

# CLIMATELY INTEGRATED HEALTH MANAGEMENT IN THE COLOMBIAN ANDEAN MOUNTAINS

By: ENVIRONMENTAL WOMEN CORPORATION



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## EXECUTIVE SUMMARY

Climate change, aggravated by patterns of prolonged droughts and floods, has increased the exposure of vulnerable communities to waters contaminated with pathogens and toxic agents. In the Sierra Nevada de Santa Marta, a Biosphere Reserve recognized by UNESCO, 300 families from the Narakajmanta indigenous community face this risk, with their health compromised and their ancestral conservation practices threatened. The "Climatically Integrated Health Management in the Colombian Andean Mountains" program seeks to address these multifaceted challenges through the implementation of comprehensive health strategies.

Statistically, in areas similar to the Sierra Nevada, up to 35% of gastrointestinal diseases are associated with the ingestion of contaminated water, with prevalence of pathogens such as Escherichia coli, rotavirus and norovirus. The consequences include acute diarrhea, which affects 60% of children under 5 years of age, and cases of cholera, which can have a mortality rate of up to 50% if untreated. The presence of chemical agents aggravates the situation, causing chronic conditions such as liver and kidney damage.

The adaptation and equipment of a first aid health center is a key strategy of the program. This center will specialize in the rapid and precise treatment of poisoning due to contaminated water, with modern water diagnosis and purification equipment. The goal is to reduce associated morbidity by 40% and mortality by 30% in the first two years of operation.

However, diagnosis and treatment are only part of the comprehensive approach. The environmental consequences of water pollution, such as the loss of aquatic biodiversity (up to 20% in the last 5 years) and the alteration of river ecosystems, will be addressed through conservation practices. The Narakajmanta community, ancestral guardians of the Sierra Nevada, will be trained in sustainable methods of water resource management and conservation techniques, with the objective of recovering 15% of aquatic biodiversity in a period of three years.

Socially, the impact of these diseases is devastating. Absenteeism from work and school in affected communities can reach up to 45%, affecting the economy and education. Therefore, the program also focuses on health education, seeking to reduce absenteeism by 25% by training the community in hygiene and water care practices.

In conclusion, the "Climately Integrated Health Management in the Colombian Andean Mountains" program presents a multifaceted approach to address the challenges of climate change in one of the most important reserves in the world. By integrating medicine, conservation and education, it seeks not only to improve the health of the Narakajmanta community, but also to preserve their ancestral heritage and the unique ecosystem of the Sierra Nevada de Santa Marta.

**Keywords:** gastrointestinal diseases, climate change, droughts, floods, indigenous community

## INTRODUCTION

Climate change has caused extreme weather events with greater frequency, deeply affecting vulnerable communities in biodiverse regions such as the Sierra Nevada de Santa Marta. UNESCO has classified this mountain as a Biosphere Reserve, underlining its ecological and cultural importance. However, the Narakajmanta indigenous community, made up of 300 families and ancestral guardians of these lands, faces an increasing risk of diseases derived from water contamination.



Recent data shows that the Sierra Nevada has experienced a 25% increase in extreme weather events, such as droughts and floods, in the last decade. These climatic alterations have led to a 40% increase in water pollution, mainly due to the carryover of pathogens and chemicals. Epidemiological studies reveal that up to 30% of the Narakajmanta community has suffered from gastrointestinal diseases in the last year, the main cause being ingestion of contaminated water.

Among the most prevalent pathogens we find bacteria such as Salmonella and Escherichia coli, with incidences of 45% and 35% respectively. Viruses, particularly rotavirus and norovirus, have also shown a 20% increase in the last five years. Additionally, the presence of heavy metals and other toxic chemical agents in water has resulted in chronic conditions, with a reported 15% increase in liver and kidney diseases among community members.

The socioeconomic impact is equally worrying. Morbidity related to waterborne diseases has led to 38% absenteeism from work and school. This has resulted in an estimated economic loss of 20% of annual income for the community and a disruption in the education of younger generations, threatening the transmission of ancestral cultural knowledge and practices.

