ecosystems and agricultural resilience to extreme climatic events (Mora Penagos, 2020; Pilgrim & Pretty , 2010). Studies in this field have shown that sustainability in biocultural territories not only depends on the conservation of biodiversity, but also on strengthening the processes of intergenerational transmission of knowledge, which requires greater investment in community training and environmental governance (Valderrama-Pérez, El- Hani & Molina-Andrade, 2020).

In short, environmental governance in biocultural territories must be based on participatory models that integrate local knowledge into environmental management strategies. It is essential to balance the use of resources with the conservation of biological and cultural diversity. Territorial sustainability, from a biocultural perspective, requires environmental planning approaches that recognize community identity, the corpus of environmental knowledge and the self-determination of local communities as fundamental principles for facing the socio-environmental challenges of the 21st century.

4.5 Biocultural memory and scientific education: integration of environmental knowledge in territorial sustainability

Bioculturality is an essential component in the connection between the corpus of environmental knowledge and the socio-ecological practices of rural communities such as Fómeque, in Cundinamarca. This concept integrates traditional knowledge with ecological diversity, generating an interdependence between collective memory and the sustainability of the natural environment (Toledo & Barrera-Bassols, 2008). In this way, the understanding of the territory not only encompasses its physical dimension, also incorporates a worldview that integrates local knowledge about biodiversity, agro-food production and natural resource management.

In Fómeque, the territorial planning recognizes the value of biocultural heritage as a central axis in the design of strategies for sustainable development. The Territorial Development Plan 2020-

2023 highlights the importance of connecting the corpus of local environmental knowledge with policies for the conservation and responsible use of ecosystems, strengthening socio-ecological resilience in the region (Municipal Mayor's Office of Fómeque in Cundinamarca, 2020). However, this recognition faces significant challenges in its effective implementation within territorial planning policies.

From a discursive perspective, bioculturality is a constantly evolving construct, and its historical analysis reveals the transformation of narratives about the relationship between society and nature over time. Guilhaumou (2002) states that discourses on environment and culture not only transmit information, also shape communities' perception of their territory. In this context, intercultural science education requires a dialogical approach, combining local and academic knowledge to strengthen food sovereignty and security.

The international movement La Via Campesina (2017) stresses that food sovereignty goes beyond access to food, involving cultural and territorial self-determination. The preservation of traditional agricultural practices is essential to ensure food self-sufficiency in rural communities and mitigate the effects of climate change. This vision coincides with the proposal of Leff (2020), who defends a dialogue of knowledge that recognizes the environmental rationality of local communities as an essential pillar for sustainable development.

Bioculturality is closely linked to the notion of territorial heritage. Boege (2021) highlights that biocultural diversity in indigenous peoples and rural communities is reflected not only in their ecological knowledge, also in their practices of self-management and territorial autonomy. Intercultural scientific education must be understood as an integrative process that goes beyond the mere transmission of traditional scientific knowledge, incorporating an intercultural perspective that values and respects the diverse forms of knowledge in each territory.

In the educational field, Melo (2020) argues that traditional ecological knowledge can be integrated into science teaching through participatory methodologies that involve communities. This requires recognizing the importance of orality, experience, and daily practice as valid forms of knowledge transmission. In this way, bioculturality becomes not only a subject of study, but a pedagogical approach that strengthens cultural identity and fosters territorial sustainability.

In conclusion, bioculturality in Fómeque is crucial to develop intercultural scientific education strategies that integrate the corpus of local environmental knowledge into training processes. Its link with food sovereignty and security highlights the importance of formulating public policies that recognize traditional knowledge and strengthen community management of natural resources. Thus, the corpus of environmental knowledge in the region becomes an essential tool to build more resilient societies committed to the sustainability of the natural environment.

5. Discussion

The findings of this study highlight the relevance of bioculturality in the design of strategies for territorial sustainability, intercultural scientific education and environmental governance in Fómeque. These results resonate with previous research exploring the interconnection between biodiversity and cultural practices in rural communities (Maffi, 2005; Berkes , 2012; Toledo &

Barrera-Bassols, 2008), offering a framework to discuss its implications for food sovereignty and security, as well as for environmental knowledge management and collective decision-making.

