



Carbon credits as an alternative for the development of Las Damas, Alluriquín, Santo Domingo

Bonos de carbono como una alternativa de desarrollo del recinto Las Damas, Alluriquín, Santo Domingo

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Abstract

Nowadays it is of vital importance to reduce the generation of greenhouse gas emissions. Given the problem of climate change, which has led to seek solutions globally, involving environmental and economic issues, opening the market for carbon credits and green bonds. The main objective of this research was to evaluate carbon bonds as an alternative for the development of the Las Damas, Alluriquín, Santo Domingo area. Based on this, a mixed approach was used, the type of research, bibliographic and field, whose methods were inductive-deductive and historical-logical, with a non-experimental-transversal design, using the documentary review and the survey to collect the information. From the findings, it became evident that the population is unaware of the environmental services provided by the forest and carbon credits. It is concluded that one option is forestry projects through sustainable cattle ranching developing Clean Development Mechanism.

Key words: Internal control, cash, credit union.

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Resumen

En la actualidad es de vital importancia disminuir de la generación de las emisiones de gases de efecto invernadero. Dada la problemática del cambio climático, que ha conllevado a buscar soluciones de manera global, implicando lo ambiental y económico abriendo el mercado de los bonos de carbono y bonos verdes. El objetivo principal de esta investigación fue evaluar los bonos de carbono como una alternativa de desarrollo del recinto Las Damas, Alluriquín, Santo Domingo. En función a esto, se empleó un enfoque mixto, el tipo de investigación, bibliográfica y de campo, cuyos métodos fueron inductivo-deductivo y histórico-lógico, con un diseño no experimental-transversal, utilizando la revisión documental y la encuesta para recolectar la información. De los hallazgos, se evidenció que la población desconoce los servicios ambientales que les proporciona el bosque y los bonos de carbono. Se concluye que una opción son los proyectos forestales mediante la ganadería sostenible desarrollando Mecanismo de Desarrollo Limpio.

Palabras clave: control interno, valor, unión de crédito

Introduction

The increase in greenhouse gas (GHG) emissions has generated climatic alterations in the world, which is why, since the 1990s with the United Nations Framework Convention on Global Climate Change, periodic meetings have been held to monitor the planet's climate situation. In this regard, after the summit in 1997, the Kyoto Protocol (KP) is signed, which establishes limitations on the emission of Greenhouse Gases by industrialized countries, and establishes that countries can negotiate among themselves their surplus GHG emission quotas, depending on the limits that each one has granted and can compensate through carbon credits certificates. (Gamba, 2015). In this situation, the KP allows participants to reduce emissions in their countries of origin or to take advantage of the so-called flexible mechanisms: Emissions Trading, Joint Implementation and Clean Development, as well as to quantify the carbon absorbed by the so-called sinks such as forests or croplands.

In relation to the above, the Joint Implementation Mechanism is conceived, in which projects will be developed to reduce emissions or absorb emissions by managing sinks between countries in which both countries will benefit by integrating to meet their proposed goal together. In this sense, the bonds generated through the mechanism are called ERUs: Emission Reduction Units-Clean Development Mechanism (CDM), which means that a developed country acquires formal commitments to reduce or limit greenhouse gas emissions, a situation that has generated a scenario to develop emission reduction projects in developing countries (Lino and Marmolejo, 2019).

It is important to highlight the benefit of developing countries with the transfer of environmentally sound technologies provided by the most advanced countries, thus contributing to the sustainable development of the participating countries.

The International Capital Market Association (ICMA), instituted the principles under which carbon credits would be traded to promote transparency and integrity in the market, which involve best practices to guarantee revenues, a process of socio-environmental evaluation and project selection. In this sense, the carbon market is understood as "a public policy instrument to transform Carbon Dioxide (CO₂) into economic assets such as other goods, which can be traded and valued through financial instruments called carbon bonds" (Nayar and Lizarraga, 2019). Likewise, it is highlighted that the first investors in this new class of carbon bonds were the Europeans and Japanese, since they are among the countries with the highest GHG emissions (Díaz, 2016).