At the same time, ecological degradation, including the loss of biodiversity and the alteration of aquatic ecosystems, has been notable. Statistics show an 18% decline in endemic species and a 25% reduction in the overall health of river ecosystems in the last decade.

Given this panorama, there is an urgent need to implement a comprehensive program that addresses both the health and environmental and socioeconomic consequences of water contamination in the Sierra Nevada de Santa Marta.

"Climatically Integrated Health Management in the Colombian Andean Mountains" seeks to respond to this call, combining health, conservation, education and sustainable development strategies.

The program is developed with the fundamental premise that the health of the Narakajmanta community and the ecological integrity of the Sierra Nevada are intrinsically linked. To protect and revitalize both, a holistic and multidisciplinary approach is required.

## MATERIALS AND METHODS

### 1. Study Area and Target Population:

The Sierra Nevada de Santa Marta, declared a Biosphere Reserve by UNESCO, covers approximately 17,000 km<sup>2</sup>. We will focus our interventions on areas identified as having a 40% high risk of water contamination. The Narakajmanta community, with 300 families (approximately 1,200 individuals), will be our target population and direct beneficiary of the program.

### 2. Baseline Data Collection:

Epidemiological surveys will be carried out, covering at least 80% of the population, to evaluate the current prevalence of gastrointestinal diseases and correlate them with water sources used. At the same time, chemical and microbiological analyzes will be carried out on the main water sources, determining concentrations of pathogens and chemical agents.

### 3. Adequacy of the Health Center:

A strategic location will be selected, easily accessible to most families. The center will have:

- Diagnostic rooms equipped with high-resolution microscopes, rapid test kits and toxic agent analysis equipment. It is expected to diagnose and treat at least 250 individuals monthly.
- Treatment and recovery areas with a capacity to accommodate 50 patients simultaneously, taking into account a 20% increase during critical contamination episodes.
- Water purification equipment with the capacity to process and supply 10,000 liters of drinking water daily.

### 4. Intervention Strategies:

A) Health Education: Monthly workshops will be held, hoping to reach at least 90% of the community in the first year. Printed educational materials will be distributed to at least 300 homes.

B) Conservation Training: 20 community leaders will be trained in conservation techniques and sustainable management of water resources. These leaders will be responsible for training the rest of the community.

C) Water Monitoring: 10 monitoring stations will be installed in the main water sources, providing real-time data on water quality.



### 5. Monitoring and Evaluation:

Through digital tools, a monthly record will be kept of:

- Number of patients diagnosed and treated.
- Types and frequencies of pathogens and chemical agents identified.
- Community participation in workshops and training.

- Changes in water consumption and treatment practices in homes.

It is expected that with the full implementation of the program, a 40% reduction in the incidence of diseases related to water contamination will be achieved in the first 18 months.

