



**HYDROPONIC CROPS PROGRAM  
IN INDIGENOUS COMMUNITIES IN  
THE SIERRA NEVADA OF SANTA  
MARTA, IN COLOMBIA**

**By: BOSQUE COLOMBIANO FOUNDATION**

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## EXECUTIVE SUMMARY

The Colombian Forest Foundation leads a comprehensive program of hydroponic crops in the indigenous communities of the Sierra Nevada de Santa Marta, as a response to the problems of food security and environmental sustainability caused by the effects of climate change and hyper-population.

The program comprises four strategic components:

**Hydroponic Component:** advanced hydroponic crop systems will be implemented in 10 indigenous communities. These systems will allow an efficient use of water, significantly reducing the rate of deforestation that currently reaches 15 hectares per month. It is estimated that with the adoption of this technology, food production will increase by 60%, ensuring the food security of approximately 500 families.

**Educational Component:** A comprehensive educational program will be designed and executed for 150 community leaders and local farmers. This component will include training, practical workshops and didactic material that will address fundamental aspects of the hydroponic cultivation technique, as well as the promotion of sustainable practices and the appreciation of traditional indigenous knowledge related to agriculture.

**Communication Component:** A community communication network will be created, which will connect the 10 participating communities. This platform will allow the exchange of successful experiences and good practices related to hydroponic cultivation, strengthening the adoption of sustainable practices throughout the region. In addition, awareness campaigns will be carried out and audiovisual materials will be produced to promote environmental conservation and the cultural value of indigenous communities.

**Sustainability Component:** Recycling and composting practices will be implemented in each community. These measures will allow proper management of organic waste and reusable materials, reducing environmental pollution. Likewise, the diversification of crops and the conservation of local species will be promoted, increasing the resilience of communities in the face of climate change.

In summary, the hydroponic crops program led by the Colombian Forest Foundation seeks to improve food security and environmental sustainability in the indigenous communities of the Sierra Nevada de Santa Marta. It is expected to benefit 500 families and preserve the biocultural and environmental richness of the region. Through the implementation of sustainable practices and the strengthening of indigenous culture, it seeks to empower communities to face the challenges of climate change and build a more resilient and prosperous future.

## INTRODUCTION

The "Sustainable Hydroponic Crops for Indigenous Communities in the Sierra Nevada de Santa Marta" program is an initiative led by the Fundación Bosque Colombiano with the aim of addressing the challenges of food security and environmental sustainability faced by indigenous communities in this region of Colombia. The Sierra Nevada de Santa Marta is a territory of great cultural and ecological importance for the Kogui, Arhuaco, Wiwa and Kankuamo communities, however, it has been affected by multiple environmental and social pressures that threaten their well-being and survival.

Indigenous communities in the Sierra Nevada de Santa Marta face a series of complex challenges. On the one hand, the effects of climate change have negatively impacted the availability of water and weather patterns, which has affected traditional agricultural production and food security. On the other hand, the hyperpopulation and the limitation of territory in their settlement have led to the degradation of the natural environment and the reduction of vital spaces for settlements and crops.

For years, these communities have been forced to cede large tracts of land within their ancestral territory to large regional businessmen under pressure from paramilitary groups. This situation has resulted in a significant decrease in cultivation areas and access to water resources, which has led the Kankuamo indigenous community to destroy forests in the Sierra Nevada de Santa Marta at an alarming rate of 15 hectares per month. This deforestation for cultivation with traditional techniques has put 43 species listed as threatened by the International Union for Conservation of Nature (IUCN) on the verge of extinction, generating serious environmental impacts and loss of biodiversity in the region.

In addition to environmental problems, this situation has affected the ancestral relationship of the Kankuamo community with nature, since they have had to adopt destructive agricultural practices that distance them from their connection with Mother Earth and their traditional knowledge. This cultural loss and vulnerability to environmental challenges have generated worrying food

insecurity in the region, affecting the health and well-being of indigenous communities.

