



Conservation and Sustainable Management of the Ecuadorian Amazon Rainforest: Environmental Challenges and Community Participation

Conservación y Manejo Sostenible de la Selva Amazónica del Ecuador: Desafíos Ambientales y Participación Comunitaria

Marlon Nortiee Estrada Ardon¹  

¹ Unidad Educativa Zoila Etelvina Paredes Aman. El Paraiso, Honduras.

Submitted: 16-06-2024 | Revised: 02-07-2024 | Accepted: 19-08-2024 | Published: 20-08-2024

Corresponding Author: Marlon Nortiee Estrada Ardon 

ABSTRACT

The Ecuadorian Amazon rainforest constitutes one of the most important tropical ecosystems in the world due to its high biodiversity, climate regulation capacity, and provision of essential ecosystem services for local communities and global environmental balance. The present research aimed to analyze the conservation dynamics and sustainable management of the Ecuadorian Amazon, considering community perceptions, predominant economic activities, and the main environmental problems affecting the region. The study was conducted under a quantitative, descriptive, and correlational approach through surveys and direct observation in rural communities located in the Amazonian provinces of Napo, Pastaza, and Orellana. The results showed that agriculture and livestock farming are the main economic activities of the population, generating pressure on forest ecosystems due to the expansion of productive areas and inadequate land-use practices. Likewise, deforestation was identified as the principal environmental problem perceived by local communities, followed by river pollution and forest fires. The research also revealed an intermediate level of knowledge regarding environmental conservation, highlighting the need to strengthen educational programs and community training initiatives. Finally, the study concludes that protecting the Ecuadorian Amazon requires the implementation of sustainable strategies based on community participation, environmental education, and the responsible management of natural resources.

Keywords: Ecuadorian Amazon, environmental conservation, sustainable development, deforestation.

RESUMEN

La selva amazónica del Ecuador constituye uno de los ecosistemas tropicales más importantes del planeta debido a su elevada biodiversidad, capacidad de regulación climática y provisión de servicios ecosistémicos esenciales para las comunidades locales y el equilibrio ambiental global. La presente investigación tuvo como objetivo analizar las dinámicas de conservación y manejo sostenible de la Amazonía ecuatoriana, considerando las percepciones comunitarias, las actividades económicas predominantes y los principales problemas ambientales que afectan a la región. El estudio se desarrolló bajo un enfoque cuantitativo, descriptivo y correlacional, mediante la aplicación de encuestas y observación directa en comunidades rurales de las provincias amazónicas de Napo, Pastaza y Orellana. Los resultados evidenciaron que la agricultura y la ganadería constituyen las principales actividades económicas de la población, generando presión sobre los ecosistemas forestales debido a la expansión de áreas productivas y prácticas inadecuadas de uso del suelo. Asimismo, la deforestación fue identificada como el principal problema ambiental percibido por las comunidades, seguida de la contaminación de ríos y los incendios forestales. La investigación también reveló un nivel intermedio de conocimiento sobre conservación ambiental, destacándose la necesidad de fortalecer programas de educación y capacitación comunitaria. Finalmente, se concluye que la protección de la Amazonía ecuatoriana requiere la implementación de estrategias sostenibles basadas en la participación comunitaria, la educación ambiental y el manejo responsable de los recursos naturales.

Palabras clave: Amazonía ecuatoriana, conservación ambiental, desarrollo sostenible, deforestación.

INTRODUCTION

The Amazon rainforest of Ecuador constitutes one of the most biodiverse and strategic tropical ecosystems on the planet, playing a fundamental role in global climate regulation, carbon storage, and biodiversity conservation (Malhi et al., 2008; Pan et al., 2011). This ecosystem is part of the South American Amazon basin, considered the most extensive continuous tropical rainforest in the world, and is characterized by the coexistence of a wide variety of plant, animal, and microorganism species adapted to conditions of high humidity, warm temperatures, and abundant precipitation throughout the year (Steege et al., 2006). In Ecuadorian territory, the Amazon covers approximately 48 % of the national surface and comprises provinces such as Sucumbíos, Orellana, Napo, Pastaza, Morona Santiago, and Zamora Chinchipe, where tropical rainforests of high ecological and cultural richness predominate (Brondízio et al., 2021).