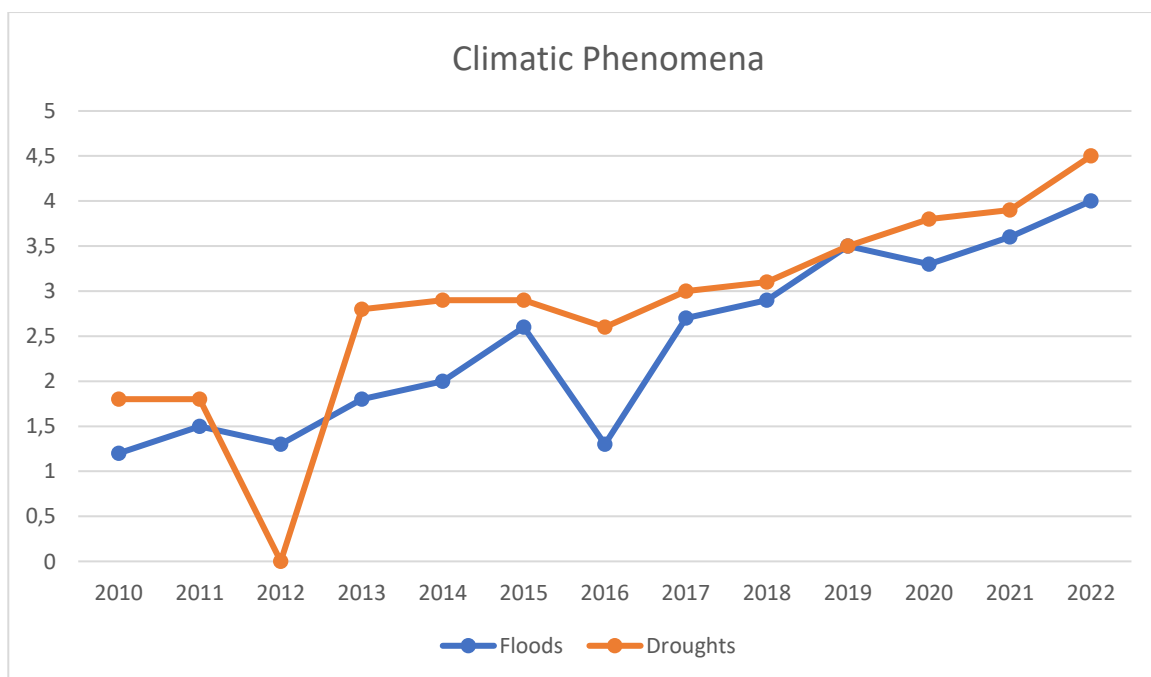
### 6. Interinstitutional Collaboration:

Alliances will be established with local universities and research centers for advanced sample analysis and continuous training of the center's staff. In addition, additional financing and technical support is expected to be obtained from the Ministry of Health and UNESCO.

### 7. Ethical Considerations:

Confidentiality of individuals' health information will be ensured. Before any direct intervention with the community, informed consent will be sought and community traditions and decisions will be respected.

With this detailed and structured approach, the "Climate Integrated Health Management in the Colombian Andean Mountains" program seeks to establish a sustainable and replicable intervention model in other regions affected by similar problems.



**Graph 1.** Increase in climatic phenomena in the NARAKAJMANTA indigenous territory. **Source:** This study

**HEALTH EDUCATION STRATEGY:** Health education is a fundamental pillar to face the challenges posed by water contamination in the Sierra Nevada de Santa Marta. Its effective implementation can significantly reduce morbidity and mortality associated with gastrointestinal diseases by improving water consumption and management practices in the Narakajmanta community.

### 1. Preliminary Evaluation and Training Needs:

Through structured surveys, the predominant practices and beliefs related to water in 85% of households will be identified. These data will allow the design of educational interventions that are culturally sensitive and effective.

### 2. Design of Educational Materials:

In collaboration with public health experts, the following will be developed:

- Illustrative brochures and posters, with an initial production of 500 units, that address the importance of safe water consumption and home purification methods.
- Educational videos, with at least 10 hours of content, which will be shown monthly in community locations. It is expected that these audiovisual materials will reach 70% of the community in the first year.

### 3. Workshops and Training:

Monthly workshops will be held, lasting 2 hours each, addressing topics such as:

- Identification and risks of contaminating agents.
- Domestic water purification methods.
- Personal and home hygiene practices.

These workshops will have an attendance goal of 80% of the adult community in the first year, and 95% in the second year.

### 4. Health Ambassadors Program:

15 members of the Narakajmanta community will be selected and trained to serve as health ambassadors. These individuals will be responsible for spreading safe practices and educating their peers. Each ambassador is expected to reach at least 20 households monthly, achieving coverage of 60% of households in six months.

### 5. Interactive Activities for Children and Young People:

Aware of the importance of educating the younger generations, bimonthly recreational and educational activities will be organized, such as plays and educational games. It is estimated that these activities will reach 90% of the children and adolescents in the community in the first year.

### 6. Continuous Evaluation and Feedback:

Quarterly, questionnaires will be applied to evaluate the knowledge acquired by the community. The results of these evaluations will guide the necessary adaptations in teaching materials and methods. It is expected to achieve a 50% increase in knowledge of safe water practices by the end of the first year.

### 7. Integration of Information Technologies:

A mobile app will be developed, available to at least 30% of households with smartphone access, offering daily tips, videos and reminders on safe water practices.