In this context, the characterization of ecosystem services in the rural peasant systems of Fómeque has been key to understanding how the interaction between traditional knowledge and natural resources supports agroecological production and strengthens local food security. Reina Usuga and Rivas Guzmán (2015) emphasize that land management in these communities is deeply influenced by the biocultural worldview of its inhabitants, who have developed sustainable strategies for the conservation and rational use of ecosystems.

On the other hand, Hernández Barbosa and Neusa Vargas (2015) examine the local knowledge about fauna that rural students possess, revealing how contextualized learning can improve the recognition and appreciation of local biodiversity. This aspect is essential to train citizens with environmental awareness and commitment to the sustainability of their territories. Clavijo (2021) evaluates community initiatives in the Mortiñal area through the La Rana Project and the Ecoparche, accenting their impact on the appropriation of environmental knowledge and the promotion of community participation in the protection of the natural environment.

From a broader perspective, socio-environmental action in these contexts must be analyzed under the principles of environmental rationality. Bueno and Fernandes (2016) argue that Enrique Leff 's conceptual framework allows us to understand how community practices can be integrated into intercultural scientific education, promoting a holistic approach to environmental governance and collective decision-making. This integrative approach not only strengthens territorial sustainability, also promotes a dialogue of knowledge that enriches the corpus of environmental knowledge.

The results of this study underline the need to establish an educational and governance model that integrates traditional and scientific knowledge in land management. Intercultural scientific education, combined with biocultural- based territorial planning strategies, can enhance food sovereignty and strengthen environmental resilience in Fómeque, promoting territorial sustainability from a comprehensive approach. This intercultural educational model not only favors the continuity of the corpus of environmental knowledge, also strengthens biocultural identity and promotes inclusive community management.

5.1. Corpus of environmental knowledge and territorial governance

The corpus of environmental knowledge identified in Fómeque has played a fundamental role in strengthening agroecological practices and in the sustainable management of natural resources. The integration of traditional knowledge with scientific approaches has allowed the creation of participatory environmental management mechanisms, fostering a dialogue of knowledge that enriches territorial governance (Boege, 2021; Nemogá, 2016). This exchange of knowledge has not only consolidated local sustainability, but has also strengthened the community's biocultural identity, deeply linking new generations with their natural environment.

However, significant challenges have been identified in integrating this corpus of environmental knowledge into formal educational programs. Molina et al. (2013) point out that current

curricular structures present limitations in incorporating this knowledge effectively, which restricts the appropriation of the territory by new generations. This educational disconnect not only affects the continuity of agroecological practices, also weakens the intergenerational transmission of biocultural knowledge.

Despite these challenges, experiences in Latin America have shown that the inclusion of local knowledge in science education can strengthen biocultural identity and improve environmental governance (Molina-Andrade & Robles-Piñeros, 2022). In Fómeque, projects such as school gardens and the teaching of ethnobotany have facilitated the integration of traditional and scientific knowledge, providing contextualized and participatory pedagogical tools. These initiatives have not only promoted meaningful learning, have also strengthened the community's bond with the territory, contributing to agroecological sustainability (Bejarano, 2024).

In conclusion, the Fómeque corpus of environmental knowledge constitutes a solid basis for strengthening biocultural identity and promoting territorial sustainability. However, its integration into formal education requires the adaptation of pedagogical approaches that foster a dialogue of knowledge and respect cultural diversity. This intercultural approach will not only enrich science teaching, will also enhance environmental governance through active community participation and a deeper sense ofbelonging.

5.2. Bioculturality and food security

The link between bioculturality and food security in Fómeque reveals how agroecological practices strengthen community resilience and promote food self-sufficiency. In this context, traditional knowledge on water management, native crops and the use of native seeds have proven to be fundamental for food sovereignty in rural areas (Gómez-Galindo, González Galli & García Franco, 2019; Berkes, 2012). This knowledge, transmitted from generation to generation, not only ensures the genetic diversity of crops, also sustains adaptive agricultural systems that respond effectively to environmental changes and extreme weather events.

