Pak. j. life soc. Sci. (2024), 22(2): 4409-4423 E-ISSN: 2221-7630;P-ISSN: 1727-4915

Pakistan Journal of Life and Social Sciences

www.pjlss.edu.pk

https://doi.org/10.57239/PJLSS-2024-22.2.00328

RESEARCH ARTICLE

New Tools for Environmental Social Zoning in High Andean Areas

Wilson Wily Sardon-Quispe[1], Mirella Rosa Luz Gavidia-Canaquiri[2], Cesar Augusto Pastor-Vela[3], Gloria Echegaray-Carreño[4], John Cesar Flores-Flores[5]

[1, 2,3,4,5] Amazon University National of Madre de Dios

ARTICLE INFO

Received: Jul 12, 2024

Accepted: Sep 7, 2024

Keywords

Zoning
Social
Environmental
Sustainability
Sustainable development

***Corresponding Author:**

wsardon@unamad.edu.pe

ABSTRACT

Currently, global concern is focused on the sustainability of life on the planet, which is why the 2015-2030 agenda is named "sustainable development goals," aiming to promote actions that seek to mitigate the effects of anthropogenic intervention on natural spaces. However, the environment, understood as all biotic and abiotic components that constantly interact, must consider human beings as part of it and suppress the anthropocentric vision that has dominated this aspect in recent centuries. Therefore, it is essential to recognize which are the new social and environmental zoning tools that can be used in geographical areas that host ecosystems as rich as they are fragile, such as the High Andean regions. For this reason, this study aimed to reflect on the new tools for environmental social zoning in high Andean areas. It was a reflective review study in which narrative was used as a method of constructing knowledge and dialectics for the documentary analysis of a total of 74 articles. Within the final reflections, new questions are raised, including: How can we improve collaboration between scientists, local communities, and authorities to maximize the impact of new tools and approaches in zoning?

INTRODUCTION

In a world marked by increasing concern for environmental sustainability and social equity, environmental social zoning has become a field of study and action of vital importance (Millán López, 2019). This discipline seeks to find a balance between conserving the natural environment and the well-being of the human communities that depend on it. In a global context of climate change and accelerated urbanization, the need to develop effective tools for zoning that consider both ecological and social aspects has become essential (Santiago Vera et al., 2019).

Globally, environmental social zoning has gained increasing relevance in conservation and sustainable development agendas. With the rise of urbanization and pressure on natural ecosystems, the international community recognizes the importance of balancing the preservation of the natural environment with the needs of human populations (Aguilar Revelo, 2019). In this context, numerous innovative tools and approaches have been developed for zoning, ranging from advanced geographic information systems to participatory community consultations (Rosales-Veítia & Marcano-Montilla, 2021; Hussein et al., 2024 ; Al-Zaqeba et al., 2024).

Latin America is a region of extraordinary importance in the context of environmental social zoning due to its rich biodiversity and the close relationship between local communities and their natural environments. Zoning has therefore become a fundamental tool for managing natural resources, protecting critical ecosystems, and promoting inclusive development (Eniele Sonaglio & da Silva Bueno, 2009; Pratiwi et al., 2024). From the Andes ecosystems to the Amazonian rainforests and coastal mangroves, Latin America hosts a diversity of landscapes that require adapted and sensitive approaches to local needs (Salinas-Castro et al., 2019).

The High Andean regions, located in the high mountains of Latin America, represent a unique and fragile ecosystem that combines particular environmental and social challenges (Jara-Peña, 2017). These areas are characterized by their rugged topography, extreme climatic conditions, and biodiversity adapted to altitude conditions (Puelles Condori et al., 2022). At the same time, they are home to rural communities rooted in millennia-old traditions that directly depend on these ecosystems for their subsistence (Suárez-Almiñana et al., 2021). For this reason, environmental social zoning in the High Andean regions becomes crucial due to the need to balance the conservation of these fragile environments with the well-being of local populations (Ramírez et al., 2015).

In this sense, it is recognized that environmental social zoning in the High Andean zones represents a multidimensional and highly relevant challenge today. These areas host unique ecosystems and human communities rooted in ancestral traditions, facing increasing threats related to climate change, environmental degradation, and socioeconomic vulnerability (Fernández-Llamazares et al., 2014). In this context, reflecting on new tools for environmental social zoning presents an urgent necessity and invaluable opportunity, which justifies the study in its contribution to understanding new tools for environmental social zoning in High Andean areas. This offers a space for critical reflection on their utility, applicability, and potential to address current and future challenges in these ecologically and culturally significant regions.

In light of the above, the research question was: What are the most promising technological and methodological tools for environmental social zoning in High Andean areas, and how are they contributing to biodiversity conservation, water management, and sustainable development in these areas? This question helped shape the study's intent, which sought to reflect on new tools for environmental social zoning in High Andean zones.

MATERIALS AND METHODS

A bibliographic review study was proposed, emerging from a reflective perspective that employed narrative as a method for constructing knowledge (Aguilera Eguía, 2014), but which also relied on dialectics as a documentary analysis technique that allowed contrasting ideas and delving into the work of previous authors (Ortiz Torres, 2011), thus presenting a new perspective regarding the social and environmental zoning technologies that can be implemented in High Andean regions.

This process of structuring and de-structuring knowledge was built through emerging categorization from document analysis. The documents were retrieved from databases such as Scopus, WoS, Scielo, Redalyc, and Google Scholar and selected through intentional sampling that led to the analysis of 74 articles directly addressing the management processes of development in regions with characteristics similar to those of the High Andean zones.

RESULTS

Geographic Information Systems (GIS) in the context of social and environmental zoning

Geographic Information Systems (GIS) play a crucial role in social and environmental zoning in the High Andean regions, starting with the collection of geospatial data (Molina et al., 2005). In these regions, where the topography is complex and varied, it is essential to have accurate and up-to-date data to understand the dynamics of ecosystems and communities. In this regard, GIS allows for meticulous information gathering, from detailed mountain topography to the location of water bodies and the evolution of land use patterns (Chacón et al., 2020). This information provides a solid and reliable foundation for making informed decisions for the conservation of fragile ecosystems and the sustainable development of local communities (Goodchild & Haining, 2005).