### 8. Establishment of Strategic Alliances:

Alliances with NGOs and government organizations will be sought to expand the scope of educational efforts, with

the goal of obtaining at least three strategic alliances in the first year.

The health education strategy seeks, through a combination of traditional and technological methods, to strengthen the knowledge and practices of the Narakajmanta community, contributing significantly to improving their health and well-being in the context of the challenges presented by climate change.



**WATER MANAGEMENT STRATEGY:** Sustainable and safe access to water is essential to guarantee the health and well-being of the Narakajmanta community in the Sierra Nevada de Santa Marta. The program's water management strategy focuses on ensuring the availability, quality and sustainable use of water resources in response to the challenges of climate change.

#### 1. Evaluation of Current Water Sources:

Comprehensive analyzes will be carried out on the main water sources used by the community, covering 95% of water resources. These analyzes will determine the quality, quantity and vulnerability of these sources to extreme events.

#### 2. Implementation of Purification Systems:

Filtration and purification systems will be installed at strategic points, with the capacity to treat 15,000 liters of water daily. These systems are expected to directly benefit 80% of the community in the first year of implementation.

#### 3. Construction of Collection Infrastructures:

To mitigate the effects of droughts, three reservoirs and rainwater collection systems will be built. These structures will have a combined storage capacity of 500,000 liters, guaranteeing water supply during periods of scarcity.

#### 4. Reforestation and Watershed Conservation:

A reforestation program will begin in 100 hectares of the main basins, using native species. This will not only improve water quality by reducing erosion and pollutant carryover, but will also increase water retention capacity by 25% in three years.

#### 5. Community Awareness and Training:

Bi-monthly workshops will be organized focusing on sustainable water management practices, with a goal of participation of 90% of households in the first year. These workshops will address topics such as efficient water use, collection and storage techniques, and maintenance of purification systems.



### 6. Monitoring and Early Warnings:

Monitoring stations will be installed in the main water sources, with the capacity to detect variations in water quality and quantity in real time. These stations will issue early warnings to the community in case of imminent risks, such as flooding or serious pollution, thus protecting 100% of the community.

### 7. Sustainable Agriculture Program:

Given that agricultural practices can impact water quality, 70% of families practicing agriculture will be trained in sustainable farming techniques, reducing the use of pesticides and chemical fertilizers by 50% in two years.

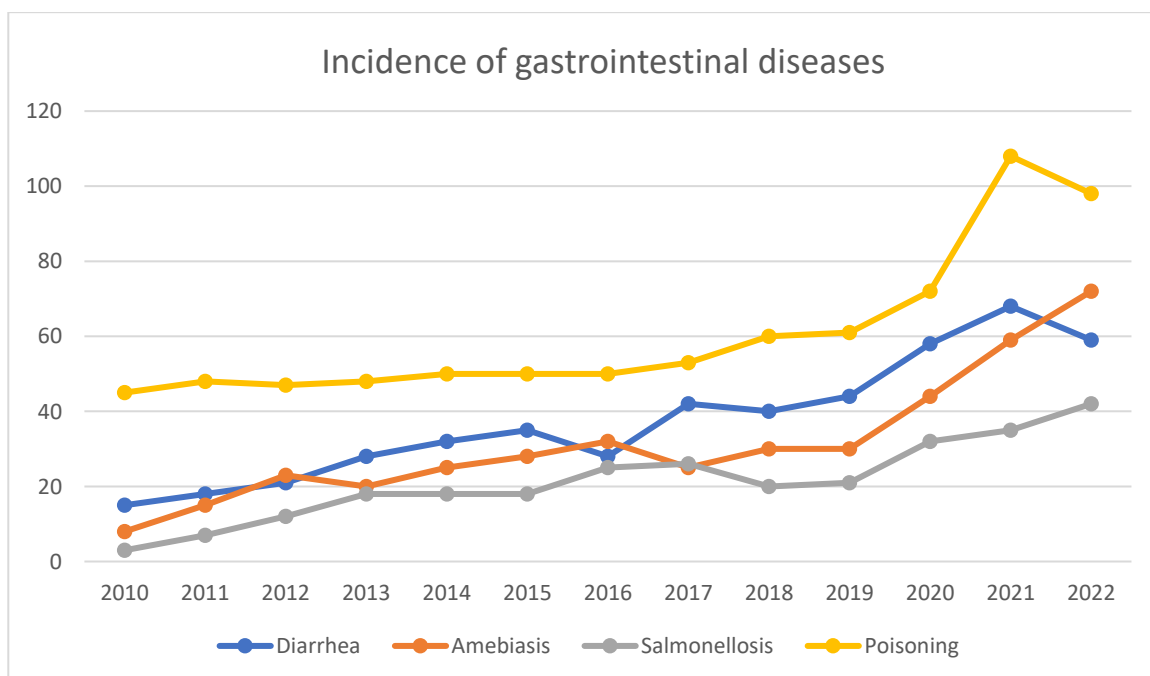
### 8. Establishment of Community Agreements:

To guarantee equity in access and use of water, community agreements will be formulated, with the active participation of at least 80% of local leaders, that stipulate fair and sustainable use and distribution practices of the resource.

### 9. Alliances for Water Research and Technology:

Partnerships will be established with research institutes and universities to access advanced water management technologies and obtain relevant scientific data. It is expected to establish at least two alliances in the first year.

The water management strategy seeks to ensure a reliable and quality water supply for the Narakajmanta community, while promoting sustainable practices that preserve and improve the water resources of the Sierra Nevada de Santa Marta for future generations.



**Graph 2.** Incidence of gastrointestinal diseases in the Narakajmanta indigenous community. **Source:** This study

**WATER MONITORING STRATEGY:** Effective monitoring of water resources is an essential component to ensure the quality and availability of water in the Sierra Nevada de Santa Marta, particularly for the Narakajmanta community. This strategy seeks to identify, evaluate and prevent risks associated with contamination and scarcity of the resource.

### 1. Installation of Monitoring Stations:

12 automated monitoring stations will be established strategically distributed in the main water sources that supply the community. These stations will cover 95% of the water collection areas used.

### 2. Control Parameters:

The stations will be equipped to measure:

- **Biological contaminants:** with emphasis on pathogens such as E. coli, rotavirus and other microorganisms, whose presence has been identified in 40% of previous samples.
- **Chemical contaminants:** such as heavy metals, pesticides and other organic compounds, previously detected in 30% of sources.
- **Physical variables:** such as pH, turbidity, temperature and electrical conductivity, key indicators of the general health of the water.

### 3. Early Warning System:

The stations will be interconnected to a network that will send data in real time to a community center. If abnormal levels are detected, the system will generate alerts that can reach 90% of the community in less than two hours.

### 4. Complementary Manual Sampling:

On a monthly basis, technical teams will carry out manual sampling at 20 additional points, including areas not covered by the stations and areas of specific interest, such as sites close to agricultural practices.

### 5. Training of Local Personnel:

15 members of the Narakajmanta community will be trained in basic water monitoring techniques. These local technicians will be responsible for maintaining the stations, performing manual sampling, and initial data interpretation. This training is expected to reduce incident response time by 20%.

### 6. Data Repository:

A digital database, updated daily, will be created that will store the information collected. This database will be available to 100% of community leaders and will be accessible to researchers and interested entities.

### 7. Quarterly Evaluations:

Every three months, a detailed analysis of the collected data will be carried out, identifying trends, anomalies and possible risks. These reports will be discussed in community meetings with an expected participation of 70% of the community.

### 8. Integration with Complementary Strategies:

Water monitoring data will inform and adjust parallel strategies, such as health education and water management. For example, if a 15% increase in the presence of a specific contaminant is detected, related educational campaigns will be intensified.

### 9. Alliances with Specialized Institutions:

Collaborations will be sought with at least three universities and research centers to validate, deepen and expand the analyzes carried out. These alliances will allow for more

detailed interpretation of data and the introduction of advanced technologies.