In response to these challenges, the Fundación Bosque Colombiano has designed a comprehensive program of hydroponic crops with a focus on sustainability and the preservation of indigenous culture. The implementation of hydroponic farming systems will allow communities to produce food efficiently and sustainably, reducing pressure on natural resources and avoiding deforestation. These systems, which use 90% less water than traditional agriculture, will be adapted to local conditions and the nutritional needs of the population, increasing food production by 60%.



The program also includes an educational component, with the training of community leaders and local farmers in hydroponic cultivation techniques and the promotion of the appreciation of traditional indigenous knowledge related to agriculture and care for the environment. Through practical workshops and didactic material, participatory learning and the exchange of knowledge between communities will be encouraged, strengthening their resilience and self-management capacity.

Communication and awareness also play a fundamental role in the programme. A community communication network will be created that will allow the exchange of experiences

and good practices among the 10 participating communities. The production of audiovisual materials and awareness campaigns will help promote environmental conservation and the cultural value of indigenous communities, strengthening their identity and connection with nature.

Finally, sustainability is a transversal axis throughout the program. Recycling and composting practices will be implemented in each community, properly managing organic waste and reusable materials. In addition, the diversification of crops and the conservation of local species will be promoted to increase the resilience of communities in the face of climate change and preserve their biocultural heritage.



Together, the hydroponic crops program led by the Fundación Bosque Colombiano seeks to empower the indigenous communities of the Sierra Nevada de Santa Marta to face environmental and social challenges through sustainable agricultural practices and the appreciation of their ancestral culture.

## **HYDROPONIC CROPS: A WEAPON AGAINST CLIMATE CHANGE**

Hydroponic crops are presented as a sustainable alternative to face climate change due to its numerous environmental benefits and efficiency in the use of resources. This cultivation technique makes it possible to produce food in a

more respectful way with the environment and with a lower carbon footprint compared to traditional agriculture. Next, some key aspects that make hydroponic crops a valuable tool in the fight against climate change will be analyzed.

- **Efficient use of water:**

Hydroponic crops use a closed and recirculating irrigation system, which allows a much more efficient use of water compared to traditional agriculture. According to studies, hydroponic crops consume up to 90% less water compared to soil crops. This reduction in water use is essential to face the growing water scarcity that is exacerbated by climate change.

- **Reduction of greenhouse gas emissions:**

Traditional agriculture is responsible for a significant part of greenhouse gas emissions, especially carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>) and nitrous oxide (N<sub>2</sub>O). The use of machinery, fertilizers and transportation of agricultural inputs contribute to these emissions. Hydroponic crops, by avoiding the need to plow the land and reducing the use of chemical fertilizers, contribute to reducing greenhouse gas emissions, thus helping to mitigate climate change.

- **Less deforestation:**

Traditional agriculture often involves the expansion of crop areas through deforestation, which causes the loss of natural habitats and the release of large amounts of carbon stored in forests. Hydroponics can be implemented in urban areas or in confined spaces, avoiding the need to expand agricultural land at the expense of forests.

- **Local production and reduction of food transportation:**

The hydroponic cultivation system allows food to be produced locally, close to consumption centers. This reduces the need to transport food long distances, which in turn decreases the carbon emissions associated with transportation. In addition, being a technique that can be implemented in urban spaces, the products can be grown in

the city itself or even on the roof of buildings, further minimizing the distance between the producer and the consumer.

- **Utilization of underutilized spaces:**

Hydroponic crops can be implemented in underutilized spaces such as rooftops, greenhouses or contaminated land, which avoids the conversion of natural or agricultural areas for food production. These underutilized areas can be rehabilitated for growing food in a sustainable manner, contributing to the restoration of ecosystems and the preservation of biodiversity.