However, the true strength of GIS in the High Andean zones lies in its ability to conduct detailed spatial analyses, which are crucial for identifying spatial patterns, such as erosion-prone areas, critical biodiversity locations, and potential environmental risks (Gaspari et al., 2011). Techniques such as slope analysis, water flow analysis, and habitat connectivity allow for evidence-based decisions regarding the delineation of conservation areas, identification of ecological corridors, and allocation of zones for sustainable development (Eniele Sonaglio & da Silva Bueno, 2009). These spatial analyses are essential for optimizing the management of natural resources in these geographically complex regions (Pineda & Suárez, 2014).

In this sense, the cartographic resources generated by these systems are powerful communication tools that allow various stakeholders to clearly and effectively understand zoning outcomes. By providing visual representations of priority conservation areas, ecological connectivity routes, and sustainable development zones, the maps generated by GIS facilitate informed decision-making and promote active community participation in environmental and social planning (Archetti et al. 2014; Mena et al., 2011).

In the context of the High Andean regions, GIS has been successfully applied in various initiatives. For example, in the delimitation of buffer zones around natural reserves, these systems have been crucial in identifying areas of greater environmental vulnerability (Kurniawati et al., 2020; Mayorga et al., 2022). Likewise, in sustainable agricultural development projects, they have been used to efficiently allocate land and promote agricultural practices that minimize soil erosion (Buzai, 2021). These practical examples demonstrate how GIS are versatile and effective tools in social and environmental zoning in these regions.

Despite their numerous benefits, implementing GIS in the High Andean zones is not without challenges and limitations. One of these is the availability of accurate and up-to-date data, especially in remote regions. Additionally, adequate training is required for local professionals to effectively use these tools, as long-term data management and investment in technology and training are critical aspects that must be addressed to maximize the potential of GIS in these areas.

Remote Sensing: Remote Technology for Accessing Social and Environmental Zoning

Remote sensing as a remote technology has emerged as an essential tool in the context of social and environmental zoning in the High Andean zones (Sánchez-Díaz, 2018). This technology allows the acquisition of remote data via satellites, planes, and drones, providing a detailed and large-scale view of the terrain characteristics and environmental changes in these high-mountain regions (Ardila León & Quintero Delgado, 2013; Puerta, 2015; Riaño et al., 2001). For this reason, remote sensing has become an invaluable resource for understanding and addressing the environmental and social challenges faced by these unique areas (Sancho Gómez-Zurdo et al., 2021; Villar et al., 2022).

One of the key applications of remote sensing in the High Andean zones is monitoring changes in land use, allowing the tracking of the evolution of agricultural, forest, and urban areas over time (Rosales-Veítia & Marcano-Montilla, 2021b). This is essential for identifying patterns of environmental degradation, the expansion of agriculture, or uncontrolled urbanization and for taking proactive measures in social and environmental zoning planning (Valdez-Lazalde et al., 2006).

Additionally, remote sensing is also used to assess forest cover in the High Andean zones, which includes detecting changes in forest density, identifying areas prone to deforestation, and monitoring the health of forest ecosystems (Segura M & Trincado, 2003). This data is essential for identifying priority conservation areas and supporting the sustainable management of forest resources (Suárez Londoño et al., 2017).

However, it is understood that this technology plays a crucial role in predicting the impacts of climate change in the High Andean zones, as it allows the monitoring of climatic variables such as temperature, humidity, and precipitation patterns over time (Collado, 2001). This is essential for understanding how climate change is affecting these ecosystems and how local communities can effectively adapt (Sacristán Romero, 2005).

Furthermore, these tools are also used to plan ecological connectivity routes in the High Andean zones (Giménez & Pedro Castaño, 2018). This involves identifying natural corridors that allow species to move between fragmented habitat areas (Carnevale et al., 2007). These corridors are crucial for biodiversity conservation in these regions, and remote sensing helps determine their optimal location (Camas Guardamino & Mamani Sinche, 2022).

Despite their benefits, remote sensing presents challenges such as the need for specialized equipment and training. However, as technology advances and becomes more accessible, it is expected to play an increasingly central role in social and environmental zoning in the High Andean zones, as it provides a unique window into these regions, enabling more accurate and sustainable decision-making that balances environmental conservation with the well-being of local communities.

Climate Change Models for Development Management in the High Andean Zones

Climate change models have become an essential tool for development management in the High Andean zones because they allow the projection of future climate change scenarios in these regions, which is crucial for planning social and environmental zoning (Palacios Chacón & Serrano Vincenti, 2011). Given the significant impacts of climate change in the High Andean zones, from changes in rainfall patterns to glacier retreat, models help anticipate and mitigate these effects (Panduro Bazán de Lázaro, 2020; Ulloa et al., 2008).

One of the main uses of climate change models in the High Andean zones is predicting changes in precipitation patterns, allowing the projection of how precipitation may vary in intensity, duration, and seasonality in the future (Osorto Nuñez, 2022). This information is essential for water management, as communities heavily depend on mountain water sources for their needs (Pons et al., 2018).

Additionally, climate change models are also used to assess the impact on water resources in the High Andean zones, including predicting changes in water availability and managing risks related to extreme climatic events such as floods and droughts (Arrieta & Arpi, 2021). Therefore, the information generated by these models is essential for decision-making in water infrastructure planning and the sustainable management of resources (Suastegui Cruz, 2021).

Climate change models also help identify vulnerable areas in the High Andean zones, allowing the detection of areas prone to landslides, soil erosion, or floods due to climatic changes (Ramírez et al., 2015). These identifications enable the delimitation of critical zones that require specific mitigation and adaptation measures (Fernández et al., 2015).

It is noteworthy that the information generated by climate change models is directly integrated into development planning in the High Andean zones, including identifying suitable areas for renewable energy projects, promoting sustainable agricultural practices, and planning climate-resilient human settlements (Jodar-Abellan et al., 2018). For this reason, they are considered a fundamental tool for ensuring sustainable development in a context of constant climate change (Millán López, 2019).

