AGEAS AND AEDES MOSQUITOES: DEADLY THREAT PRESENT IN THE EMBERA KATIO COMMUNITY IN TIERRALTA, COLOMBIA.

SUMMARY

The Embera Katío indigenous community in Tierralta, Córdoba, is facing a serious environmental and public health crisis due to the accumulation of plastic waste and the lack of an efficient solid waste management system. The absence of adequate public policies has led to unsustainable practices, such as burning garbage, which releases toxic substances and causes respiratory diseases. In addition, the accumulated plastics retain stagnant water, creating ideal breeding grounds for the *Aedes aegypti* mosquito, which transmits dengue and Zika. In 2023, 4,300 cases of dengue were reported in the area, an increase of 132% compared to the previous year. In 2022, Ecoceanos managed to achieve a plastic compacting machine, reducing the volume of waste by 70% and generating local jobs. However, the instability of the electricity supply and high operating costs have limited its effectiveness. This document analyzes the problem, proposes technical and social solutions, and evaluates the expected results. The solutions include stabilizing the electricity supply, using renewable energies, optimizing the compaction system, and strengthening the circular economy. An 80% reduction in the volume of waste, a significant decrease in cases of dengue and Zika, and the generation of local jobs are expected. This comprehensive approach seeks to improve the quality of life of the community, protect the environment and respect the Embera Katío culture.

Keywords: Plastic waste, public health, Embera Katío, dengue, circular economy, waste management, renewable energy, environmental pollution.

INTRODUCTION

The Embera Katío are an indigenous people with a rich history and cultural traditions that date back centuries. They live mainly in the region of Tierralta, Córdoba, in Colombia, where they have maintained a close relationship with nature and a way of life based on subsistence agriculture, fishing, hunting and the elaboration of handicrafts. Their diet consists mainly of traditional crops such as maize, cassava, banana and a variety of tropical fruits, supplemented with protein obtained from fishing in nearby rivers and hunting wild animals. The community's daily activities revolve around planting, food gathering, handicrafts and participation in community rituals that reinforce their cultural identity and connection to the territory.

The Embera Katío culture is characterized by its deep respect for nature and its worldview, which integrates the human being with the environment. However, in recent decades, the community has faced significant challenges stemming from globalization, the lack of adequate public policies, and the introduction of plastic products into its environment. The absence of an efficient waste collection and management system has generated an environmental and health problem that threatens their well-being and their traditional way of life. The introduction of plastics and other non-biodegradable materials has altered the ecological balance of the region. The Embera Katío, accustomed to a sustainable way of life, do not have the tools or knowledge to manage these new types of waste. As a result, plastics accumulate in makeshift dumps, polluting the soil, water, and air. Burning garbage, a common practice to reduce the volume of waste, releases toxic substances that affect the health of the population, especially the most vulnerable groups, such as children, pregnant women and the elderly.

This document seeks to analyze the problem of plastic waste in the Embera Katío community, propose sustainable solutions and evaluate its potential impact on the quality of life of the inhabitants and on the protection of the environment. To better understand the impact of plastic waste on the Embera Katío community, it is important to examine how these materials have become part of their daily lives. For generations, the Embera Katío have used natural materials such as palm leaves, mud, and plant fibers to make utensils, dwellings, and tools. However, with the advent of industrial products and increased trade with external populations, plastics have become an easy and accessible alternative, albeit with serious environmental consequences.

The lack of adequate infrastructure for the disposal of this waste has exacerbated the problem, as plastic waste ends up accumulating in rivers, roads, and community spaces. This phenomenon not only affects the aesthetics of the environment, but also puts local fauna at risk, as animals can ingest plastic fragments or become trapped in them, which alters the natural balance of the ecosystem. The health of the community is also severely affected by the accumulation of plastic waste. The open burning of these materials is a common practice due to the lack of alternatives for their disposal, but it generates toxic gas emissions that can cause respiratory diseases, dermatological problems and other health conditions. In addition, the presence of residues in water sources contaminates the community's supply, exposing them to gastrointestinal diseases and other problems arising from the consumption of water unfit for human consumption. Soil contamination also affects the quality of crops, jeopardizing the food security of the Embera Katío. Faced with this problem, it is necessary to implement sustainable solutions that reduce the amount of plastic waste in the community and promote more environmentally friendly alternatives.