The results of this research coincide with previous studies that have shown that communities that preserve their traditional knowledge have a greater capacity to adapt to environmental changes and extreme weather events (Pilgrim & Pretty , 2010; Mora Penagos, 2020). In Fómeque, the corpus of environmental knowledge has allowed the implementation of sustainable agroecological practices, guaranteeing food security and strengthening biocultural identity. However, the need to strengthen the dialogue between academic knowledge and peasant knowledge has been identified in order to promote sustainability policies that recognize and value this knowledge as fundamental elements in the management of the territory (Toledo & Barrera-Bassols, 2008).

In this sense, the integration of traditional and scientific knowledge not only enriches the corpus of environmental knowledge, also enhances participatory territorial governance. This approach not only strengthens food security and sovereignty, also promotes socio-ecological resilience by adapting to local conditions and fostering long-term sustainability. Recognizing the value of bioculturality in territorial management is key to facing contemporary environmental challenges, ensuring the continuity of agroecological practices and strengthening the community social fabric.

5.3. Intercultural scientific education and territorial appropriation

One of the most relevant findings of this study is the evidence that intercultural science education plays a key role in the consolidation of sustainable biocultural territories. This approach not only promotes contextualized learning, also fosters a dialogue of knowledge that integrates the corpus of environmental knowledge into training processes. Previous studies have indicated that science teaching in rural communities must transcend western paradigms and incorporate ancestral knowledge into educational programs to strengthen biocultural identity and promote territorial sustainability (Aikenhead & Jegede, 1999; Baptista & Araujo, 2019).

In Fómeque, the appropriation of the territory through intercultural training processes has been strengthened by the creation of educational content on local biodiversity, the use of participatory methodologies in the classroom and the implementation of citizen science projects in rural communities (Bejarano, 2024; Molina et al., 2013). These pedagogical strategies facilitated contextualized learningand fostered respect for traditional knowledge, enhancing the continuity of the corpus of environmental knowledge in new generations.

These results reinforce the perspective that intercultural scientific education not only contributes to biocultural sustainability, also strengthens cultural identity and territorial resilience. Robles-Piñeros, Molina-Andrade & Baptista (2021) highlight that the integration of local and academic knowledge, favors the conservation of biodiversity and promotes food self-sufficiency and participatory territorial governance. This dialogue of knowledge enriches the corpus of environmental knowledge, creating a bridge between western science and the local worldview, fostering a holistic vision of the territory and strengthening community social cohesion.

In conclusion, intercultural scientific education in Fómeque contributed to the transmission of local ecological knowledge, and promoted a deep sense of belonging and territorial responsibility. This integrative approach has allowed the corpus of environmental knowledge to evolve in a contextualized way, respecting cultural diversity and strengthening biocultural identity. Thus, intercultural teaching is not only presented as a pedagogical tool, but as an essential mechanism for territorial sustainability and the consolidation of resilient communities.

5.4. Environmental governance in biocultural territories

The results of this study reveal that environmental governance in biocultural territories faces multiple challenges, including the lack of recognition of traditional knowledge in public policies and the fragmentation of environmental management systems (Toledo & Barrera-Bassols, 2008). These obstacles limit the integration of the corpus of environmental knowledge into decision-making processes, restricting the development of contextualized sustainable strategies. However, the findings also show that communities that have adopted participatory mechanisms in environmental management have handled to implement more effective sustainable strategies adapted to their local realities (Boege, 2021; Nemogá, 2016).

In Fómeque, environmental co-management experiences have proven to be a successful model of participatory governance, where active collaboration between local actors, environmental organizations and state entities has strengthened territorial sustainability and ensured equitable access to natural resources. Robles-Piñeros, Molina-Andrade & Baptista (2021) underline that

this form of co-management enhances socio-ecological resilience, also strengthens the community fabric, promoting a sense of belonging and collective responsibility in the management of the territory.