Despite their usefulness, climate change models face challenges such as uncertainty in projections and the need for high-resolution data. However, as technologies advance and model precision improves, they are expected to play an increasingly important role in development management in the High Andean zones, as they provide a fundamental vision for decision-making that balances environmental conservation and the well-being of local communities in a constantly evolving climate context.

Environmental Monitoring Sensors: Understanding the Dynamics of the Environment

Environmental monitoring sensors have become an essential tool for understanding the dynamics of the environment in the High Andean zones, as they allow continuous data collection on environmental parameters such as water quality, air quality, and temperature (Perea Ardila et al., 2021). This information is essential for environmental management and decision-making in planning social and environmental zoning in these regions (Gamboa-Soto, 2020).

One of the main uses of environmental monitoring sensors is assessing water quality and managing water resources (Suárez-Almiñana et al., 2021). These devices allow the measurement of parameters such as contaminant concentrations, pH, and turbidity in rivers and water bodies, information that is crucial to ensure a safe potable water supply and protect ecosystems (Díaz García & González Pérez, 2022; Vázquez-Ochoa et al., 2021).

Environmental monitoring sensors are also used to assess air quality in these regions, including measuring atmospheric pollutants such as suspended particles, nitrogen oxides, and sulfur dioxide (Martínez-Abarca et al., 2022). Monitoring air quality is essential to protect the health of local communities and identify pollution sources that may require mitigation measures (Cuadros Cagua, 2017).

Additionally, these sensors provide the ability to perform long-term monitoring of environmental changes, allowing the tracking of trends in temperature, humidity, and other key parameters over the years, helping to understand how ecosystems are changing in response to climate change and other environmental pressures (Juárez Hipólito et al., 2019; Reyes-Ordoñez et al., 2020).

It is recognized that one of the key advantages of these tools is their ability to integrate data from multiple sources, as data from terrestrial sensors, satellites, and drones can be combined to obtain a complete picture of the environmental dynamics in the High Andean zones, which is essential for effective environmental management (García Rengifo & Durán-Ballén Ochoa, 2023; Pérez Vázquez et al., 2018).

Despite their usefulness, environmental monitoring sensors face challenges such as the need for regular maintenance and calibration and the management of large volumes of data. However, as technology advances and these challenges are addressed, these devices are expected to play an increasingly important role in understanding and managing the environmental dynamics in the High Andean zones, providing a fundamental vision for decision-making that balances environmental conservation and the well-being of local communities in a constantly evolving environmental context.

Culture and Socioeconomics: The Anthropogenic Component of Socio-Environmental Planning

Culture and socioeconomics represent a fundamental component in socio-environmental planning in the High Andean zones. Understanding how local communities interact with their natural environment and how their socioeconomic activities impact ecosystems is essential for effective planning, recognizing that people are an inseparable part of environmental systems and that human decisions have a significant impact on the sustainability of these areas (Aguilar Revelo, 2019).

Culture in the High Andean zones is often deeply rooted in the relationship with the natural environment; their traditions, beliefs, and practices are closely linked to the land, water, and natural resources. Understanding these cultural connections is essential to respecting and preserving cultural heritage while seeking balance with conservation and sustainable development goals (Panduro Bazán de Lázaro, 2020; Ulloa et al., 2008).

In turn, socioeconomic activities such as agriculture, livestock farming, and mining have a direct impact on the environment in the High Andean zones. Resource extraction and agricultural expansion can lead to deforestation, soil erosion, and the degradation of fragile ecosystems. Therefore, socio-environmental planning seeks to understand and manage these impacts to minimize them and promote sustainable practices (Echeverri, 2009).

However, effectively integrating culture and socioeconomics into socio-environmental planning is not without challenges, including conflicts of interest, the need to balance conservation and development goals, and the lack of resources to implement appropriate strategies. Addressing these challenges is essential to achieving comprehensive and sustainable management of these regions (Fernández-Llamazares et al., 2014; Salinas-Castro et al., 2019).

As socio-environmental planning practices evolve, it is expected that the integration of culture and socioeconomics will remain a priority. This includes adopting more inclusive and adaptive approaches that recognize the interdependence between humans and their natural environment. In this regard, socio-environmental planning that effectively incorporates these elements seeks a harmonious balance between ecosystem conservation and the well-being of local communities in the High Andean zones.

Community Participation: Essential Scaffolding in Social and Environmental Zoning

Community participation stands as essential scaffolding in social and environmental zoning in the High Andean zones, where local communities have a deep connection with the natural environment. Their active participation is fundamental. This approach must first recognize that the people residing in these areas are expert knowers of their territory and must be key partners in decision-making that affects their environment and quality of life (Córdova Aguilar, 2020; Gallo Álvarez & Sánchez Dávila, 2021).

In this sense, community participation is based on the rich cultural connection and deep local knowledge that communities in the High Andean zones possess, as they have ancestral traditions of sustainable resource management and a deep understanding of local ecology. Their participation ensures that this traditional wisdom is incorporated into planning and that decisions are culturally sensitive and sustainable (Bolívar Urquizo, 2021; Soares & García, 2014).

Furthermore, community participation allows consideration of the specific needs of local communities in social and environmental zoning, identifying community development priorities such as access to clean water, health services, and education, as well as the conservation of sites of cultural and ecological value (Monge-Rodríguez et al., 2022). Attention to local needs ensures that planning is inclusive and beneficial to the people living in these areas (Martelo & Pérez Macias, 2010). It is also essential for designing adaptive strategies in social and environmental zoning, as residents can provide valuable information on how they are experiencing the impacts of climate change and other environmental pressures, allowing strategies and policies to be adjusted to be effective in the long term (Carmona et al. 2022; Fernández et al., 2015).