One of the most effective strategies is environmental education, which can empower the community with the necessary knowledge to manage waste properly. Workshops on recycling, composting, and reusing materials can contribute to a change in the way the Embera Katío handle waste. It is also essential to establish partnerships with governmental and non-governmental organizations that can provide technical support and resources for waste management. Implementing selective collection systems and setting up collection centers for sorting plastics and other recyclables can help mitigate the problem. These centers would not only serve as collection points, but could also generate economic opportunities for the community through the sale of recyclable materials. Another key strategy is to encourage the use of biodegradable alternatives and

traditional materials instead of plastics. The rescue of ancestral practices in the manufacture of utensils and containers can reduce dependence on industrial products and strengthen the cultural identity of the Embera Katío. In addition, promoting the production and marketing of handicrafts made from natural materials can become a sustainable source of income for the community. The adoption of circular economy practices can also play a critical role in reducing plastic waste. Initiatives such as making ecobricks from plastic bottles can offer innovative solutions for the construction of homes and other community infrastructure. In this way, a problem is transformed into an opportunity for sustainable development. Finally, the active participation of the community in the design and implementation of solutions is crucial.

Consultation and dialogue with community leaders ensure that the proposed strategies are culturally appropriate and respond to the real needs of the population. Raising awareness and mobilizing the Embera Katío around the issue of plastic waste can strengthen social cohesion and foster a collective commitment to environmental protection. In conclusion, the introduction of plastics in the Embera Katío community has generated a serious environmental and health problem that requires urgent and sustainable solutions. The combination of environmental education, adequate infrastructure, promotion of alternative materials and community participation can contribute to mitigating the negative effects of plastic waste and improving the quality of life of the population. It is critical that both authorities and organizations interested in environmental conservation work together with the Embera Katío to develop effective and sustainable long-term strategies. Only through a comprehensive and collaborative approach will it be possible to preserve the cultural and natural richness of this indigenous community, ensuring a healthier and more sustainable future for generations to come.

DESCRIPTION OF THE PROBLEM

The Embera Katío community is facing a serious environmental and public health crisis due to the uncontrolled accumulation of plastic waste and the lack of an efficient solid waste management system. The absence of adequate public policies and the lack of basic infrastructure have led to unsustainable practices, such as the burning of garbage, which releases toxic substances into the air and contributes to the proliferation of respiratory diseases. In addition, the accumulated plastics retain stagnant water, creating ideal breeding grounds for the Aedes aegypti mosquito, the main vector of diseases such as dengue and Zika. In 2023, 4,300 cases of dengue were reported in the area, representing an increase of 132% over the previous year and 264% compared to the average of the last five years. Dengue, in its initial phase, causes high fever, headache, fatigue, muscle and joint pain, nausea and rashes. In severe cases, it can lead to internal bleeding, persistent vomiting, severe abdominal pain, and fluid loss shock, which can lead to organ failure and death if not treated early. This situation is compounded by a lack of access to adequate health services, which delays timely care and increases the rate of complications and mortality among community members.

Faced with this problem, in 2022 a plastic compactor machine was implemented as an innovative solution to address the accumulation of waste. During the first six months of operation, it was possible to reduce the volume of plastic waste by 70%, preventing its dispersion in the environment and improving the quality of life of the inhabitants. This measure also made it possible to recover public spaces previously saturated with waste, reducing visual pollution and the risk of diseases associated with the accumulation of garbage. However, since the end of 2023, the operation of the machine has been affected due to the

voltage instability of the local power grid, which operates below the levels required for the continuous start and operation of the engine.

This situation has caused frequent interruptions in the service, limiting the capacity to process waste and generating temporary accumulations that put the sustainability of the program at risk. As a palliative measure, an internal combustion generating plant was implemented, which allows energy to be supplied independently. However, this solution presents two critical problems: first, high fuel consumption and rising operating costs have made its use financially unfeasible in the long term, especially in a community with limited economic resources. Secondly, the noise level generated by the generating plant exceeds the acceptable thresholds for the environment of the community, affecting the tranquility of the inhabitants and generating nuisance, especially at night.

This has provoked resistance from the community, which, while recognizing the benefits of the compactor, also faces difficulties in living with the collateral effects of its operation. In this context, it is essential to develop sustainable strategies that guarantee the operation of the machine without generating negative impacts on the community. One possible solution is the installation of a solar energy system, which would allow the compactor to be powered without relying on the local electricity grid or fossil fuels. This alternative, in addition to being ecological and reducing costs in the long term, is aligned with the traditional way of life of the Embera Katío community, which has based its existence on a harmonious balance with nature. The implementation of solar panels could be complemented with a battery energy storage system, ensuring a stable supply of electricity even in periods of low solar irradiation. In addition, it is necessary to strengthen environmental education programs within the community, promoting the separation of waste at the source and encouraging sustainable practices to reduce the generation of plastic waste. Awareness campaigns on the impact of plastic on health and the environment could help to change consumption habits and reduce dependence on single-use products.