These findings are consistent with previous studies that have indicated that participatory governance models improve the effectiveness of environmental policies by incorporating local knowledge into decision-making. In Fómeque, the integration of the corpus of environmental knowledge has enabled the development of sustainable agroecological practices adapted to the biocultural context, strengthening food sovereignty and community management of water resources. This intercultural approach has promoted a dialogue of knowledge that enriches sustainability strategies and strengthens territorial governance.

In conclusion, environmental governance in Fómeque accent the need for public policies that recognize the value of the corpus of environmental knowledge and encourage community participation in the management of the territory. Participatory co-management models ensure an equitable distribution of natural resources, also strengthen biocultural identity and enhance territorial sustainability. The dialogue of knowledge emerges as a key strategy to integrate traditional and scientific knowledge, building intercultural bridges that strengthen social cohesion and guarantee the continuity of the corpus of environmental knowledge in future generations.

5.5 Conclusion of the discussion

The results of this study confirm that bioculturality, intercultural scientific education and environmental governance are deeply interrelated in the construction of sustainable territories. The incorporation of these approaches in public policies and educational systems can play a crucial role in strengthening food sovereignty, preserving the corpus of environmental knowledge and territorial resilience in the face of contemporary environmental challenges. In this context, it is essential to design strategies based on community participation and the exchange of knowledge to ensure long-term sustainability in biocultural environments such as Fómeque.

The environmental characterization of the springs in the Gramal and La Pastora areas of Fómeque shows the close connection between the community and the local water ecosystems. Rincón Rincón and Uñate Velásquez (2019) emphasize that traditional knowledge about water management is essential for the conservation of these resources, highlighting the need to integrate this knowledge in the construction of the corpus of environmental knowledge. In addition, the implementation of green business initiatives, such as the one developed by the aloe vera agricultural producers' association in Fómeque, shows that economic sustainability and the protection of the natural environment, are compatible when approaches that promote community self-management and the responsible use of natural resources are adopted (Rodríguez Franco & Sánchez Rodríguez, 2020).

Water management for irrigation in rural communities in Fómeque is essential to ensure food security and strengthen climate resilience. Nivia Nivia (2020) proposes an assessment framework to measure the sustainability of community irrigation systems, highlighting the importance of designing environmental governance strategies that optimize water use and ensure

equitable distribution. These participatory management practices ensure the continuity of the corpus of environmental knowledge, also strengthen food sovereignty and promote sustainable community resilience.

These findings emphasize the need for a comprehensive approach to building sustainable territories, where intercultural scientific education, participatory governance, and bioculturality intertwine to generate a holistic vision. Recent studies have underlined the importance of epistemological approaches that promote the dialogue of knowledge between scientific knowledge and the corpus of local environmental knowledge (Falla Ramírez, Gómez Contreras & Velázquez Arias, 2024).

On the other hand, the analysis of the bibliographic information mapping has allowed us to identify the key environmental categories that should be included in the curricular design and in the creation of training strategies related to food security and science teaching (Pulido & González, 2024). Along these lines, González et al. (2024) highlight that the environmental aspects of Fómeque can become fundamental axes to strengthen educational processes, promoting contextualized learning that is relevant to the local environment.

From a practical perspective, the research experience in the project on inclusion and recognition of cultural diversity has made it possible to consolidate teaching methodologies that foster dialogue between academic knowledge and the corpus of environmental knowledge in rural communities (López Martínez, 2024). These initiatives highlight the relevance of food sovereignty not only as a theoretical concept, but as an essential practice for the conservation of biodiversity and territorial self-sufficiency (de Prager et al., 2024).

The connection between food sovereignty and biodiversity conservation has been widely studied in the field of rural development, showing that communities that manage their resources from a biocultural perspective manage to guarantee long-term food security (de Prager et al., 2024). In this sense, the integration of the corpus of environmental knowledge into educational plans offers a valuable opportunity to strengthen food autonomy and promote sustainable development in Fómeque.

Promoting environmental management models that recognize traditional knowledge and enhance the active participation of communities is crucial to address the challenges of climate change and environmental degradation. In this context, Fómeque is presented as a successful example of how the combination of knowledge and collective action can contribute to territorial sustainability and strengthen food sovereignty.

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