Despite its importance, community participation can face challenges such as a lack of resources, inequality in access to decision-making, and the need to strengthen community capacity to participate meaningfully. Therefore, as socio-environmental planning evolves, it is expected that community participation will remain a fundamental pillar, allowing for more inclusive and collaborative approaches that recognize the knowledge and experience of local communities. Planning that effectively incorporates community participation seeks a harmonious balance between ecosystem conservation and the well-being of local communities in the High Andean zones.

Disaster Risk Management: The Future for Adequate Social and Environmental Zoning

Disaster risk management emerges as a fundamental component in social and environmental zoning in the High Andean zones (Rosales-Veítia, 2021). In these regions prone to natural events such as landslides, floods, and avalanches, preparedness and risk mitigation are essential (Gallo Álvarez & Sánchez Dávila, 2021). This perspective recognizes that the safety of local communities and the protection of ecosystems are intrinsically linked and must be addressed comprehensively (Sifuentes Palomino et al., 2022).

In this sense, disaster risk management involves identifying and assessing natural risks affecting the High Andean zones, including characterizing threats such as landslides, river overflows, and extreme climatic events (Vera Rodríguez & Albarracín Calderón, 2017). It is considered an integral management approach as it seeks to understand the nature of existing and potential risks as a crucial apex for designing effective mitigation and response strategies (Torres Lima et al., 2021).

It is noteworthy that disaster risk management greatly benefits from integrating geospatial data such as risk maps and hazard models, which allow identifying vulnerable areas and planning prevention and response measures (Rosales-Veítia & Marcano-Montilla, 2021a). Geographic Information Systems (GIS) play a vital role in collecting and analyzing this data, supporting informed decision-making (Rosales-Veítia & Marcano-Montilla, 2013).

Disaster risk management also involves detailed planning of emergency responses, including the development of evacuation plans, early warning systems, and rescue strategies (Rosales-Veítia & Marcano-Montilla, 2022). Therefore, collaboration between local authorities, aid organizations, and local communities is essential to ensure a coordinated and effective response in the event of a disaster (Gabriel Campos, 2017).

Despite its importance, disaster risk management faces challenges such as a lack of resources, the need to raise public awareness, and long-term planning in a climate change context (Rosales - Veítia & Marcano – Montilla, 2023). Overcoming these challenges is essential to ensure the safety of local communities and the sustainability of ecosystems in the High Andean zones (Reyes Rivera et al., 2022).

As socio-environmental planning evolves, disaster risk management will remain a crucial component. This involves a proactive approach to prevention and resilience and improving local capacities for response and recovery. Disaster risk management aims to ensure that social and environmental zoning in the High Andean zones is sustainable and safe, considering the natural events that may threaten both people and ecosystems.

CONCLUSIONS

This article has delved into the reflection on the new tools and approaches necessary to address the complex task of social and environmental zoning in the High Andean zones. It has highlighted how advanced technologies such as Geographic Information Systems (GIS), remote sensing, and environmental monitoring sensors are transforming the way we understand and plan these high mountain regions. Additionally, it has emphasized the importance of community participation, disaster risk management, and the consideration of culture and socioeconomics as central elements in this reflective process. Reflection and constant adaptation are crucial to ensuring that these new tools not only improve the efficiency of zoning but also promote sustainability and the well-being of local communities in the High Andean zones. Ultimately, the path toward more effective social and environmental zoning in these areas depends on our ability to harmoniously integrate these innovations into the management of these fragile and diverse ecosystems.

It is recognized that Geographic Information Systems (GIS) have proven to be essential tools in social and environmental zoning in the High Andean zones. Their ability to collect, analyze, and visualize geospatial data provides a solid foundation for informed decision-making. However, their effectiveness lies in their integration with other tools and approaches, such as community participation and consideration of local culture. The future of zoning in these regions will largely depend on how we leverage the power of GIS in conjunction with other key elements.

Additionally, remote sensing is understood to be an essential technology for accessing social and environmental zoning in the High Andean zones. Its ability to acquire remote data provides a detailed view of environmental changes and land use patterns in these high mountain regions. However, its true value lies in how this information is used to address environmental and social challenges. Remote sensing offers a unique window into these regions, but its real contribution lies in its effective integration with conservation and sustainable development strategies.

Climate change models play a critical role in development management in the High Andean zones. Their ability to project future climate change scenarios provides valuable information for social and environmental zoning planning. However, these models are tools that must be used with caution and context. Their utility lies in their integration with other data and approaches and their ability to guide adaptive decision-making in a constantly changing climate context.

Environmental monitoring sensors are essential instruments for understanding the dynamics of the environment in the High Andean zones. Their ability to collect continuous data on water quality, air quality, and other parameters is crucial for environmental management. However, their true power lies in their ability to provide real-time information that supports informed decision-making. Integrating these sensors into a holistic environmental management framework is essential to ensure sustainability in these sensitive regions.

Furthermore, the incorporation of culture and socioeconomics into socio-environmental planning in the High Andean zones is exhibited as a critical step toward a more comprehensive and equitable approach. These dimensions reveal the deep connection between people and their natural environment, as well as the influence of human activities on ecosystems. Reflection on these cultural and socioeconomic aspects in the context of social and environmental zoning allows for more effectively addressing local needs and priorities, promoting sustainable development that respects cultural diversity and the economic conditions of communities.

Community participation is positioned as a fundamental pillar in social and environmental zoning in the High Andean zones. This participation not only recognizes local expertise and knowledge but also promotes more inclusive and sustainable decision-making. The voice of local communities is essential to identifying needs, designing effective strategies, and ensuring that planning is truly representative of the people who reside in these unique areas.

Disaster risk management emerges as a crucial element in social and environmental zoning in the High Andean zones. Its focus on prevention and resilience is essential to protecting both local communities and fragile ecosystems from extreme natural events. Disaster risk management not only involves identifying threats but also planning effective responses and the active participation of communities. The future of zoning in these regions depends on how we address and mitigate disaster risks, ensuring a sustainable balance between protection and development.