In this vein, the Paris Agreement prioritizes GHG reduction through this mechanism with the aim of boosting sustainable development through projects that promote the use of clean technologies in the framework of global projections for the investment of approximately one trillion dollars annually between now and the end of 2035 in carbon credits (Washington, 2017)

In the case of Ecuador, up to 2012 there are official figures from the Ministry of the Environment which registers 18 projects, among which hydroelectric projects stand out, followed by biomass-energy, methane capture, biogas-sanitary landfill, sanitary landfill and energy efficiency. The first CDM-anchored project in the country began in 2004 with the use of energy-saving light bulbs, which meant that the Ecuadorian government received close to US\$4.6 million to reduce 400,000 tons of carbon emissions (Gallegos, 2012). Likewise, in 2019, the Quito Stock Exchange (BVQ) and the Ministry of the Environment signed an agreement for the country's entry into the green bonds stock market (BVQ, 2019). This, given by the Biodiversity Finance Initiative (BIOFIN) of the United Nations Development Programme (UNDP, 2019). In that year, Banco Pichincha identified thematic bonds as an opportunity to strengthen its leadership in sustainability in Ecuador and the region, among which are the Green Bonds, which are Stock Certificates that ensure the financing of activities or projects that contribute to the mitigation of climate change.

According to data from the Ministry of Environment, Water and Ecological Transition, between 2006 and 2021, 33 projects have been offered under the CDM that received payments from the private sector for the issuance of Certified Emission Reductions (CERs) for investments in energy and waste processes.

The government is currently working on the Zero Carbon Ecuador Program, which will allow economic compensation for projects that have the potential to reduce verified greenhouse gas emissions; in exchange, interested parties will receive badges or certificates that will endorse the reduction of the carbon footprint.

Within the framework of this scenario, the objective of this research is: to evaluate carbon credits as a development alternative for the San José de las Damas, Alluriquín,

Santo Domingo area, considering the socio-ecological dynamics and the ecosystem services associated with the agroforestry systems of the territory. In this way, the analysis of the perception of the inhabitants regarding the environmental and economic benefits derived from the conservation of the forest system made it possible to generate a proposal for a scheme to access the carbon or green bonds market.

Materials and methods

The research is oriented with a mixed approach, the type of research is bibliographic and field, which allowed the documentary review and direct contact in the Las Damas Campus. The methods used were inductive-deductive, being considered inductive because it starts from the particular, the carbon bonds, to the general, the environmental services, at the same time it is also deductive because it goes from the general to the particular and historical-logical to conceive a critical work of previous research, handle them as a reference and compare them with the results. The design of this work was non-experimental - transversal, since the research did not involve the manipulation of variables, focusing only on observation in a natural environment for its analysis. Likewise, it was cross-sectional, because the data were collected at a single point in time (Hernández and Mendoza 2018). It should be noted that no manipulation of the information was carried out within the Las Damas Campus, and the data correspond to the specific period 2022.

With regard to the population and sample, a population of 101 inhabitants was established according to the INEC, 2010 Population and Housing Census, and the sample was calculated using the following formula:

$$n = \frac{Z^2 \cdot p \cdot q \cdot N}{NE^2 + Z^2 \cdot p \cdot q}$$

n= Sample size.

P= Probability of occurrence (example may be 0.5)

Q= Probability of non-occurrence (example can be 0.5)

N= Population

Z= Confidence level (between 0.90 and 0.99). 0.95 is recommended.

E= Significance level (Admissible from 0.01 to 0.9)

The sample is made up of 43 inhabitants of Recinto Las Damas.

Among the techniques and instruments used to collect information, a documentary review was used to evaluate the dynamics of CO2 capture in the San José de las Damas precinct with respect to the stock market, which was presented through a SWOT matrix. On the other hand, the survey was used through the Kobocollect application directed to the inhabitants over 18 years of age of the Las Damas precinct, it was carried out with a questionnaire of structured questions, in digital format to analyze the local knowledge

associated with the supply of environmental services derived from the existing forest systems from the environmental economics approach to "value an environmental good or service based on what individuals are willing to pay to prevent its deterioration or disappearance" (Moreno and Barreto, 2013 p. 59). This made it possible to understand the magnitude of importance that the sector's inhabitants would have on where they live and also on the expectations of social, economic and mainly environmental development. The aforementioned, considering the Millennium Ecosystem Assessment Board (Millennium Ecosystem Assessment Board, 2005). Given their importance, the linkages between ecosystem services and human well-being are presented in Figure 1, which are commonly found and includes an indication of the extent to which socioeconomic factors are likely to mediate the linkage.

Figure 1. Ecosystem changes for human well-being.



Source: Millennium Ecosystem Assessment

In this regard, these are classified into provisioning, regulating, supporting and cultural ecosystem services. Environmental services can be the provision and care of water sources, biodiversity conservation, air purification, carbon storage, ecotourism, among others (Palacios et. al., 2019).