Finally, it is crucial to involve government entities and non-governmental organizations in the design and implementation of waste management policies adapted to the specific needs of the community. The establishment of strategic alliances could facilitate the obtaining of technical and financial resources for the improvement of the waste collection and disposal system, ensuring the long-term sustainability of the project and protecting both the health of the Embera Katío and the ecological balance of their territory.

JUSTIFICATION

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The problem of plastic waste in the Embera Katío community not only represents an environmental challenge, but also a threat to public health and the preservation of their culture and traditional way of life. The lack of sustainable solutions perpetuates cycles of pollution and poverty, especially affecting the most vulnerable groups, such as children, pregnant women and the elderly. In addition, the burning of plastics and the proliferation of mosquito-borne diseases aggravate the living conditions of the community and increase the burden on the local health system. The implementation of technical and social solutions that address these problems in a comprehensive manner would not only improve the quality of life of the inhabitants, but would also contribute to the protection of the environment and the strengthening of the local economy. There is an urgent need to take concrete steps to ensure the sustainability of the plastic compacting machine project and to promote waste management practices that respect the culture and environment of the Embera Katío community.

POSSIBLE SOLUTIONS

The problem of plastic waste in the Embera Katío community requires comprehensive solutions that address both technical challenges and social, economic and environmental aspects. Below are four key proposals to improve waste management and promote sustainable development in the community.

1. Stabilization of the electricity supply

A stable power supply is essential for the efficient operation of equipment such as the plastic compacting machine. To achieve this, the following actions are proposed:

- Technical diagnosis: Carry out a detailed study of the energy needs of the compacting machine and evaluate the conditions of the local electricity grid. This will make it possible to identify failures and limitations in the supply.
- Installation of stabilizers: Implement voltage stabilizers or transformers to ensure a constant and adequate flow of energy,

avoiding fluctuations that can damage equipment.

- Photovoltaic solar energy: Install solar energy systems to supplement the electricity supply. This solution not only reduces dependence on the electricity grid, but also decreases the use of fossil fuels, contributing to environmental sustainability.

2. Compaction system optimization

The energy and operational efficiency of the compacting machine is key to maximizing its impact. To this end, the following measures are suggested:

- Efficiency evaluation: Perform a technical analysis of the energy consumption of the compacting machine and identify opportunities for improvement, such as modernizing components or implementing more efficient technologies.
- Schedule adjustment: Program the operation of the machine at times that minimize the impact of noise on the community and coincide with periods of greater stability in the electricity supply. This can also reduce operating costs.

3. Strengthening the circular economy

The circular economy is a key strategy to transform plastic waste into economic and environmental opportunities. To promote it, the following actions are proposed:

- Community training: Implement workshops and training programs in recycling, waste management and entrepreneurship. This will allow community members to gain skills to manage waste sustainably and generate income through the sale of compacted plastic.
- Strategic alliances: Establish agreements with recycling companies and specialized organizations to guarantee the continuous sale of compacted plastic. Such partnerships can also facilitate access to larger markets and better prices.

4. Mitigation of environmental and health impacts

The accumulation of plastic waste and its improper management have negative consequences for the environment and the health of the community. To mitigate these impacts, the following measures are proposed:

- Environmental education: Develop awareness campaigns to promote the separation of waste at the source and encourage sustainable practices. These campaigns must be culturally appropriate and respect the Embera Katío worldview.
- Vector control: Implement regular waste collection and fumigation programs to prevent the proliferation of disease-carrying insects and rodents. This will contribute to improving the sanitary conditions of the community.

EXPECTED RESULTS

The implementation of solutions for the management of plastic waste in the Embera Katío community has the potential to generate positive impacts in the environmental, social, economic and health fields.

The expected results following the implementation of the proposed measures are detailed below:

1. Reduced the volume of plastic waste by 80%

One of the main objectives is to significantly decrease the amount of plastic waste accumulated in the community. Through the efficient compaction of plastics, the promotion of recycling and environmental education, it is expected to achieve an 80% reduction in the volume of this waste. This will not only contribute to cleaning up the environment, but will also prevent contamination of the soil, rivers, and surrounding ecosystems. In addition, reducing plastic waste will decrease the need to burn garbage, a practice that releases toxic substances and pollutes the air.