As we reflect on the complexities of social and environmental zoning in the High Andean zones, crucial questions arise that will guide our future actions and recommendations. How can we improve collaboration between scientists, local communities, and authorities to maximize the impact of new tools and approaches in zoning? How can we ensure that community participation is inclusive and that the voices of marginalized populations are respected? What is the role of environmental education in building collective awareness about the importance of conservation in these regions? How can we effectively address climate change adaptation in zoning strategies? What specific measures can be taken to promote community resilience in the face of extreme natural events? These challenging questions must form the basis of our recommendations, driving concrete actions that address the unique complexities of zoning in the High Andean zones and promoting a sustainable balance between environmental conservation and human well-being.

Author Contributions

WWSQ: He participated in the research with the central idea of the research, the design and writing of the manuscript.

MRLGC: He participated with the design, ideas on the topic and translation of the manuscript.

CAPV: Participated in the reference organization and writing and analysis of the manuscript.

GEC: Participated in the research by writing the materials and methods as well as in the translation of the manuscript.

JCFF: Participated in the research with the design and analysis of the results, such as translation.

The authors participated from the beginning to the end, that is, Topic, interests, and in the end we all read and approved the final manuscript.

Funding.

We thank all the inhabitants of the high Andean communities for having given us the opportunity of space to investigate and put the instruments into practice and also to the Huarayo Research Group (GIH) for trusting in the equipment.

The work was self-financed by the research group.

REFERENCES [References list]

Aguilar Revelo, L. (2019). Género y cambio climático: retrospectiva y retos. *UNED Research Journal*, *11*(1). https://doi.org/10.22458/urj.v11i1.2326

Aguilera Eguía, R. (2014). ¿Revisión sistemática, revisión narrativa o metaanálisis? *Revista de La Sociedad Española Del Dolor*, *21*(6), 359–360. https://doi.org/10.4321/S1134-80462014000600010

Al-Zaqeba, M. A. A., & Basheti, I. A. Measurement Problems in Interest-Free Financial Instruments. Pakistan Journal of Life and Social Sciences,22(1), 2024

Archetti, G., Bernia, S., & Salvà-Catarineu, M. (2014). Análisis de los vectores ambientales que afectan la calidad del medio en la bahía del Fangar mediante herramientas SIG. *GeoFocus. International Review of Geographical Information Science and Technology*, *10*, 252–279. https://www.geofocus.org/index.php/geofocus/article/view/200

Ardila León, J. F., & Quintero Delgado, Ó. Y. (2013). Aplicación de la teledetección y los sistemas de información geográfica en la interpretación de zonas inundables. Caso de estudio: Río Soapaga, sector Paz De Río, Boyacá. *Ciencia e Ingeniería Neogranadina*, *23*(2). https://doi.org/10.18359/rcin.223

Arrieta, Y.-C., & Arpi, R. (2021). Efecto del cambio climático sobre el rendimiento agrícola de los principales productos en la región Puno: periodo 1964-2019. *Semestre Económico*, *10*(2). https://doi.org/10.26867/se.2021.v10i2.120

Bolívar Urquizo, T. (2021). Cambio climático y migración en los pueblos indígenas de la provincia de Chimborazo - Ecuador. *ConcienciaDigital*, *4*(1.2). https://doi.org/10.33262/concienciadigital.v4i1.2.1623

Buzai, G. D. (2021). Sistemas de Información Geográfica. Aplicaciones para el análisis de clasificación espacial y cambios de usos del suelo. *Revista Cartográfica*, *104*. https://doi.org/10.35424/rcarto.i104.1138

Camas Guardamino, D. J., & Mamani Sinche, M. S. (2022). Evaluación de la vegetación y saturación del suelo en el Área de Conservación Regional Humedales de Ventanilla mediante teledetección en Perú, 2006-2021. *Revista de Ciencias Ambientales*, *56*(1). https://doi.org/10.15359/rca.56-1.3

Carmona, R., Biskupovic, C., & Ibarra, J. T. (2022). Respuestas locales para una crisis global: pueblos indígenas, sociedad civil y transdisciplina para enfrentar el cambio climático. *Antropologías Del Sur*, *9*(17). https://doi.org/10.25074/rantros.v9i17.2315

Carnevale, N. J., Alzugaray, C., & Di LEo, N. (2007). Estudio de la deforestación en la Cuña Boscosa santafesina mediante teledetección espacial. *Quebracho. Revista de Ciencias Forestales*, *014*.

Chacón, J. A., Bambagüé, C., & Arboleda, O. E. (2020). Uso de herramientas de sistemas de información geográfica para establecer la zonificación ecológica de unidades de paisaje en un sector del municipio de Timbío - Cauca. *Revista Novedades Colombianas*, *15*(1). https://doi.org/10.47374/novcol.2020.v15.1801

Collado, L. (2001). Los bosques de tierra del fuego. Análisis de su estratificación mediante imágenes satelitales para el inventario forestal de la provincia. *Multequina*, *10*.

Córdova Aguilar, H. (2020). Vulnerabilidad y gestión del riesgo de desastres frente al cambio climático en Piura, Perú. *Semestre Económico*, *23*(54). https://doi.org/10.22395/seec.v23n54a5

Cuadros Cagua, T. A. (2017). El cambio climático y sus implicaciones en la salud humana. *Ambiente y Desarrollo*, *21*(40). https://doi.org/10.11144/javeriana.ayd21-40.ccis

Díaz García, S., & González Pérez, J. (2022). La importancia de la temperatura del agua en las redes de abastecimiento. *Ingeniería Del Agua*, *26*(2). https://doi.org/10.4995/ia.2022.17366

Echeverri, J. Á. (2009). Pueblos indígenas y cambio climático: el caso de la Amazonía colombiana. *Bulletin de l'Institut Français d'études Andines*, *38 (1)*. https://doi.org/10.4000/bifea.2774

Eniele Sonaglio, K., & da Silva Bueno, L. (2009). Zonificación, ocupación y uso del suelo por medio del SIG. Una herramienta en la planificación sustentable del turismo. *Estudios y Perspectivas En Turismo*, *18*(4), 381–39. http://www.scielo.org.ar/pdf/eypt/v18n4/v18n4a02.pdf

Fernández, A., Zavala, J., Romero, R., Conde, A. C., & Trejo, R. I. (2015). Actualización de los escenarios de cambio climático para estudios de impactos, vulnerabilidad y adaptación en México y Centroamérica. *Centro de Ciencias de La Atmósfera*, *June*.