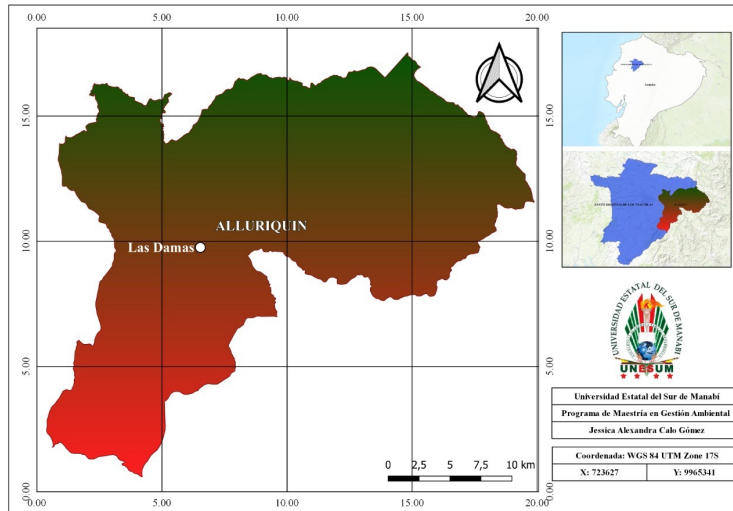
Likewise, the study area was characterized through the analysis of the ecological landscape matrix under the methodology of visual landscape analysis at a local scale (Encinas, 2000) to observe the integrity of the sector, which also includes several indicators such as: nearby water bodies, native cover, access roads, urbanization and conventional crops, which are presented below with images.

Characterization

Regarding the description and location of the San José de las Damas precinct, it is located in the Alluriquín area, which is 4556.40 m long and has a surface area of 40.20 ha, limits to the North: Santo Domingo de los Colorados Parish; to the South: Sigchos

Canton (Cotopaxi Province); Buena Fe Canton (Los Ríos Province); to the East: Metropolitan District of Quito and Mejía Canton (Pichincha Province); Sigchos Canton (Cotopaxi Province); and to the West: Santo Domingo de los Colorados Parish: Santo Domingo de los Colorados Parish.

Image 1. Map of the location of Las Damas, Alluriquín, Santo Domingo.



Source: Own elaboration

In the San José de Las Damas area, the nearby bodies of water are the Damas River, which rises in the foothills of the Andes. Andesit flows into the Toachi River and passes through the center of the town of Alluriquín.

Image 2: Nearby water bodies

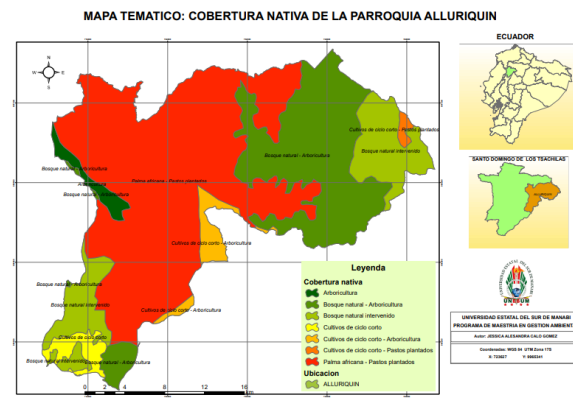


Source: Own elaboration

The climate in the sector where the main population centers are located: Unión del Toachi, Alluriquín (Recinto San José de Las Damas) and El Paraíso, has a semi-warm humid climate. It is important to note that Alluriquín mainly has forests and pastures. Sixty-one point forty-five percent of the land is pasture for cattle. In Recinto San José de Las Damas, the soil classification is class VI, non-arable land with severe limitations for irrigation, suitable for use with pasture and forest species, occasionally permanent crops may be included, 2,018 hectares. Typology of rural production land (Plan de Desarrollo y Ordenamiento Territorial Alluriquín [PDOT], 2020-2023. GAD Parroquial Rural Alluriquín).

By 2019, 46.70% of the territory was used for pasture while, in 2010, 48.71% of the territory was used for this activity; as for forests in 2019, it occupies 41.42% of the territory in relation to 2010, which occupied 48.90% of the territory, resulting in a decrease of 7.48% (5,070.79 ha) of forest cover, which means that deforestation practices continue.

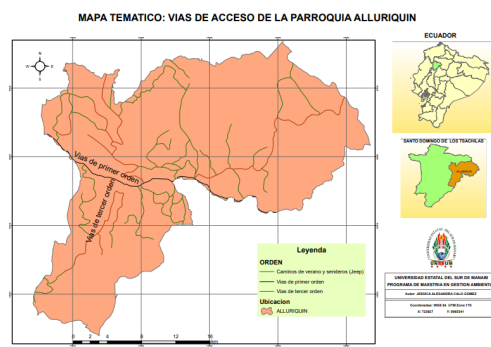
Image 3. Native coverages



Source: Own elaboration

In terms of access roads, it is connected to three important socioeconomic zones: Santo Domingo, 19 km away; Las Mercedes, 27 km away; and Sigchos (Cotopaxi), 60 km away, where the province converges with the central highlands.