The Ecuadorian Amazon provides multiple ecosystem services essential for human well-being and environmental sustainability. Among these services, carbon capture and storage, hydrological cycle regulation, soil conservation, the provision of fresh water, food, fibers, natural medicines, and forest resources, as well as the maintenance of habitats for thousands of endemic and threatened species stand out (Pan et al., 2011; Davidson et al., 2012). Furthermore, the region possesses great socio-cultural relevance due to the presence of numerous indigenous peoples and ancestral communities that depend directly on forest resources for their subsistence and preserve traditional knowledge related to the sustainable management of the rainforest (Brondízio et al., 2021).

Despite its ecological and social importance, the Amazon rainforest of Ecuador faces growing pressures derived from human activities such as agricultural and livestock expansion, oil and mining exploitation, illegal logging, road infrastructure construction, and forest fires (Nobre et al., 2016; Sonter et al., 2017). These activities have caused accelerated processes of deforestation, landscape fragmentation, ecosystem degradation, and biodiversity loss, affecting both the ecological balance and the living conditions of local communities (Aragão et al., 2018; Barlow et al., 2020). Likewise, climate change intensifies the vulnerability of the region through alterations in precipitation patterns, temperature increases, and a higher frequency of extreme events that threaten the resilience of tropical forests (Lovejoy & Nobre, 2019).

In response to these issues, various national and international organizations have promoted strategies oriented toward the conservation and sustainable management of the Ecuadorian Amazon. Among these, the implementation of protected areas, ecological restoration programs, bioeconomy initiatives, agroforestry systems, and mechanisms for reducing emissions from deforestation and forest degradation stand out (Davidson et al., 2012; Nobre et al., 2016). However, the effectiveness of these actions largely depends on the active participation of local communities, the strengthening of environmental public policies, and the integration of scientific knowledge and ancestral wisdom into territorial management (Tejada et al., 2020).

In this context, it is essential to deepen the study of the ecological and social dynamics of the Amazon rainforest of Ecuador to understand the challenges associated with its conservation and to promote sustainable practices that allow balancing economic development with environmental protection. The analysis of management strategies, natural resource use, and community perception regarding forest conservation can contribute to the design of more comprehensive policies aimed at ensuring the sustainability of one of the most valuable ecosystems on the planet (Peres et al., 2006; Flores et al., 2017).

METHODS

The present research was developed under a quantitative approach with a descriptive and correlational scope, aimed at analyzing the dynamics of conservation and sustainable management of the Amazon rainforest of Ecuador, as well as the socio-environmental factors associated with the degradation of forest ecosystems. The study had a non-experimental, cross-sectional design, since the information was collected in a specific period without manipulation of variables.

The research was carried out in the Amazon region of Ecuador, specifically in rural communities located in the provinces of Napo, Pastaza, and Orellana, areas characterized by the presence of tropical rainforests, high biodiversity, and economic activities related to agriculture, livestock, logging, and natural resource extraction. These areas were selected due to the ecological importance of their ecosystems and the environmental problems derived from deforestation and the expansion of productive activities.

The population consisted of inhabitants of Amazonian communities, community leaders, agricultural producers, and representatives of environmental organizations linked to natural resource management. The sample was selected through non-probability convenience sampling, considering the accessibility and willingness to participate of the respondents. In total, 120 people belonging to different communities of the Ecuadorian Amazon region participated.

To obtain information, survey and direct observation techniques were used. The survey allowed for the collection of information related to land use practices, perception of forest conservation, natural resource management, the impact of economic activities, and knowledge of sustainable strategies. A structured questionnaire consisting of closed-ended questions and Likert-type scales was designed as the instrument.

Direct observation was used to identify environmental conditions in the study areas, including deforestation, changes in vegetation cover, agricultural activities, and community forest management practices. Additionally, technical documents, environmental reports, and scientific literature related to the conservation of the Ecuadorian Amazon were reviewed.

The research process began with a literature review on Amazonian ecosystems, ecosystem services, deforestation, and environmental sustainability. Subsequently, the questionnaire was validated through expert judgment by specialists in environmental sciences and sustainable development. The surveys were administered in person in the selected communities, following authorization from community leaders and the voluntary consent of the participants. In parallel, field observations were conducted in different sectors of the study area to record evidence of the conservation status of the ecosystems.