2. Significant decrease in cases of dengue and Zika

The accumulation of plastic waste and the lack of an adequate garbage management system create conditions conducive to the proliferation of mosquitoes that are vectors of diseases such as dengue and Zika. With the implementation of regular waste collection, fumigation and vector control programs, it is expected to drastically reduce the cases of these diseases. A cleaner environment free of mosquito breeding sites will improve the health of the community, especially the most vulnerable groups, such as children, pregnant women and the elderly.

3. Generation of local jobs and strengthening of the circular economy

Sustainable plastic waste management can become a source of employment and income for the community. Through training in recycling and entrepreneurship, community members will be able to actively participate in the plastic value chain, from its collection and compaction to its sale to recycling companies. This will not only generate local jobs, but will also strengthen the circular economy, promoting a development model that prioritizes the reuse and recycling of materials.

4. Improved air quality and reduced respiratory diseases

Burning plastic waste is a common practice in many communities that lack waste management systems. This practice releases toxic substances such as dioxins and furans, which pollute the air and cause respiratory diseases. With the implementation of solutions such as compacting plastics and eliminating improvised garbage dumps, it is expected to significantly reduce the burning of waste. As a result, air quality will improve and cases of respiratory illnesses will be reduced, benefiting the health of the entire community.

5. Empowering the community through training and active participation

One of the most important outcomes is the empowerment of the Embera Katío community through education and active participation in waste management. Training programs in recycling, waste management, and entrepreneurship will not only provide practical tools, but will also strengthen the sense of belonging and the community's ability to make informed decisions about its development. This empowerment will contribute to preserving their culture and their connection with the territory, while encouraging the adoption of sustainable practices.

ANALYSIS OF THE RESULTS

The implementation of the proposed solutions for the management of plastic waste in the Embera Katío community represents a comprehensive approach that addresses not only environmental challenges, but also social, economic and health aspects. The expected results and their potential impact on the community are then discussed.

Stabilization of electricity supply and use of renewable energies

The stabilization of the electricity supply and the incorporation of renewable energies, such as solar photovoltaic, are essential to guarantee the efficient operation of the plastic compacting machine. A stable power supply will prevent interruptions in the compaction process, allowing larger volumes of waste to be handled continuously. In addition, the use of renewable energy will reduce dependence on the local power grid and fossil fuels, contributing to environmental sustainability and reduced operating costs in the long term. This approach not only improves the efficiency of the waste management system, but also aligns community practices with sustainable development principles.

Strengthening the local economy and the circular economy

Training community members on recycling, waste management, and entrepreneurship, along with creating strategic partnerships with recycling companies, has the potential to transform plastic waste into a source of income. By compacting and selling the plastic, the community can generate local jobs and strengthen its economy, promoting a circular economy model that prioritizes the reuse and recycling of materials. This approach not only reduces dependence on external resources, but also empowers the community to take control of its economic development, fostering self-sufficiency and resilience.

Improving public health and protecting the environment

Environmental education and vector control campaigns are key components to improving public health and protecting the environment. Environmental education will allow the community to understand the importance of separating waste and adopting sustainable practices, which will reduce the accumulation of plastics and soil and water pollution. On the other hand, vector control programs, such as regular waste collection and fumigation, will decrease the proliferation of mosquitoes that transmit diseases such as dengue and Zika. In addition, reducing garbage burning will improve air quality, decreasing cases of respiratory diseases and contributing to a healthier environment.

Community empowerment and cultural preservation

One of the most significant results is the empowerment of the Embera Katío community through training and active participation in waste management. By involving community members at all stages of the process, from collection to sale of compacted plastic, a sense of belonging and shared responsibility is fostered. This empowerment not only strengthens the community's capacity to face future challenges, but also preserves its culture and its connection to the territory. By integrating modern waste management practices with their traditional worldview, the Embera Katío are able to maintain their cultural identity while adopting innovative solutions to improve their quality of life.

CONCLUSION

The Embera Katío community faces an environmental and public health crisis stemming from the accumulation of plastic waste and the lack of adequate waste management systems. This problem not only threatens their well-being, but also puts at risk their traditional way of life and their deep connection with nature. However, through the implementation of technical, social and environmental solutions, it is possible to transform this situation and lay the foundations for a more sustainable and resilient future. This comprehensive approach not only addresses current challenges, but also respects and strengthens the culture and traditions of the Embera Katío.