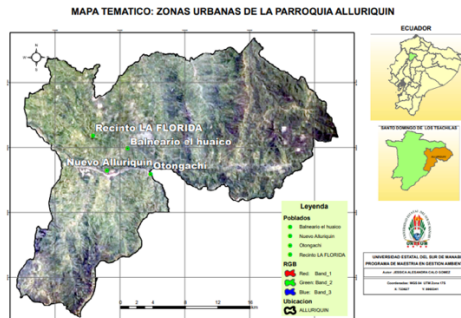
Image 4. Access roads



Source: Own elaboration

The San José de Alluriquín parish, where the San José de Las Damas compound is located, is a rural sector in which most of the houses are owned, mostly houses and a few half-timbered houses.

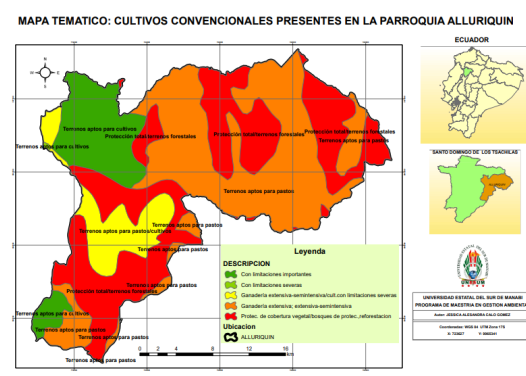
Image 5. Urbanization



Source: Own elaboration

Permanent crops make up only 0.001% of the vegetation cover, semi-permanent crops 0.627% and 4.09% is an agricultural mosaic. In terms of agricultural crops, apart from pastures, there is an emphasis on guadua, sugar cane, banana, citrus and corn (PDOT-Alluriquín 2020-2023).

Image 6. Conventional crops



















Source: Own elaboration





Results

This section presents the results of the research divided into the characterization of the environmental services of the study area, the survey applied to the population and the SWOT matrix.

Status of the provisioning, regulating and cultural services of the ecosystems analyzed based on the Millennium Ecosystem Assessment, indicating whether the service has improved or degraded.

Table 1. Status of ecosystem services in Las Damas, Alluriquín, Santo Domingo.

Services	Categories	Situation	
		Las Damas Campus	Global
<p>Of provision</p> <p>Improvement </p> <p>Increase in the production of the service or in the quantity produced per unit of measure.</p> <p>Degradation </p> <p>Current utilization exceeds sustainable levels.</p>	Crops		
	Cattle		
	Timber (Forest loss)	+/-	+/-
	Fresh water (Sustainable use for domestic consumption and risk due to constant rainfall)		
<p>Regulatory</p> <p>Improvement </p> <p>Service change to enable people to achieve greater benefits</p> <p>Degradation </p> <p>Decrease in profits due to changes in service or human pressures</p>			
	Air quality regulation	+/-	
	Climate regulation (carbon sequestration).		
	Water regulation		+/-
	Water purification (water quality)		

Cultural			
Improvement 	Aesthetic values	+/-	
Increased quantity and quality of natural areas			
Degradation 	Recreation and ecotourism	+/-	
Change in ecosystem characteristics			

Source: Millennium Ecosystem Assessment

Own elaboration.