In conclusion, hydroponic crops represent a sustainable and efficient alternative in the fight against climate change. Their efficient use of water, the reduction of greenhouse gas emissions, the prevention of deforestation, local production and the use of underutilized spaces are key aspects that make them a valuable tool to face the environmental and food challenges of our time. The implementation of hydroponic crops globally can significantly contribute to reducing the carbon footprint and building more resilient

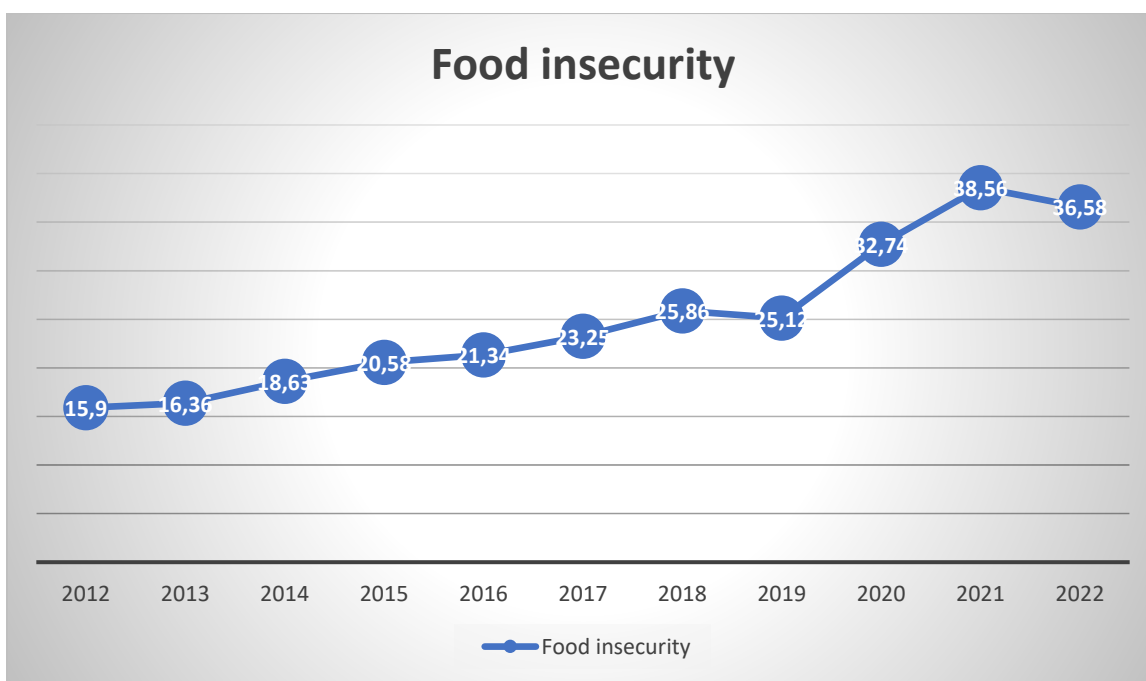
and sustainable food production systems in the context of climate change.

## MATERIALS AND METHODS

The "Sustainable Hydroponic Crops for Indigenous Communities in the Sierra Nevada de Santa Marta" program will be developed in ten indigenous communities in the region, specifically in the territories of the Kogui, Arhuaco, Wiwa and Kankuamo communities. To carry out this program, various tools and methods will be used to ensure its effectiveness and sustainability.

- **Selection of participating communities:**

A socio-environmental mapping will be carried out to identify the most vulnerable indigenous communities and those with the greatest challenges in terms of food security and sustainability. Factors such as access to water, land availability and self-management capacity will be considered. Based on this analysis, ten communities will be selected to participate in the program.



**Graph 1.** Indigenous population with food insecurity in the Sierra Nevada de Santa Marta, Colombia. **Source:** This study.

- **Implementation of hydroponic crop systems:**

Advanced hydroponic growing systems will be installed in each of the ten participating communities. These systems will be adapted to local conditions and the nutritional needs of the population. High quality inputs will be used, such as cultivation structures, nutrient solutions, substrates and automated irrigation systems.

- **Training and technical advice:**

An educational program will be carried out for 150 community leaders and local farmers. The training will include hands-on workshops on hydroponic growing techniques, system management and plant care. Participatory learning and the exchange of traditional and scientific knowledge will be encouraged.