Environmental and public health crisis

The introduction of plastics and other non-biodegradable materials in the community has generated an ecological imbalance that affects both the environment and the health of its inhabitants. The accumulation of waste in makeshift dumps pollutes the soil, rivers, and air, while burning garbage releases toxic substances that cause respiratory diseases and other health problems. In addition, the proliferation of mosquitoes in these landfills increases the risk of diseases such as dengue and Zika, especially affecting the most vulnerable groups, such as children, pregnant women and the elderly. Faced with this situation, it is urgent to implement solutions that address both the causes and consequences of this crisis.

Technical solutions: stabilisation of the electricity supply and renewable energies

One of the key solutions to improve plastic waste management is to ensure a stable and sustainable electricity supply. The installation of voltage stabilizers and transformers will allow the plastics compactor machine to operate efficiently and continuously, avoiding interruptions that limit its processing capacity. In addition, the implementation of solar PV systems will not only reduce reliance on the power grid and fossil fuels, but will also align community practices with environmental sustainability principles. These technical solutions are essential to ensure that waste management infrastructure operates optimally and with a lower environmental impact.

Estrategias sociales: capacitación y fortalecimiento de la economía circular

Además de las soluciones técnicas, es fundamental implementar estrategias sociales que empoderen a la comunidad y promuevan un modelo de desarrollo sostenible. La capacitación en temas de reciclaje, manejo de residuos y emprendimiento permitirá a los miembros de la comunidad adquirir habilidades prácticas para gestionar los residuos plásticos de manera eficiente y generar ingresos a través de la venta de plástico compactado. Estas iniciativas no solo fortalecerán la economía local, sino que también fomentarán la economía circular, un modelo que prioriza la reutilización y el reciclaje de materiales para reducir el desperdicio y la contaminación. Al involucrar a la comunidad en estas actividades, se promueve un sentido de responsabilidad compartida y se fortalece su capacidad para enfrentar desafíos futuros.

Environmental protection and improvement of public health

The implementation of these solutions will have a direct impact on protecting the environment and improving public health. Reducing the volume of plastic waste and eliminating makeshift dumps will decrease soil, water, and air pollution, preserving local ecosystems and biodiversity. In addition, reducing garbage burning will improve air quality and decrease cases of respiratory diseases. Vector control programs, such as regular waste collection and fumigation, will reduce mosquito growth and, therefore, cases of mosquito-borne diseases. These advances will contribute to a healthier and safer environment for the entire community.

Respect for Embera Katío culture and traditions

A fundamental aspect of this comprehensive approach is respect for the culture and traditions of the Embera Katío. The proposed solutions not only seek to improve the living conditions of the community, but also to preserve its cultural identity and its connection with the territory. By integrating modern waste management practices with their traditional worldview, it ensures that solutions are culturally appropriate and sustainable in the long term. This participatory and respectful approach strengthens the empowerment of the community and its capacity to make informed decisions about its development.

Towards a sustainable and resilient future

The implementation of these solutions represents an opportunity to transform the current crisis into an opportunity for sustainable development. By addressing environmental, social, and economic challenges holistically, the foundation is laid for a more resilient future, where the Embera Katío community can thrive while protecting their environment and culture. This approach not only benefits the community, but also serves as an inspiring model for other regions facing similar challenges.

In conclusion, the plastic waste crisis in the Embera Katío community is a call to action to implement innovative and sustainable solutions. Through collaboration between the community, local authorities and allied organizations, it is possible to build a future where human well-being and environmental protection go hand in hand, respecting and celebrating the cultural richness of the Embera Katío.

REFERENCES

1. **World Bank.** (2023). *Solid waste management and its impact on vulnerable communities in Latin America.*
2. **World Health Organization (WHO).** (2023). *Effects of environmental pollution on the health of indigenous populations.*
3. **United Nations Environment Programme (UNEP).** (2022). *The impact of plastics on terrestrial and aquatic ecosystems.*
4. **Humboldt Institute.** (2023). *Biodiversity and pollution: Evaluation of the impact of plastic waste on Colombian fauna.*
5. **Colombian Air Quality Monitoring Network.** (2023). *Effects of waste burning on air quality and public health.*
6. **United Nations Children's Fund (UNICEF).** (2023). *Impact of vector-borne diseases on children in vulnerable communities.*
7. **National Health Security Agency of Colombia.** (2022). *Strategies for the prevention of dengue and other mosquito-borne diseases.*
8. **Economic Commission for Latin America and the Caribbean (ECLAC).** (2023). *Analysis of waste management in indigenous and rural communities.*
9. **Food and Agriculture Organization of the United Nations (FAO).** (2022). *Impact of plastic pollution on the food security of fishing communities.*
10. **Ministry of Health of Colombia.** (2023). *National Plan for the Control of Vector-Borne Diseases.*