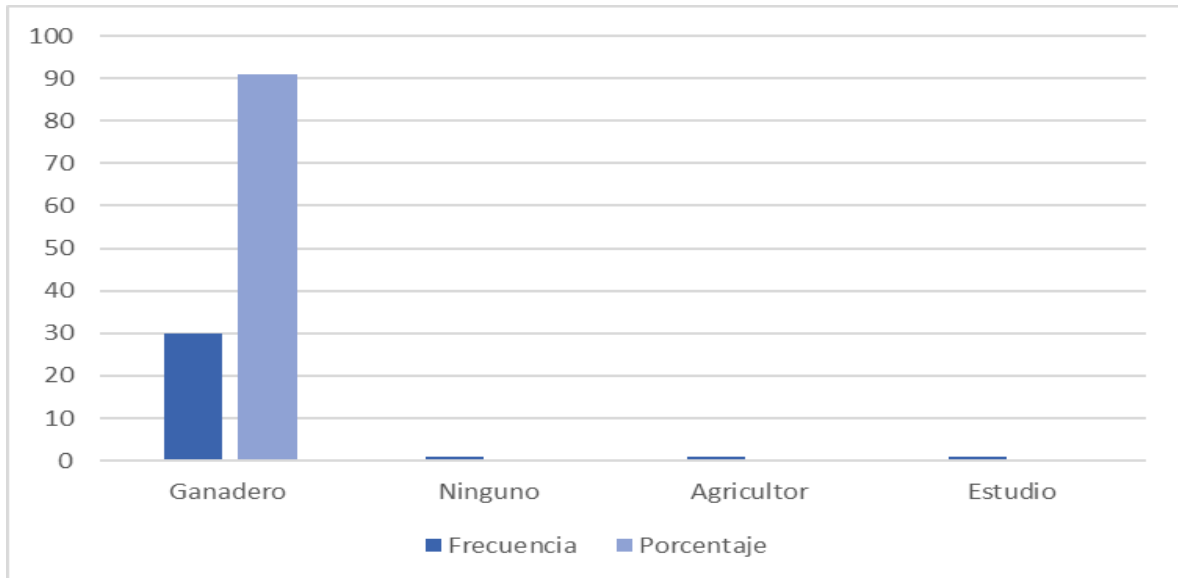
2. Data collected from the surveys, presented with a descriptive analysis reflected by categorization. However, only 35 residents who wished to participate responded, and in some questions, not all of them answered. Among the reasons for not responding were that they were not in the area and fear of giving information because they were only cowboys on the farm.

2.1 Socio-demographic category, outlines the age, sex, educational level, time living in the study area, the participants have an average age, of an average adult of 45 years and in reference to sex, most of the respondents were women. Regarding the level of education attained, most of them only have high school and none of them have a university degree. In Alluriquín, 4% of the population (368 people) have higher education, according to data from INEC, Population and Housing Census 2010. Regarding the length of time living in Recinto San José de las Damas, it was found that most people have lived there all their lives, only 2 people come to visit but do not live there permanently and only one expressed that they have lived there for more than 6 months or 1 year. It should be noted that this is a rural sector in which most of the dwellings are their own and are of the house type, according to the last census mentioned above.

2.2 Category labor, distinguishes the activity practiced with remuneration or benefit, the majority of 90.9% of the inhabitants are engaged in livestock farming, which indicates their interest in this sector, emphasizing that Alluriquín is located in the Agricultural Corridor of the province's milk (GAD Parroquial Rural Alluriquín, 2023).

Livestock production in the parish is extensive. This implies that livestock is the main commercial activity.

Figure 2. Type of work



Source: Survey, Own elaboration

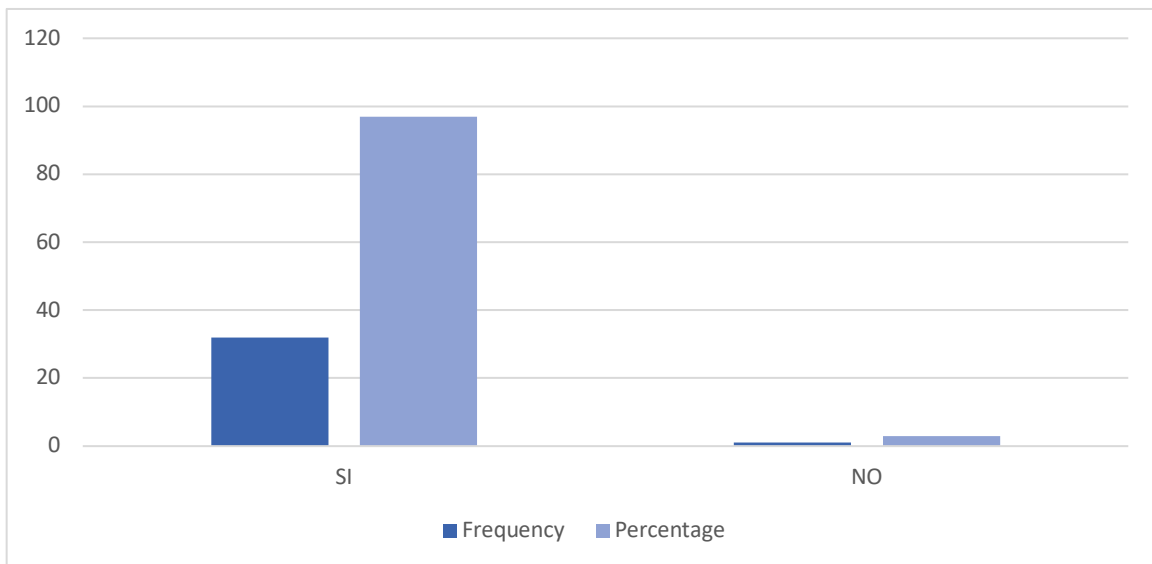
2.3 Category environmental services, of provision among which the category livestock and fresh water are increasing the production of the service, of regulation, climate regulation (carbon sequestration) stands out, in which a change in the service can be achieved so that people can obtain greater benefits. In cultural services, aesthetic values, recreation and ecotourism there is degradation change in the characteristics of the ecosystem. With respect to the respondents, it is evident that they are 100% unaware of the subject, and therefore ignore that environmental services have a direct impact on the maintenance of life, creating benefits and wellbeing for people and communities. The survey also revealed landslides and overflowing rivers, which means that excessive rainfall in the sector causes natural disasters that threaten the safety of the inhabitants.