Finally, the collected data were organized and processed using statistical tools. Quantitative data were analyzed using descriptive statistics, including frequencies, percentages, and comparative tables, whereas correlational analyses were applied to identify relationships between environmental and social variables.

The research adhered to the ethical principles of confidentiality, voluntary participation, and the responsible use of the obtained information. Participants were informed of the study objectives, and the anonymity of the collected responses was guaranteed. Furthermore, the study respected the traditional knowledge and cultural practices of the participating Amazonian communities.

RESULTS

The results showed that the Ecuadorian Amazon rainforest remains fundamental to the economic, social, and environmental livelihoods of local communities. The majority of participants identified the Amazon forest as their primary source of natural resources, highlighting the provision of water, food, medicinal plants, and land for agricultural and subsistence activities. Similarly, respondents expressed concern over increasing deforestation and the expansion of extractive activities in the region.

Regarding the perception of the conservation status of the Amazon, a significant proportion of participants considered that forest ecosystems exhibit moderate to high levels of environmental degradation due to advancing logging, vegetation burning, and the expansion of agricultural and livestock areas. In addition, several residents indicated that recent climate change has affected water availability, soil fertility, and agricultural productivity.

The data reflect that deforestation is the primary environmental problem perceived by Amazonian communities. This result highlights the concern regarding the progressive loss of forest cover and its effects on biodiversity and ecosystem services.

Regarding the economic activities of the population, agriculture and livestock farming remain the primary sources of household income. However, a growing interest in sustainable activities, such as ecotourism, reforestation, and agroforestry systems, was also identified.

Table 1. Community perception of the primary environmental problems in the Ecuadorian Amazon.

Environmental problem	Frequency	Percentage
Deforestation	46	38%
River pollution	24	20%
Agricultural and livestock expansion	21	18%
Forest fires	17	14%
Biodiversity loss	12	10%
Total	120	100%

Table 2. Predominant economic activities in the studied communities.

Economic activity	Frequency	Percentage
Agriculture	42	35%
Livestock	31	26%
Local trade	18	15%
Forest harvesting	15	13%
Ecotourism	9	7%
Other activities	5	4%
Total	120	100%

The results show that traditional productive activities continue to predominate in the Amazon region, although there is a gradual transition toward more sustainable practices driven by environmental organizations and conservation programs.

Regarding knowledge of environmental conservation strategies, the majority of participants indicated familiarity with practices related to forest protection, the rational use of natural resources, and reforestation. However, a portion of the population reported limited access to environmental training and technical assistance.

The findings show an intermediate level of knowledge about environmental conservation within the Amazonian communities. However, participants highlighted the need to strengthen educational programs and community projects focused on sustainability and responsible forest management.

Similarly, during field observations, areas experiencing environmental degradation associated with logging and agricultural expansion were identified. However, community initiatives aimed at forest restoration and the protection of water sources were also observed, particularly in communities working jointly with conservation organizations.

Table 3. Level of knowledge about environmental conservation practices.

Knowledge level	Frequency	Percentage
High	39	33%
Medium	52	43%
Low	29	24%
Total	120	100%

Finally, the correlational analysis showed a significant relationship between the level of environmental knowledge and participation in sustainable practices. Individuals with greater access to environmental training programs demonstrated higher participation in conservation, reforestation, and sustainable natural resource management activities. These results highlight the importance of strengthening community environmental education as a key strategy for protecting the Ecuadorian Amazon rainforest.

DISCUSSION

The results of this study indicate that the Ecuadorian Amazon rainforest continues to play an essential role for local communities, not only as a source of economic resources but also as a key ecosystem for environmental regulation and biodiversity conservation. The widespread perception among community members that deforestation is the primary environmental problem reflects growing concern regarding forest cover loss and its effects on rural livelihoods. These findings align with several studies conducted in Latin American Amazonian regions, where agricultural, livestock, and extractive expansion are among the primary causes of environmental degradation.