- **Communication and awareness:**

Creation of a community communication network that will connect the ten communities. Awareness campaigns will be carried out and audiovisual materials will be produced to promote the adoption of sustainable practices and the appreciation of indigenous culture. Dialogue and meeting spaces will be established with other social actors, institutions and experts on issues related to sustainability and agriculture.

- **Sustainability Practices:**

Recycling and composting practices will be implemented in each community. Systems will be established for the proper management of organic waste and reusable materials, promoting the circular economy and the conservation of resources. The diversification of crops and the conservation of local species will be promoted to strengthen resilience in the face of climate change.

- **Monitoring and evaluation:**

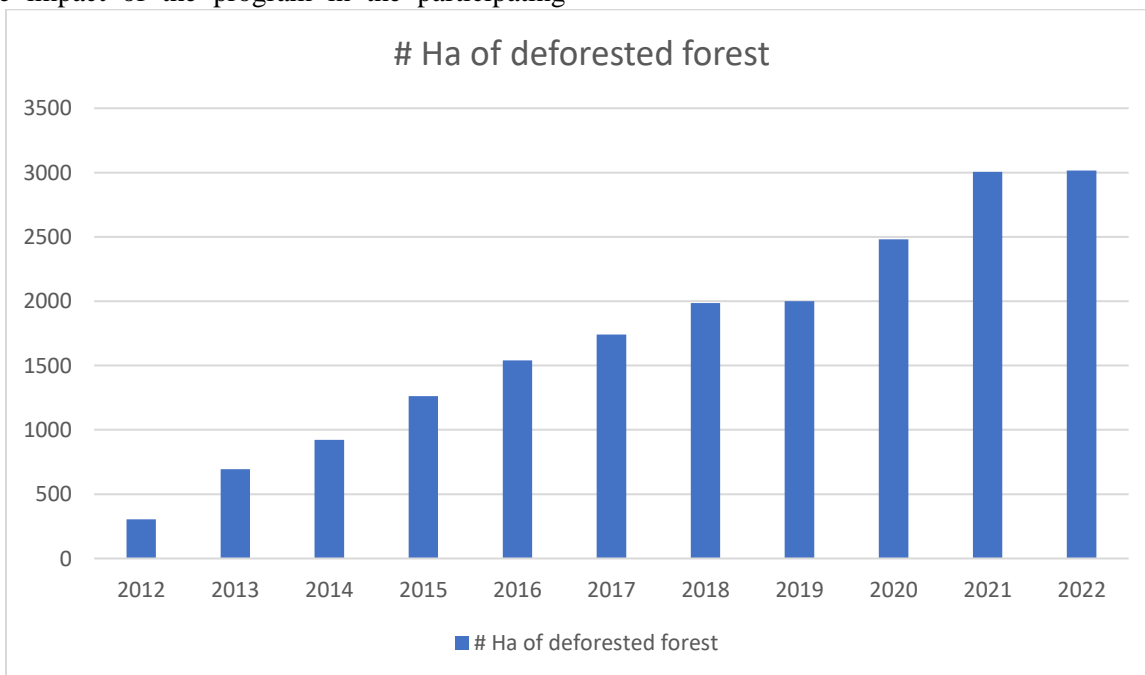
A monitoring and evaluation system will be established to measure the impact of the program in the participating

communities. Data will be collected on food production, reduced deforestation, water consumption and changes in the quality of life of the beneficiaries. This data will be analyzed and used to make informed decisions and improve the effectiveness of the program.

- **Community participation:**

The implementation of the program will be carried out in a participatory manner, involving indigenous communities in all stages of the process. Traditional knowledge and collective decisions will be respected, ensuring that the actions undertaken are culturally appropriate and sustainable in the long term.