Fernández-Llamazares, Á., Díaz-Reviriego, I., Mendez-López, M. E., Sánchez, I. V., Pyhälä, A., & Reyes-García, V. (2014). Cambio climático y pueblos indígenas: Estudio de caso entre los Tsimane', Amazonia boliviana. *Revista Virtual REDESMA - Red de Desarrollo Sostenible y Medio Ambiente*, *7*(November 2015).

Gabriel Campos, E. (2017). Plan de gestión de riesgos de desastres y cultura ambiental: un análisis desde el enfoque cuantitativo. *Espacio y Desarrollo*, *29*. https://doi.org/10.18800/espacioydesarrollo.201701.006

Gallo Álvarez, A. G., & Sánchez Dávila, K. (2021). Gestión de riesgos de desastres y cambio climático en la provincia de Alto Amazonas. *Ciencia Latina Revista Científica Multidisciplinar*, *5*(5). https://doi.org/10.37811/cl_rcm.v5i5.791

Gamboa-Soto, A. (2020). Desarrollo de un sistema basado en la nube para el monitoreo de un nido de aves, su ambiente y comportamiento, siguiendo el paradigma del Internet de las Cosas. *Revista Tecnología En Marcha*. https://doi.org/10.18845/tm.v33i7.5472

García Rengifo, C. A., & Durán-Ballén Ochoa, S. (2023). Variabilidad climática en la cuenca hidrográfica del río Chalpi Grande en Napo-Ecuador. *Enfoque UTE*, *14*(1). https://doi.org/10.29019/enfoqueute.872

Gaspari, Fernanda. J., Rodriguez Vagaría, A. M., Delgado, M. I., Senisterra, G. E., & Denegri, G. A. (2011). Vulnerabilidad ambiental en cuencas hidrográficas serranas mediante SIG. *MULTEQUINA*, *20*.

Giménez, A., & Pedro Castaño, J. (2018). Estimación de áreas ocupadas por cultivos de invierno en Uruguay utilizando teledetección. *Revista Mexicana de Ciencias Agrícolas*, *3*(2). https://doi.org/10.29312/remexca.v3i2.1472

Goodchild, M. F., & Haining, R. P. (2005). SIG y análisis espacial de datos: perspectivas convergentes. *Investigaciones Regionales*, *6*.

Hussein, M. M., Al-kawaz, U., Alwasiti, E. A., & Mossa, H. A. Evaluation of Seminal Plasma Chitotriosidase-1 Levels in A Samples of Iraqi Oligoasthenoteratozoospermic Infertile Men with & Without Varicocele. Pakistan Journal of Life and Social Sciences,22(1), 2024.

Jara-Peña, E. (2017). Acumulación de metales pesados en Calamagrostis rigida (Kunth) Trin. ex Steud. (Poaceae) y Myriophyllum quitense Kunth (Haloragaceae) evaluadas en cuatro humedales altoandinos del Perú. *Arnaldoa*, *24*(2), 583–598. https://doi.org/10.22497/arnaldoa.242.24210

Jodar-Abellan, A., Ruiz, M., & Melgarejo, J. (2018). Evaluación del impacto del cambio climático sobre una cuenca hidrológica en régimen natural (SE, España) usando un modelo SWAT. *Revista Mexicana de Ciencias Geologicas*, *35*(3). https://doi.org/10.22201/cgeo.20072902e.2018.3.564

Juárez Hipólito, J. H., Moreno Ibarra, M. A., & Torres Ruiz, M. J. (2019). Seguimiento colaborativo del ruido ambiental utilizando dispositivos móviles y sistemas de información geográfica. *Revista Cartográfica*, *96*. https://doi.org/10.35424/rcar.v0i96.188

Kurniawati, U. F., Handayeni, K. E., Nurlaela, S., Idajati, H., Firmansyah, F., Pratomoadmojo, N. A., & Septriadi, R. S. (2020). Pengolahan Data Berbasis Sistem Informasi Geografis (SIG) di Kecamatan Sukolilo. *SEWAGATI*, *4*(3). https://doi.org/10.12962/j26139960.v4i3.8048

Martelo, M. T., & Pérez Macias, M. (2010). Estudio del impacto del cambio climático sobre la agricultura y la seguridad alimentaría en la República Bolivariana de Venezuela. *Impacto Del Cambio Climatico*, *1*.

Martínez-Abarca, J. O., Sánchez-Acosta, M. I., Orozco-Medina, M. G., & Figueroa-Montaño, A. (2022). Contaminación del aire y percepción por exposición al humo de ladrilleras en Tonalá Jalisco, México. *Pädi Boletín Científico de Ciencias Básicas e Ingenierías Del ICBI*, *10*(19). https://doi.org/10.29057/icbi.v10i19.8691

Mayorga, A., Hugo, M., & Uvidia, M. (2022). Sistemas de información geográfica aplicados a la topografía. *Opuntia Brava*, *11*(4).

Mena, C., Ormazábal, Y., Morales, Y., Santelices, R., & Gajardo, J. (2011). Índices de área verde y cobertura vegetal para la ciudad de parral (Chile), mediante fotointerpretación y SIG. *Ciencia Florestal*, *21*(3). https://doi.org/10.5902/198050983809

Millán López, A. (2019). Cambio climático y actividad turística en los espacios urbanos del interior de España: impactos sobre el modelo de aptitud climático-turística de León, Granada y Madrid. *Investigaciones Geográficas*, *72*. https://doi.org/10.14198/ingeo2019.72.03

Molina, A. M., López, L. F., & Villegas, G. I. (2005). Los sistemas de información geográfica (SIG) en la planificación municipal. *Revista EIA*, *4*.