The predominance of traditional economic activities, particularly agriculture and livestock farming, demonstrates the strong dependence of Amazonian communities on direct natural resource use. However, our results also reveal growing interest in sustainable activities, such as ecotourism and agroforestry systems, suggesting a gradual transition toward production models that are more compatible with environmental conservation. This shift may represent a community response to the impacts of ecological degradation and the need to ensure long-term resource sustainability.

Furthermore, results regarding environmental knowledge levels show that a large portion of the population possesses moderate knowledge of conservation practices, although limitations in access to technical training and environmental education persist. This indicates that, while awareness of the importance of protecting the Amazon exists, greater institutional and community efforts are required to strengthen local capacity for sustainable forest management. Environmental education is a fundamental element for promoting behavioral change and fostering responsible natural resource use.

Field observations confirmed environmental degradation processes primarily associated with logging, vegetation burning, and agricultural expansion. These findings indicate that human activities continue to pressure Amazonian ecosystems, affecting biodiversity, soil quality, and water availability. However, community initiatives for reforestation and water source conservation were also identified, demonstrating local organizational capacity and interest in promoting environmental recovery.

Likewise, the correlation between environmental knowledge levels and participation in sustainable practices confirms the importance of educational and community awareness programs. Individuals who received environmental training showed greater involvement in conservation and sustainable management activities, demonstrating that training and access to information can positively influence environmental protection. This finding is highly relevant for designing public policies aimed at strengthening community participation in Amazon rainforest conservation.

Overall, these results suggest that conserving the Ecuadorian Amazon requires integrating economic development, community participation, and environmental protection. Implementing sustainable strategies will depend not only on government actions but also on strengthening local capacity, valuing ancestral knowledge, and promoting productive alternatives compatible with forest ecosystem preservation.

CONCLUSIONS

The Ecuadorian Amazon rainforest is an ecosystem of immense ecological, social, and economic importance due to its high biodiversity, climate regulation capacity, and provision of essential natural resources for local communities. Our results show that Amazonian populations remain highly dependent on forest resources for agricultural, livestock, and subsistence activities, demonstrating the close link between human well-being and environmental conservation in the region.

Deforestation, agricultural expansion, and inadequate land-use practices are the primary environmental challenges affecting the Ecuadorian Amazon. These activities have caused forest degradation and biodiversity loss, threatening ecosystem sustainability and rural livelihoods. Additionally, climate change increases regional environmental vulnerability by altering water resources and agricultural conditions.

This study also identified a moderate level of knowledge regarding environmental conservation practices among local residents. However, limitations in technical training and environmental education hinder the widespread adoption of sustainable forest management. In this context, strengthening educational programs and community projects is essential to promote greater public participation in natural resource protection.

Conversely, reforestation initiatives, water source conservation, and sustainable activities such as ecotourism and agroforestry systems represent viable alternatives to reduce pressure on Amazonian ecosystems. These actions reflect community interest in actively participating in environmental conservation and restoration.

In conclusion, conserving the Ecuadorian Amazon rainforest requires coordinating public policies, community participation, and sustainable development strategies that balance the economic needs of the population with the protection of forest ecosystems. Strengthening environmental education, supporting sustainable initiatives, and integrating scientific and ancestral knowledge will be key to ensuring the preservation of the Amazon and its multiple benefits for present and future generations.