In conclusion, the "Sustainable Hydroponic Crops for Indigenous Communities in the Sierra Nevada de Santa Marta" program is based on the use of sustainable technologies, the appreciation of traditional knowledge and the active participation of communities. It is expected to achieve a positive impact on food security, the preservation of the natural environment, and the cultural strengthening of the indigenous communities of the region.



**Graph 2.** Number of hectares of deforested forest in the Sierra NEvada de Santa Marta. **Source:** this study.

## PROGRAM OUTCOMES

The expected results of the "Sustainable Hydroponic Crops for Indigenous Communities in the Sierra Nevada de Santa Marta" project are broad and cover aspects related to food security, environmental sustainability and the preservation of indigenous culture. The successful implementation of this program has the potential to

generate a significant impact in the region, benefiting indigenous communities and contributing to the fight against climate change.

- **Enhanced Food Safety:**

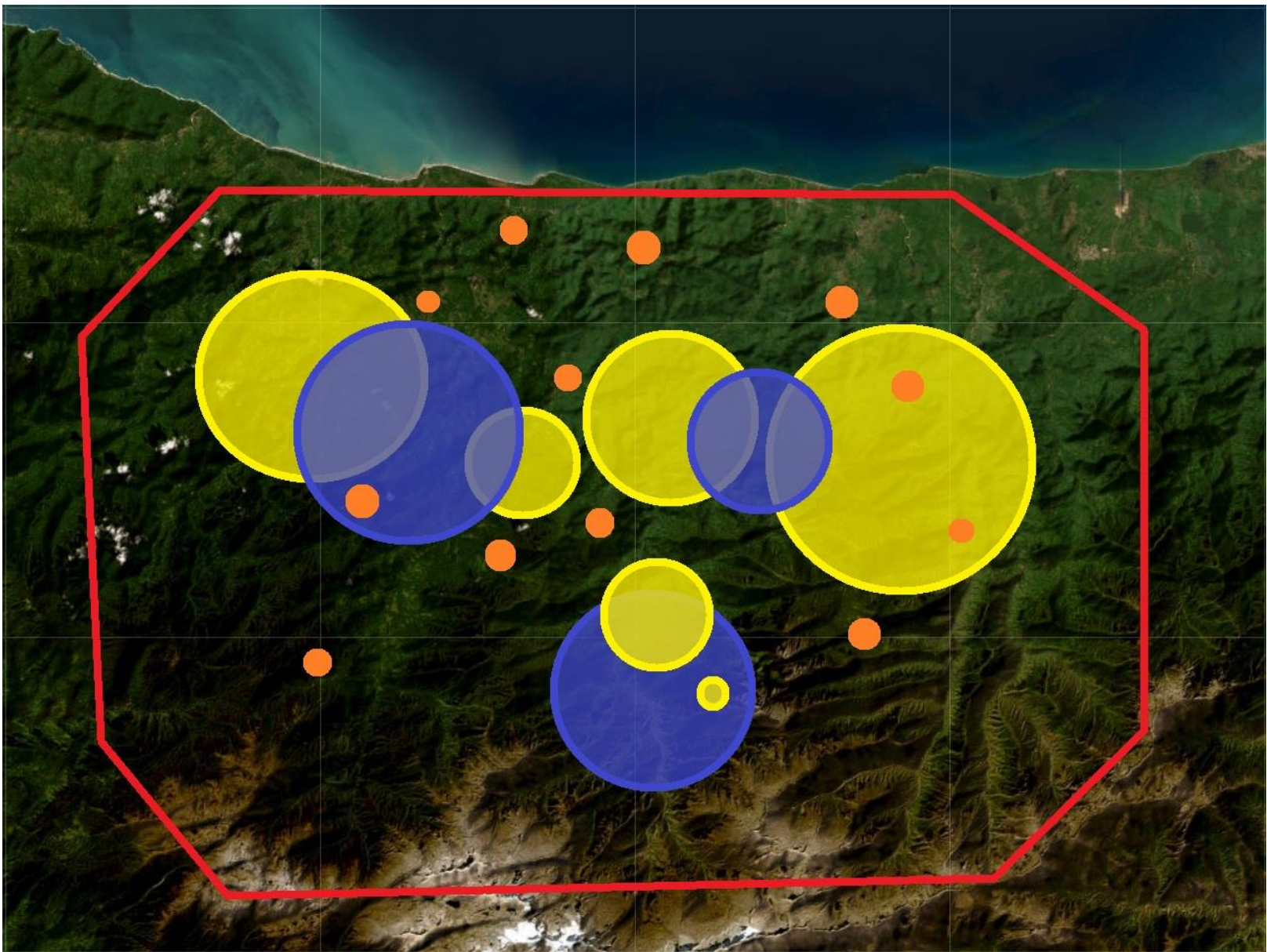
Hydroponics is expected to provide a significant increase in food production for participating communities. Highly