The results show that the population agrees on the main reasons why there is no incidence of forestry and / or ecological projects, is due to the lack of interest of the authorities to publicize the economic, social and environmental benefits that would bring to the precinct, as well as others mentioned that there are no suitable professionals to generate these projects, as well as economic support from the government. This reality still disagrees with the efforts made by the national government in conjunction with the Ministry of Environment, Water and Ecological Transition to carry out CDM and the Ecuador Zero Carbon Program, still does not reach the population of the productive livestock sector of Alluriquín, which can benefit by implementing actions and measures for the quantification of greenhouse gas emissions and develop projects to mitigate GHG emissions. In the country, the green economy with tools such as Socio Bosque and REDD, in correspondence to the Rights of Nature,

points out Nieto (2018) are stripped, radicalized and distorted in a perverse way, with the purpose of commercializing the so-called environmental services.

2.4 Carbon credits category, emphasizing that 96.96% do not know about them, only one person representing 3.04% has heard about them, although, knowing the economic benefits provided by implementing ecological projects for the issuance of certificates, all agree that it is important to generate projects that safeguard and improve environmental conditions. It should be noted that no public or private institution has approached the area to talk about carbon credits and basically all of those surveyed said that there is a lack of interest on the part of the province's authorities to strengthen knowledge about the importance of this issue, which generates economic value, benefits the community and, of course, helps to conserve the environment.

Figure 3. Knowledge about carbon credits



Source: Survey.

Own elaboration

3. SWOT matrix, from the survey and the documentary review, a synthesized evaluation was made in a matrix with strengths, opportunities, weaknesses and threats, abbreviated as SWOT, which is a classic diagnostic tool oriented to analyze and solve problems with which the internal, which pertains to strengths and weaknesses, as well as the external, related to threats and opportunities of a situation or organization, are characterized and examined (Oion and Aranguren, 2021). It is of great help when making current and future decisions. The information allowed characterizing the current situation focused on the analysis and dynamics that CO2 capture would have with respect to the stock market that is taking place in Ecuador, as was also done in their research (Aguirre et. al., 2017).

Table 2. SWOT

Fortress	Opportunity
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<p>International agreements, conventions and plans to contribute to the global reduction of emissions from the local entity level that perpetuates the carbon credit market.</p> <p>The Constitution, the Plan for the Creation of Opportunities 2021-2025, promote the fight against climate change and the conservation of natural heritage. The National Pact for the Transition to Decarbonization, which will lead to the reduction of CO2 emissions through the ecological transition in order to take care of nature.</p> <p>Alluriquín's ecological and economic valuation is available through the parish government's PODT, which demarcates the socio-ecological system. In addition, there have been 21 CDM projects in Ecuador since 2004 that help conserve the environment and contribute to sustainable development, including changing the energy matrix.</p> <p>The potential of tourism as an environmental service in the area because it has a system of nine natural waterfalls, where extreme sports such as canyoning, which is the descent down the waterfalls, and rappelling, which is the descent down the mountains using specialized equipment, are practiced.</p>	<p>Ecuador's treaties with countries that demand carbon credits, including the United Nations Framework Convention on Climate Change.</p> <p>American, European and Japanese companies that generate CO2 emissions have a tendency to buy bonds in the Latin American market to mitigate environmental impacts.</p> <p>The support of the Ministry of Environment in conjunction with the Zero Carbon Ecuador Program makes the opening to the bond markets, in addition, in the Quito Stock Exchange there is sale of green bonds.</p> <p>The presence of FactorCO2, a company that provides technical consulting services and environmental markets that are effective instruments for climate sustainability.</p>
Weaknesses	Threats
<p>Lack of knowledge of the process to offer carbon certificates through forest and pasture preservation. Inhabitants of the communities are unaware of the potential of the forest,</p>	<p>A large initial investment is required for CO2 capture, and rates are generally low, which causes a restriction to be the main</p>