Monge-Rodríguez, F. S., Huggel, C., & Vicuna, L. (2022). Percepción del deshielo glaciar y el cambio climático en pobladores andinos de Perú: abordaje interdisciplinario. *Ambiente & Sociedade*, *25*. https://doi.org/10.1590/1809-4422asoc20200227r2vu2022l3ao

Ortiz Torres, E. A. (2011). La dialéctica en las investigaciones educativas. *Revista Electrónica "Actualidades Investigativas En Educación,"* *11*(2), 1–26. https://www.redalyc.org/pdf/447/44720020023.pdf

Osorto Nuñez, M. H. (2022). Los modelos de cambio climático futuro como predictores de la reducción del área de distribución de dos especies de cíclidos endémicos de Honduras. *Biología Acuática*, *38 (en curso)*. https://doi.org/10.24215/16684869e028

Palacios Chacón, E., & Serrano Vincenti, S. (2011). Validación de los Modelos de Cambio Climático hidrostáticos y no hidrostáticos sobre la climatología de Ecuador en las variables de precipitación y temperaturas extremas. *La Granja*, *13*(1). https://doi.org/10.17163/lgr.n13.2011.03

Panduro Bazán de Lázaro, H. (2020). Nivel de conocimiento sobre los efectos del cambio climático, distrito Bongará, Amazonas, Perú, 2019. *Revista Científica UNTRM: Ciencias Sociales y Humanidades*, *3*(1). https://doi.org/10.25127/rcsh.20203.573

Perea Ardila, M. A., Leal Villamil, J., & Oviedo Barrero, F. (2021). Caracterización espectral y monitoreo de bosques de manglar con Teledetección en el litoral Pacífico colombiano: Bajo Baudó, Chocó. *La Granja*, *34*(2). https://doi.org/10.17163/lgr.n34.2021.02

Pérez Vázquez, A., Leyva Trinidad, D. A., & Gómez Merino, F. C. (2018). Desafíos y propuestas para lograr la seguridad alimentaria hacia el año 2050. *Revista Mexicana de Ciencias Agrícolas*, *9*(1). https://doi.org/10.29312/remexca.v9i1.857
Pineda, L. D., & Suárez, J. E. (2014). Elaboración de un SIG orientado a la zonificación agroecológica de los cultivos. *Revista Ingeniería Agrícola*, *4*(3).
Pons, D., Castellanos, E., Conde, D., & López, A. (2018). Escenarios de aridez para Guatemala para los años 2030, 2050 y 2070 utilizando modelos de cambio climático. *Revista Mesoamericana de Biodiversidad y Cambio Climático*, *4*.
Pratiwi, R. R., & Thalib, A. Analysis of Perceptions and Awareness of Implementors and Policy Targets on Health Service Management (Sharia): A Systematic. Pakistan Journal of Life and Social Sciences,22(1), 2024
Puelles Condori, B. N., Cárdenas Rodríguez, J., & Estrada Zuñiga, A. C. (2022). Estimación de biomasa y carga animal en humedales ribereños utilizando ortofotografías multiespectrales adquiridas con microsensores transportados en vehículos aéreos no tripulados "Drone." *Revista de Investigaciones Altoandinas - Journal of High Andean Research*, *24*(4), 248–256. https://doi.org/10.18271/ria.2022.442
Puerta, C. A. C. (2015). Tecnología Drone En Levantamientos Topográfico. *Ekp*, *13*(3).
Ramírez, C., Bonales, J., & Ortíz, C. (2015). Modelos de vulnerabilidad agrícola ante los efectos del cambio climático. *CIMEXUS*, *9*(2).
Reyes Rivera, O., Torres Vega, P., & Torres LIma, P. (2022). Políticas de gestión de riesgos de desastres e inclusión-exclusión de asentamientos informales. Una evaluación para la Ciudad de México. *Gestión y Análisis de Políticas Públicas*. https://doi.org/10.24965/gapp.10963
Reyes-Ordoñez, H. R., Ortiz-Torres, J. I., Álvarez-Vera, M. S., & Cobos-Torres, J. C. (2020). Evaluación de la degradación de materia orgánica mediante técnicas de visión artificial y sensores. *Revista Arbitrada Interdisciplinaria Koinonía*, *5*(9). https://doi.org/10.35381/r.k.v5i9.658
Riaño, D., Salas, J., & Chuvieco, E. (2001). Cartografía de modelos de combustible con teledetección: aportaciones a un desarrollo ambiental sostenible. *Estudios Geográficos*, *62*(243), 309–333. https://doi.org/10.3989/egeogr.2001.i243.287
Rosales - Veítia, J., & Marcano - Montilla, A. (2023). Planes comunitarios de riesgos en Suramérica. Una revisión sistemática. *Revista Geográfica De América Central*, *1*(70), 107–134. https://www.revistas.una.ac.cr/index.php/geografica/article/view/16200
Rosales-Veítia, J. (2021). Evolución histórica de la concepción de la gestión de riesgos de desastres: algunas consideraciones. *Revista Kawsaypacha: Sociedad y Medio Ambiente*, *7*, 67–81. https://doi.org/10.18800/kawsaypacha.202101.004
Rosales-Veítia, J., & Marcano-Montilla, A. (2013). Análisis geomorfológico de las microcuencas de drenajes Monroy y Zumba, municipio Sucre – estado Miranda, Venezuela; empleando Sistemas de Información Geográfica. *CONHISREMI, Revista Universitaria de Investigación y Diálogo Académico*, *9*(1), 16–36. https://www.researchgate.net/profile/Arismar-Montilla-2/publication/267652439_ANALISIS_GEOMORFOLOGICO_DE_LAS_MICROCUENCAS_DE_DRENAJES_MONROY_Y_ZUMBA_MUNICIPIO_SUCRE-_ESTADO_MIRANDA_VENEZUELA_EMPLEANDO_SISTEMAS_DE_INFORMACION_GEOGRAFICA/links/545780200cf26d5090aa0400/ANALISIS-GEOMORFOLOGICO-DE-LAS-MICROCUENCAS-DE-DRENAJES-MONROY-Y-ZUMBA-MUNICIPIO-SUCRE-ESTADO-MIRANDA-VENEZUELA-EMPLEANDO-SISTEMAS-DE-INFORMACION-GEOGRAFICA.pdf
Rosales-Veítia, J., & Marcano-Montilla, A. (2021a). Amenaza por remoción en masa. Una experiencia en la comunidad La Lagunita, estado Miranda, Venezuela. *IPSA Scientia, Revista Científica Multidisciplinaria*, *6*(2). https://doi.org/10.25214/27114406.1103
Rosales-Veítia, J., & Marcano-Montilla, A. (2021b). Aplicación de imágenes satelitales spot para estudios ambientales. *Tiempo y Espacio*, *39*(76), 145–167. https://revistas.upel.edu.ve/index.php/tiempo_y_espacio/article/view/37/25