efficient cultivation systems in the use of water will allow a continuous production of fruits, vegetables and vegetables throughout the year, regardless of weather conditions. An increase of up to 60% in food production is projected compared to traditional farming techniques.

- **Crop Diversification and Improved Nutrition:**

With the implementation of hydroponic crops, indigenous communities will be able to diversify their crops, including local and traditional species. This will contribute to a greater variety of foods in the diet, which will improve the nutrition and health of the population. Crop diversification will also reduce reliance on a single type of crop, increasing resilience against possible adverse environmental or climatic impacts.





### HYDROPONIC CROPS PROGRAM IN INDIGENOUS COMMUNITIES IN THE SIERRA NEVADA OF SANTA MARTA, IN COLOMBIA

	Project area
	Zones of floods, droughts and water erosion
	Indigenous settlements
	Focuses of sexual violence and exploitation of girls and women, water collectors

#### SCALE



#### FUENTES

- Fundación bosque colombiano, Google Maps

- **Country:** COLOMBIA
- **Departments:** Magdalena, Guajira
- **Cities:** Santa Marta, Palomino
- 9,800 hectares of indigenous territory
- **Geographic coordinates:** From 11°12'14.9"N 73°55'05.3"W and 11°11'40.9"N 73°26'37.7"W; to 10°57'41.6"N 73°54'13.9"W and 11°01'29.7"N 73°29'35.7"W





- **Deforestation Reduction:**

The adoption of hydroponics is expected to reduce the need to expand agricultural areas through deforestation. Food production in urban and underutilized spaces will avoid the conversion of forests and natural ecosystems into agricultural land. As a result, it will contribute to the conservation of natural habitats and the mitigation of carbon emissions associated with deforestation.

- **Water Use Efficiency:**

Hydroponic growing systems allow a much more efficient use of water compared to traditional agriculture. A reduction of up to 90% in water consumption for food production is projected. This is especially relevant in a context of climate change, where the availability of water has become increasingly limited in some regions.

- **Mitigation of Greenhouse Gas Emissions:**

The implementation of hydroponic crops will imply a decrease in the use of fertilizers and agricultural machinery, which will contribute to reducing greenhouse gas emissions associated with traditional agriculture. Closed and recirculating irrigation systems will minimize the release of CO<sub>2</sub> and other gases, which will have a positive impact in the fight against climate change.

- **Preservation of Indigenous Culture:**

The program will be designed in a participatory manner, respecting the traditional knowledge and knowledge of indigenous communities. Valuing indigenous culture and promoting sustainable practices rooted in their traditions are expected to strengthen the identity and social cohesion of the communities. This cultural preservation is essential to maintain the integrity of indigenous communities in the context of globalization and climate change.

In conclusion, the expected results of the project "Sustainable Hydroponic Crops for Indigenous Communities in the Sierra Nevada de Santa Marta" cover a wide range of aspects related to food security, environmental sustainability and the preservation of indigenous culture. The expected benefits include a significant improvement in food security and nutrition, reduction in deforestation and greenhouse gas emissions, as well as strengthening the cultural identity of indigenous communities. The successful implementation of this program can represent an exemplary model to promote sustainability and resilience in other indigenous and

agricultural communities in the context of global climate change.