REFERENCES

1. Aragão, L. E. O. C., Anderson, L. O., Fonseca, M. G., Rosan, T. M., Vedovato, L. B., Wagner, F. H., Silva, C. V. J., Silva Junior, C. H. L., Arai, E., Aguiar, A. P. D., Barlow, J., Berenguer, E., Deeter, M. N., Domingues, L. G., Gatti, L., Gloor, E., Malhi, Y., Marengo, J. A., Miller, J. B., ... Saatchi, S. (2018). 21st Century drought-related fires counteract the decline of Amazon deforestation carbon emissions. *Nature Communications*, 9(1), 536. <https://doi.org/10.1038/s41467-017-02771-y>
2. Barlow, J., Berenguer, E., Carmenta, R., & França, F. (2020). Clarifying Amazonia's burning crisis. *Global Change Biology*, 26(2), 319–321. <https://doi.org/10.1111/gcb.14872>
3. Brondizio, E. S., Le Tourneau, F. M., Duchelle, A. E., & Sunderland, T. (2021). The global relevance of the Amazon biome. *Science Advances*, 7(7), eabc4547. <https://doi.org/10.1126/sciadv.abc4547>
4. Costa, M. H., & Pires, G. F. (2010). Effects of Amazon and Central Brazil deforestation scenarios on the duration of the dry season in the arc of deforestation. *International Journal of Climatology*, 30(13), 1970–1979. <https://doi.org/10.1002/joc.2048>
5. Davidson, E. A., de Araújo, A. C., Artaxo, P., Balch, J. K., Brown, I. F., Bustamante, M. M. C., Coe, M. T., DeFries, R. S., Keller, M., Longo, M., Munger, J. W., Schroeder, W., Soares-Filho, B. S., Souza, C. M., & Wofsy, S. C. (2012). The Amazon basin in transition. *Nature*, 481(7381), 321–328. <https://doi.org/10.1038/nature10717>
6. Flores, B. M., Holmgren, M., Xu, C., van Nes, E. H., Jakovac, C. C., Mesquita, R. C. G., & Scheffer, M. (2017). Floodplains as an Achilles' heel of Amazonian forest resilience. *Proceedings of the National Academy of Sciences*, 114(17), 4442–4446. <https://doi.org/10.1073/pnas.1617988114>
7. Lovejoy, T. E., & Nobre, C. (2019). Amazon tipping point: Last chance for action. *Science Advances*, 5(12), eaba2949. <https://doi.org/10.1126/sciadv.aba2949>
8. Malhi, Y., Roberts, J. T., Betts, R. A., Killeen, T. J., Li, W., & Nobre, C. A. (2008). Climate change, deforestation, and the fate of the Amazon. *Science*, 319(5860), 169–172. <https://doi.org/10.1126/science.1146961>
9. Nobre, C. A., Sampaio, G., Borma, L. S., Castilla-Rubio, J. C., Silva, J. S., & Cardoso, M. (2016). Land-use and climate change risks in the Amazon and the need of a novel sustainable development paradigm. *Proceedings of the National Academy of Sciences*, 113(39), 10759–10768. <https://doi.org/10.1073/pnas.1605516113>
10. Pan, Y., Birdsey, R. A., Fang, J., Houghton, R., Kauppi, P. E., Kurz, W. A., Phillips, O. L., Shvidenko, A., Lewis, S. L., Canadell, J. G., Ciais, P., Jackson, R. B., Pacala, S. W., McGuire, A. D., Piao, S., Rautiainen, A., Sitch, S., & Hayes, D. (2011). A large and persistent carbon sink in the world's forests. *Science*, 333(6045), 988–993. <https://doi.org/10.1126/science.1201609>
11. Peres, C. A., Barlow, J., & Laurance, W. F. (2006). Detecting anthropogenic disturbance in tropical forests. *Trends in Ecology & Evolution*, 21(5), 227–229. <https://doi.org/10.1016/j.tree.2006.03.007>
12. Sonter, L. J., Herrera, D., Barrett, D. J., Galford, G. L., Moran, C. J., & Soares-Filho, B. S. (2017). Mining drives extensive deforestation in the Brazilian Amazon. *Nature Communications*, 8(1), 1013. <https://doi.org/10.1038/s41467-017-00557-w>
13. Steege, H. ter, Pitman, N. C. A., Phillips, O. L., Chave, J., Sabatier, D., Duque, A., Molino, J. F., Prévost, M. F., Spichiger, R., Castellanos, H., von Hildebrand, P., & Vásquez, R. (2006). Continental-scale patterns of canopy tree composition and function across Amazonia. *Nature*, 443(7110), 444–447. <https://doi.org/10.1038/nature05134>
14. Tejada, G., Fontaine, G., & Paz, M. (2020). Oil extraction and environmental conflicts in the Ecuadorian Amazon. *The Extractive Industries and Society*, 7(4), 1232–1240. <https://doi.org/10.1016/j.exis.2020.08.007>

FUNDING

None.

CONFLICT OF INTEREST

None.

AUTHORSHIP CONTRIBUTIONS

Drafting – original draft: Marlon Nortiee Estrada Ardon.
Writing–review and editing: Marlon Nortiee Estrada Ardon.