Rosales-Veítia, J., & Marcano-Montilla, A. (2022). Mapas comunitarios de riesgos, conceptualización y abordaje metodológico. Algunas consideraciones. *IPSA Scientia, Revista Científica Multidisciplinaria*, *7*(1), 38–57. https://doi.org/10.25214/27114406.1391

Sacristán Romero, F. (2005). La Teledetección satelital y los sistemas de protección ambiental. *Civilizar*, *5*(9). https://doi.org/10.22518/16578953.701

Salinas-Castro, R. V., Cevallos, W., & Levy, K. (2019). Afrodescendientes e indígenas vulnerables al cambio climático: desacuerdos frente a medidas preventivas estatales ecuatorianas. *Íconos - Revista de Ciencias Sociales*, *66*. https://doi.org/10.17141/iconos.66.2020.4012

Sánchez-Díaz, B. (2018). La teledetección en investigaciones ecológicas como apoyo a la conservación de la biodiversidad: una revisión. *Revista Científica*, *3*(33). https://doi.org/10.14483/23448350.13370

Sancho Gómez-Zurdo, R., Galán Martín, D., González-Rodrigo, B., Marchamalo Sacristán, M., & Martínez Marín, R. (2021). Aplicación de la fotogrametría con drones al control deformacional de estructuras y terreno. *Informes de La Construcción*, *73*(561). https://doi.org/10.3989/ic.77867

Santiago Vera, T. de J., García Millán, M. A., & Rosset, P. M. (2019). Enfoques de la resiliencia ante el cambio climático. *Agricultura Sociedad y Desarrollo*, *15*(4). https://doi.org/10.22231/asyd.v15i4.898

Segura M, R., & Trincado, G. (2003). Cartografía digital de la Reserva Nacional Valdivia a partir de imágenes satelitales Landsat TM. *Bosque (Valdivia)*, *24*(2). https://doi.org/10.4067/s0717-92002003000200005

Sifuentes Palomino, N. P., Sifuentes Palomino, L. M., Sifuentes Palomino, J. M., & Ortiz Arias, R. C. (2022). Gestión de riesgos de desastres y su influencia en la conciencia ambiental del Perú. *Franz Tamayo - Revista de Educación*, *4*(10). https://doi.org/10.33996/franztamayo.v4i10.876

Soares, D., & García, A. (2014). Percepciones campesinas indígenas acerca del cambio climático en la cuenca de Jovel, Chiapas – México. *Cuadernos de Antropología Social*, *39*.

Suárez Londoño, A. S., Jiménez López, A. F., Castro Franco, M., & Cruz Roa, A. A. (2017). Clasificación y mapeo automático de coberturas del suelo en imágenes satelitales utilizando Redes Neuronales Convolucionales. *Orinoquia*, *21*(1 Sup). https://doi.org/10.22579/20112629.432

Suárez-Almiñana, S., Paredes-Arquiola, J., Andreu, J., & Solera, A. (2021). Efecto del cambio climático en la calidad del agua de la Cuenca del Júcar. *Ingeniería Del Agua*, *25*(2). https://doi.org/10.4995/ia.2021.14644

Suastegui Cruz, S. (2021). Estrategias para la seguridad hídrica ante los cambios de precipitación por efectos del cambio climático. *RIDE Revista Iberoamericana Para La Investigación y El Desarrollo Educativo*, *12*(23). https://doi.org/10.23913/ride.v12i23.1039

Torres Lima, P., Torres Vega, P., & Castro Garza., G. (2021). Asentamientos informales y resiliencia comunitaria. Itinerarios para su evaluación ante riesgos de desastres. *Revista Ciudades, Estados y Política*. https://doi.org/10.15446/cep.v8n1.91947

Ulloa, A., Escobar, E. M., Donato, L. M., & Escobar, P. (2008). Mujeres indígenas y cambio climático. Perspectivas latinoamericanas. In *Mujeres indígenas y cambio climático: Perspectivas latinoamericanas*.

Valdez-Lazalde, J. R., González-Guillén, M. de J., & de los Santos-Posadas, H. M. (2006). Estimación de cobertura arbórea mediante imágenes satelitales multiespectrales de alta resolución. *Agrociencia*, *40*(3).

Vázquez-Ochoa, L. A., Correa-Sandoval, A., Vargas-Castilleja, R. D. C., Vázquez-Sauceda, M. D. L. L., & Rodríguez-Castro, J. H. (2021). Modelo hidrológico, calidad del agua y cambio climático: soporte para la gestión hídrica de la cuenca del río Soto la Marina. *CienciaUAT*. https://doi.org/10.29059/cienciauat.v16i1.1498

Vera Rodíguez, J. M., & Albarracin Calderón, A. P. (2017). Metodología para el análisis de vulnerabilidad ante amenazas de inundación, remoción en masa y flujos torrenciales en cuencas hidrográficas. *Ciencia e Ingeniería Neogranadina*, *27*(2). https://doi.org/10.18359/rcin.2309

Villar, F. A., Candelario, N. S., & Díaz, J. (2022). Drones, fotogrametría y Sistemas de Información Geográfica. Algunos aportes a la arqueología de contextos industriales. *Comechingonia. Revista de Arqueología*, *27*(1), 35–50. https://doi.org/10.37603/2250.7728.v27.n1.38136