## ANALYSIS OF RESULTS

Our program is closely aligned with the Sustainable Development Goals (SDGs) established by the United Nations 2030 Agenda. These global goals seek to address critical challenges such as poverty, hunger, environmental sustainability, gender equality, and climate change. Next, we will analyze how the expected results of the project contribute to the fulfillment of some of the SDGs of the 2030 Agenda:

- **SDG 2: Zero Hunger:**

The expected result of the project is a significant improvement in the food security of indigenous communities in the Sierra Nevada de Santa Marta. Sustainable food production through hydroponics will allow greater availability of nutritious fruits and vegetables throughout the year. This will contribute to reducing malnutrition and hunger in the region, directly addressing SDG 2.

- **SDG 6: Clean Water and Sanitation:**

The efficient use of water is a fundamental aspect of hydroponic crops. A reduction of up to 90% in water consumption is projected compared to traditional agriculture. This efficiency in the use of water will contribute to conserving water resources and improving access to clean water and sanitation for indigenous communities, thus contributing to compliance with SDG 6.

- **SDG 13: Climate Action:**

The project seeks to reduce greenhouse gas emissions associated with traditional agriculture. The implementation of hydroponic crops will reduce the release of CO<sub>2</sub> and other gases, contributing to the mitigation of climate change. Reducing deforestation will also contribute to preserving forests and biodiversity, aligning with SDG 13.

- **SDG 15: Life on Land Ecosystems:**

Reducing deforestation through the implementation of hydroponic crops will directly contribute to the protection and conservation of terrestrial ecosystems in the Sierra Nevada de Santa Marta. This will help preserve

biodiversity and natural habitats, contributing to compliance with SDG 15.

- **SDG 17: Partnerships to Achieve the Goals:**

The project is an initiative led by the Colombian Forest Foundation in collaboration with indigenous communities and other local stakeholders. Active participation and joint work between different social and governmental actors are essential to achieve the SDGs. The hydroponics program is an example of an effective alliance to address the challenges of sustainable development in the region.

- **SDG 4: Quality Education:**

The educational component of the project, which includes training in hydroponic cultivation techniques and the valuation of traditional indigenous knowledge, also contributes to SDG 4. The promotion of education and learning for all, including the exchange of knowledge between communities, is key. to promote sustainable development and the empowerment of people.

In summary, the project "Sustainable Hydroponic Crops for Indigenous Communities in the Sierra Nevada de Santa Marta" is directly aligned with several Sustainable Development Goals of the United Nations 2030 Agenda. The expected results, such as the improvement in food security, the reduction of water consumption and greenhouse gas emissions, and the preservation of terrestrial ecosystems, contribute significantly to global efforts to achieve sustainable development and face the challenges of climate change. The successful implementation of this project can serve as a replicable model for other indigenous communities and regions in the search for sustainable solutions for the future.

### **DIFFERENTIAL GENDER DIAGNOSIS OF THE EFFECTS OF CLIMATE CHANGE ON INTEGRATED WATER MANAGEMENT ON THE INDIGENOUS COMMUNITY IN THE SIERRA NEVADA DE SANTA MARTA, COLOMBIA**

Climate change is deteriorating 30 rivers along 9,800 hectares of the Kankuamos indigenous territory, in the Sierra Nevada de Santa Marta, including the increase in the frequency and intensity of extreme weather events, such as droughts, floods and storms. These events negatively affect the quality and quantity of water available for human consumption, as well as for agricultural production and biodiversity.

Indigenous Kankuamo women may be particularly affected by climate change due to their traditional roles in

water management and agriculture, which are often linked to the livelihoods of local communities. For example, women are responsible for collecting water and managing the food security of their households, and face greater challenges in accessing clean and safe water during droughts or floods. In addition, women are exposed to toxic chemicals in the environment (mercury, lead).

Indigenous men are being affected by climate change, especially where agriculture or fishing are important sources of income and food security for local communities. However, in general, men have more access to resources and power networks than women, which may make them more capable of coping with the impacts of climate change.