<p>especially in terms of providing environmental services.</p> <p>There are problems in the socio-ecological system in the parish of Alluriquín, the degradation of natural resources linked to land overuse practices, alteration of vegetation cover to expand the agricultural and livestock frontier, which have direct negative effects on native flora and fauna and alter ecosystems. In general, they cause negative consequences to nature, stimulating greater vulnerability that is expressed, among other things, in frequent landslides and soil movements that affect mobility and production and put people's lives at risk (PDOT-Alluriquín 2020-2023).</p> <p>Likewise, there is insufficient reproductive management; the use of dual-purpose cattle (milk and meat) is widespread without taking into account the characteristics of the breed; genetic improvement mechanisms are not applied; there is a lack of technological innovation in the livestock production chain; and there is very little processing of products that add value to production.</p>	<p>input for small owners in the livestock sector.</p> <p>Bureaucracy in the extensive development process for the issuance of emission reduction certificates, which involves increased costs.</p> <p>There is a potential increase in the supply of bonds that would lead to a decrease in the value of bond transactions in the market.</p>
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Source: Own elaboration.

Based on the preliminary analysis, a scheme for accessing the carbon or green bonds market was designed, which is shown in the following figure and is explained in detail by its component blocks.

Figure 3. Carbon market access scheme (green bonds)



Source: Own elaboration

To begin with, it is essential to mention that forests play a fundamental role in the reduction of atmospheric CO₂ because they fix carbon in the photosynthesis process. The parish of Alluriquín has forests and pastures, which can help reduce the carbon footprint and mitigate climate change. Reducing emissions from deforestation and degradation of native forests, through conservation activities and sustainable management of forests for their rehabilitation and carbon sequestration, could translate into economic benefits (Food and Agriculture Organization of the United Nations FAO, 2022). This is a viable option as well as the one we intend to promote in this research, through sustainable livestock farming, such as silvopastoralism, with rotational grazing techniques, where natural field production with rotational access of animals to pastures increases carbon sequestration in the soil.

Block Cattlemen's Association

In view of the cattle ranchers in the region, although there are also farmers, an association of cattle ranchers is specifically proposed for the application of carbon sequestration through optimized pasture management; so that they can be trained, a community fund can be created, agronomists and specialists can be contacted to develop the CDM project, which has a cost that can be difficult to pay for a cattle rancher.

Sustainable Livestock CDM Project Block.

Now, the Clean Development Mechanisms project, the implementation of the agrosilvopastoral system is opportune to stop erosive processes of the environment and order the system towards its economic and social improvement. This requires:

A series of requirements such as contribution to sustainable development, permanence of reductions and additionality. In this case, the implementation of the agrosilvopastoral system is opportune to stop erosive processes of the environment and order the system towards its economic and social improvement.

The document should contain the general description of the project, the methodology for the baseline, duration, validation and registration, and its acceptance. For this reason, the existence of the cattlemen's association will make the construction of the project more efficient with the help of specialists.

Company block for carbon quantification

To create the carbon credits project, verification and certification of emissions is also required, so to start with, satellite images are required, under the monitoring, reporting and verification schemes for the calculation of the quantification of the carbon to be traded and to comply with the requirements under national or international standards, which would require the hiring of a company that has a cost that may be difficult to pay for a farmer.

All of the above is a function of the "Zero Carbon" incentive level, which will be, first, quantification of the carbon footprint (level 1), then implementation of actions to reduce GHG emissions (level 2) and finally compensation of those emissions that have not been reduced, to reach carbon neutrality (level 3). (Technical Standard of the Ecuador Zero Carbon Program, 2022).

Block Bond issuers

In Ecuador, any kind of company can issue social or green bonds, regardless of the economic sector, both private and public, whether large, medium or small; to do so, they must be committed to socially responsible investments, with a sustainable strategic objective, through projects that start from scratch or advanced projects (Quito Stock Exchange, 2022).

The Quito Stock Exchange is the only one in the country that has standards for this type of issuance, provides the infrastructure for the negotiation of issues and establishes the rules to be followed by securities firms and issuers through self-regulation, both for the registration of financial instruments, as well as for their negotiation. The Superintendence of Companies, Securities and Insurance plays the role of authorizing the public offerings of Green and Social Bonds, after having concluded the whole structuring process by the securities firms.

Block Implementing the agrosilvopastoral system (Reduction of CO₂ emissions)

Once the emissions have been quantified, they must be reduced through the implementation of projects or activities to mitigate climate change, in this case with the sustainable livestock farming system. The technical standard of the Ecuador Zero Carbon Program establishes that once the requirements are met, the proponent will receive the "Carbon Footprint Reduction Certification" which will be valid for two years.