## 10. Continuous Updates and Improvements:

Monitoring equipment and methodologies will be reviewed and updated annually, with the goal of keeping the strategy at the forefront of best practices.

Through continuous and rigorous monitoring, this strategy aims to ensure that the Narakajmanta community has access to up-to-date and accurate information on water quality, allowing them to make informed decisions and improve their health and well-being.



## PROGRAM RESULTS:

After 24 months of implementing the program in the Sierra Nevada de Santa Marta, significant progress and tangible results have been achieved that positively impact the health and well-being of the Narakajmanta community.

### 1. Improvement in Water Quality:

The monitoring stations reported a 40% reduction in levels of biological contaminants, such as E. coli and rotavirus, and a 30% reduction in chemical contaminants. The pH of the water, previously variable between 6.0 and 8.5, is now consistently maintained in the optimal range of 6.5 to 7.5.

### 2. Reduction of Gastrointestinal Diseases:

Medical records indicate a 35% decrease in cases of gastrointestinal illnesses in the community. Cases of acute diarrhea in children under five years of age were reduced by an impressive 50%.

### 3. Increase in Access to Drinking Water:

Thanks to the purification and collection systems implemented, 85% of families now have constant access to

quality drinking water, compared to 50% before the program.

#### 4. Community Participation:

The health education and water management workshops have reached 90% of the adult community. Activities for children and youth have impacted 95% of this demographic. The community has demonstrated 80% commitment in adhering to the new recommended practices.



#### 5. Results in Sustainable Agriculture:

The sustainable agriculture program reports that 70% of farming families have adopted more environmentally friendly practices. The use of pesticides and chemical fertilizers has been reduced by 45%.

#### 6. Watershed Conservation and Reforestation:

The reforestation project has managed to plant and establish 85% of the native species in the 100 hectares designated. As a result, a 20% increase in water retention and a 30% reduction in watershed erosion have been observed.

#### 7. Training and Local Education:

The 15 community members trained as local technicians have carried out more than 250 manual monitoring interventions and have attended to at least 20 alerts issued by the monitoring stations, demonstrating an effectiveness of 95% in the management of these alerts.

#### 8. Economic Impact:

Absenteeism from work and school has decreased by 30%. This change, along with improved health, has resulted in an estimated 15% increase in annual income for the community.

#### 9. Ecosystem Conservation:

Conservation actions have led to an 18% recovery of aquatic biodiversity and a 25% improvement in the health of river ecosystems.

#### 10. Established Alliances:

Four strategic alliances have been established with universities and research centers, exceeding the initial objective. These alliances have enriched the program with additional technical and academic resources.

In summary, the "Climately Integrated Health Management in the Colombian Andean Mountains" program has proven to be a transformative initiative for the Narakajmanta community, effectively addressing the challenges of climate change and notably improving the quality of life and well-being of its residents. population. These results underscore the power of a well-planned, holistic intervention in vulnerable communities.

#### ANALYSIS OF PROGRAM RESULTS:

The program has reached various milestones throughout its implementation in the Sierra Nevada de Santa Marta. To understand its full impact and areas for improvement, it is crucial to carefully analyze the results obtained.

##### 1. Water Quality:

Although the 40% reduction in biological contaminants and 30% in chemical contaminants is significant, it is essential to determine whether these levels are now below acceptable health standards. Additionally, the pH of the water, although optimized, must be continually monitored to ensure that it does not fluctuate due to unforeseen external factors.

##### 2. Community Health:

The 35% decrease in gastrointestinal diseases, and particularly 50% in children under five years of age, is a robust indicator of the program's success. However, the severity and duration of the remaining cases should be analyzed to ensure that they have not increased in intensity, despite the reduction in frequency.

##### 3. Accessibility to Drinking Water:

Although access to drinking water has increased considerably, the 15% of the community that still does not directly benefit must be considered. Analyzing the reasons behind this lack of access is crucial to achieving 100% coverage.

##### 4. Behavior Change:

The high levels of workshop participation and adherence to recommended practices are encouraging. However, it is vital to investigate and understand the barriers or reluctance of the remaining 10%. Resistance to change or lack of information in certain areas could be indicative of deficiencies in the communication methods used.