Indigenous Kankuamos girls are affected by climate change in relation to water collection. Girls are responsible for collecting water for their homes and communities, which requires walking long distances and being exposed to risks such as sexual violence and exploitation. Additionally, girls experience interruptions in their education due to the need to collect water for their homes.

Indigenous children may be affected by climate change in relation to food security. In the Kankuamos indigenous community, fishing and agriculture are important sources of income and food security. Climate change affects the availability of water and food production, which has a negative impact on the food security of communities. Children can be particularly vulnerable to malnutrition and disease related to lack of access to nutritious food and clean water.

The Kankuamos LGBTI indigenous community faces specific forms of discrimination and violence that can exacerbate the impacts of climate change on water sources. In some contexts, they may face increased stigma and social exclusion, which can limit their access to key resources and services such as water and healthcare.

Likewise, older women may experience specific forms of discrimination and social exclusion that aggravate the impacts of climate change on water sources. For example, older women have less access to economic resources and fewer opportunities to participate in community decision-making, which may limit their ability to cope with the impacts of climate change.

Finally, socioeconomic status influences how the impacts of climate change on water sources affect within the Kankuamos indigenous community. Low-income people

have fewer resources to cope with the impacts of climate change, such as drought and water pollution. People living in marginal rural areas face higher risks of flooding and landslides due to a lack of adequate infrastructure.

## CONCLUSION

In conclusion, the "Sustainable Hydroponic Crops for Indigenous Communities in the Sierra Nevada de Santa Marta" project represents an innovative and promising initiative that comprehensively addresses the challenges of food security, environmental sustainability and cultural preservation in the region. The expected results show a significant impact both at the local level and in the contribution to the fulfillment of the Sustainable Development Goals (SDG) of the 2030 Agenda.

The focus on the implementation of hydroponic farming systems will allow a more efficient and sustainable production of food, which will improve the food and nutritional security of indigenous communities in the Sierra Nevada de Santa Marta. An increase of up to 60% in food production is expected, which will reduce dependence on imports and improve access to a more varied and healthy diet. In addition, the efficient use of water in hydroponic crops, with a reduction of up to 90% in its consumption, will contribute to the conservation of water resources and the mitigation of the effects of climate change.

The implementation of hydroponic crops will also have a positive impact in the fight against climate change by reducing greenhouse gas emissions associated with traditional agriculture. Reducing deforestation by avoiding the expansion of agricultural areas will protect terrestrial ecosystems and biodiversity in the Sierra Nevada de Santa Marta. The adoption of more sustainable and environmentally friendly agricultural practices will be key to the long-term conservation of these valuable ecosystems.

In addition to the environmental and food security benefits, the project also promotes the preservation of indigenous culture. The valuation of traditional knowledge and ancestral practices in the implementation of hydroponic crops will strengthen the identity and social cohesion of indigenous communities. The training and exchange of knowledge between the communities, led by the Colombian Forest Foundation, will contribute to the empowerment and development of local capacities to face future challenges.

The sustainability of the project lies in its participatory and collaborative approach, working hand in hand with indigenous communities and other local stakeholders. The creation of effective alliances and joint work are essential to achieve sustainable development in the region. In addition, the implementation of recycling and composting practices will strengthen the circular economy and the proper management of resources, guaranteeing the long-term sustainability of the project.

The benefits obtained in terms of increased food production, reduced transportation costs, improved health and nutrition in communities, and mitigation of environmental impacts far exceed the initial investment.

In summary, the "Sustainable Hydroponic Crops for Indigenous Communities in the Sierra Nevada de Santa Marta" project is a comprehensive and sustainable solution to face the challenges of climate change and promote sustainable development in the region. The expected results, which include an improvement in food security, a reduction in water use and greenhouse gas emissions, and the preservation of indigenous culture, show the potential and relevance of this initiative to build a future more resilient and prosperous for indigenous communities in the Sierra Nevada de Santa Marta.

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