Carbon Footprint Reduction Certification Renewal Block

The CDM mitigation project may request the renewal of its carbon footprint reduction or carbon neutrality certification up to 1 year after its expiration. For the renewal, it must demonstrate the reduction or maintenance of its GHG emissions, based on

absolute indicators, in relation to its reduction year; and, it commits to submit to the National Environmental Authority the verification statement of the second year of the certification (Technical Standard of the Ecuador Zero Carbon Program, 2022).

The country, having large areas of nature, has wasted its potential to carry out CDM projects and receive compensations due to its delay in getting involved in the carbon market, and has even missed out on income that other countries, such as Costa Rica, Argentina, Colombia and Uruguay, are taking advantage of.

In Colombia, environmental compensation systems have been applied in several projects such as those of Zapata et al. (2015) and Artunduaga and Escobar (2016), with excellent results in achieving sustainable management of livestock activity. In this regard, in Ecuador, there is potential for CO₂ capture, one of these projects is "Possibilities of commercialization of carbon credits from the dry forest of the province of Loja, Ecuador" (Aguirre et. al., 2017), which demonstrates the interest not only in promoting Corporate Social Responsibility, but also in the creation of socio-ecological projects that greatly benefit those who are part of the territory that is possible to generate CO₂ capture certificates.

This situation of not having compensation systems for CDM mitigation projects is due to the lack of knowledge of 100% of the population, in this case in the San José de Las Damas area, about environmental services and 99% about carbon credits, as evidenced in the survey. In addition, the Zero Carbon Ecuador Program and the sale of green bonds on the Quito Stock Exchange were only implemented in 2021, so there is still a long way to go for large organizations to seek to mitigate carbon emissions to address global warming. This result obtained is similar in terms of the population's perception to the research of Junca et. al. (2022), in which 89.2% of the inhabitants living near the Molinos de San Roque urban wetland in Xalapa, Veracruz, interviewed do not know what an environmental service is.

In this order of ideas, it is important to note that despite the welfare that environmental services for humans can offer, they are generally studied focused on recreational or ecosystemic use, opportunity costs related to indigenous groups, aesthetic benefits and scarce research linked to carbon storage (Palacios et. al., 2019).

Based on the above, it is worth highlighting the role that livestock farming plays in the intensification of environmental problems, although, at the same time, it has the potential to mitigate them (Báez, 2018). This author also mentions that, in the Cuban livestock activity, in the political and environmental management sphere, it is considered restricted because they do not have compensation systems for good practices, such as payments for environmental services, and neither is there a carbon bond market.

On the other hand, Nayar and Lizarraga (2019), who analyzed the carbon market, how its development in Argentina in recent years is progressing; to reveal the existence or not of opportunities in the market; to consider whether economic benefits for Argentine companies concur. Within their research, they also present an investment project proposal for the implementation of a silvopastoral system. Among the results, they

determined that it is profitable to invest in an environmentally sustainable project, under certain factors and assumptions. Based on these assumptions, this free development mechanism is also viable and feasible for Ecuador and for the San José de Las Damas Campus because it has the legal support of the Constitution, the Plan for the Creation of Opportunities 2021-2025, the National Transition Pact towards Decarbonization and the Ecuador Zero Carbon program.

Vargas, et. al, (2022) in Colombia, in the La Cortadera páramo, department of Boyacá, compares an environmental assessment and another with carbon credits, highlighting the positive impact of the latter, so it organizes a protocol for the provision of the carbon sequestration service in that ecosystem and an environmental management plan to mitigate the identified impacts that would favor its recovery, conservation and sustainable development, as it would occur in the study area of this research, since the San José de Las Damas site has the environmental and socioeconomic conditions necessary to propose a CDM scenario and enter the carbon market.

In this context, the proposed scheme of access to the carbon bond market (green bonds) is applicable in research such as those of Rúa (2022), Severino et. al. (2021), León et. al. (2020), Argüello et. al. (2019), among others that require economic and environmental development through sustainability.

Conclusions

Carbon credits for the development of Las Damas, Alluriquín, Santo Domingo are an alternative that generates economic income through livestock farming and contributes to the reduction of CO₂.

The population of San José Las Damas has no knowledge about carbon credits and the environmental services associated with the forestry system, so the proposal of a scheme to access the carbon credit market for future research in rural communities serves as a guide.

In the dynamics that CO₂ capture would have with respect to the stock market in the country and the study area, the strengths and opportunities stand out above the weaknesses and threats, in which treaties and global laws seek to benefit both parties that make agreements and the planet, although the monitoring and control of these projects is in question.

The scheme for accessing the carbon credit market is based on the reality of the study area and the global context carried out by blocks in which each one has its level of complexity, especially the time for the certification of the carbon footprint, although they are achievable as other Latin American countries have achieved.

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