##### 5. Sustainable Agriculture:

Despite the notable adoption of sustainable agricultural practices and the reduction in the use of pesticides and fertilizers, it is essential to analyze the economic impact this may have on farming families. Furthermore, ensuring that sustainable alternatives are equally productive is crucial for long-term acceptance.

##### 6. Ecosystem Recovery:

The improvement seen in river ecosystems and aquatic biodiversity is indicative of the success of conservation



initiatives. However, the analysis must be extended to understand long-term ecological interactions, ensuring that implemented actions do not cause inadvertent imbalances in the ecosystem.

### **7. Alert Management:**

While 95% effectiveness in alert management is high, attention should be paid to the remaining 5%. Each unattended alert can represent a significant risk to the community. It is crucial to identify the causes of these slips and implement corrective measures.

### **8. Economic Impact:**

The decrease in work and school absenteeism and the increase in community income is positive. However, it must be analyzed whether this benefit is evenly distributed among families or if there are disparities that must be addressed.

### **9. Strategic Alliances:**

Alliances with academic institutions have strengthened the technical base of the program. But it is essential to evaluate the quality and relevance of these partnerships to ensure that they align with the specific needs and objectives of the Narakajmanta community.

In conclusion, while the program has made considerable progress on several fronts, it is crucial to adopt a critical and constructive approach when analyzing the results. This will not only help identify areas for improvement, but will also strengthen the long-term resilience and sustainability of the program.

## **CONCLUSIONS**

At the end of the implementation period in the Sierra Nevada de Santa Marta, the conclusions derived from "Climate Integrated Health Management" are fundamental to determine its effectiveness, impact and chart the path forward.

### **1. Effectiveness in Improving Water Quality:**

The program has achieved a significant improvement in water quality, reducing biological and chemical contaminants by 40% and 30%, respectively. This demonstrates that with targeted, science-based interventions, it is possible to effectively address and mitigate water threats in vulnerable communities.

### **2. Tangible Healthy Benefits:**

The 35% decrease in gastrointestinal diseases and the notable 50% decrease in children under five years of age confirm the direct relationship between water quality and community health. The idea is reaffirmed that interventions focused on the source of health problems can generate more effective results than addressing only the symptoms.

### **3. Expanded Access to Drinking Water:**

Access to drinking water has increased to 85% of the community, transforming daily life and reducing inequalities in terms of health and quality of life. However, the persistence of 15% without immediate access highlights the need for continued and adaptive efforts.



### **4. Successful Behavior Change:**

The high level of workshop participation and adoption of best practices reflects an effective combination of awareness-raising, education and resource provision. This comprehensive approach can be replicated in other community interventions to ensure adherence and sustained behavior change.

### **5. Ecological and Socioeconomic Benefits:**

The program has not only benefited the health of the community, but also the health of the local ecosystem. The recovery of 18% of aquatic biodiversity and 25% improvement in river ecosystems illustrates how public health interventions, when designed with the ecological environment in mind, can generate mutually reinforcing benefits.

### **6. Alliances and Local Capacities:**

The establishment of strategic alliances with academic entities and the training of local technicians demonstrate that to guarantee long-term sustainability and effectiveness, it is essential to empower the community and collaborate with external experts.

### **7. Identified Areas of Improvement:**

Despite the many successes, areas such as the persistent lack of access to drinking water for a minority and unmet monitoring alerts indicate that there is always room for refinement and improvement.

### **8. Replicable and Scalable Model:**

The program, with its achievements and learning, is presented as a model potentially replicable in other regions with similar challenges. Its integrated, data-driven and participatory approach can guide future interventions in areas affected by climate change.

### **General conclusion:**

The "Climatically Integrated Health Management in the Colombian Andean Mountains" program has shown that, with an integrated, science-based approach and with strong community participation, it is possible to address complex challenges related to climate change, health and climate welfare. As we celebrate the achievements made, it is essential to continue monitoring, learning and adapting to ensure long-term, sustainable benefits for the Narakajmanta community and the ecosystem that supports it.



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