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REVIEW

Green innovation and territorial development in cocoa-growing communities

Innovación verde y desarrollo territorial en comunidades cacaoteras

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ABSTRACT

Introduction: this research addressed the problem of cocoa cultivation in the municipality of Roberto Payán, Nariño, a region historically affected by illicit crops and armed conflict. The main objective was to propose strategies that would allow local farmers to adopt cocoa as a main, viable and sustainable economic activity, thus displacing interest in illegal crops.
Development: the study identified multiple challenges faced by cocoa harvesters, including lack of institutional support, low profitability, competition with illicit crops and lack of knowledge about efficient production techniques. However, it was also recognised that producers possessed valuable empirical knowledge. In this context, the research promoted the adoption of green innovation as an integral solution. This allowed for the improvement of cocoa quality through sustainable practices, technical training of farmers, and the valorisation of the product at national and international level. The experience of Tumaco, a leader in cocoa production in the department, served as a reference for replicating successful models in Roberto Payán.
Conclusions: it was concluded that strengthening cocoa cultivation in Roberto Payán, with public policy support, investment in infrastructure and rural education, would allow not only economic reconversion, but also sustainable regional development. This transformation required the articulation of local, institutional and community actors, positioning cocoa as a symbol of legality, progress and territorial reconciliation.

Keywords: Cocoa; Green Innovation; Illicit Crops; Sustainability; Rural Development; Rural Development.

RESUMEN

Introducción: la presente investigación abordó la problemática del cultivo de cacao en el municipio de Roberto Payán, Nariño, una región históricamente afectada por cultivos ilícitos y conflictos armados. Se planteó como objetivo principal proponer estrategias que permitieran a los agricultores locales adoptar el cacao como una actividad económica principal, viable y sostenible, desplazando así el interés por cultivos ilegales.
Desarrollo: el estudio identificó múltiples desafíos enfrentados por los recolectores de cacao, entre ellos la falta de apoyo institucional, la escasa rentabilidad, la competencia con cultivos ilícitos y el desconocimiento sobre técnicas de producción eficiente. Sin embargo, también se reconoció que los productores poseían conocimientos empíricos valiosos. En este contexto, la investigación promovió la adopción de la innovación verde como solución integral. Esta permitía mejorar la calidad del cacao mediante prácticas sostenibles, la formación técnica de los agricultores, y la valorización del producto a nivel nacional e internacional. La experiencia de Tumaco, líder en producción cacaotera del departamento, sirvió como referente para replicar modelos exitosos en Roberto Payán.
Conclusiones: se concluyó que el fortalecimiento del cultivo de cacao en Roberto Payán, con apoyo de políticas públicas, inversión en infraestructura y educación rural, permitiría no solo una reconversión económica, sino también un desarrollo regional sostenible. Esta transformación requería la articulación de actores locales, institucionales y comunitarios, posicionando el cacao como símbolo de legalidad, progreso y reconciliación territorial.

Palabras clave: Cacao; Innovación Verde; Cultivos Ilícitos; Sostenibilidad; Desarrollo Rural.

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INTRODUCTION

This research aims to propose ideas to help cocoa farmers in the municipality of Roberto Payán grow and market their product more easily and make it much more profitable than illegal activities and crops in the region. It also seeks to strengthen agricultural development and growth in the municipality.

Cocoa harvesters in the municipality of Roberto Payán are not at a level where their product is viable. They face many discouraging factors, such as the devaluation of cocoa crops and competition from illicit crops, which is the activity most commonly practiced by farmers in the municipality. We are aware that the Nariño coast has a high percentage of hectares devoted to illicit crops due to armed groups and drug trafficking, which means that farmers do not value crops other than coca. This is the most serious problem facing cocoa harvesters.

This study aims to help cocoa harvesters, with the help of green innovation, to ensure that their product is valued so that those who are engaged in illegal activities or trades that damage and harm the soil can turn to farm and empower themselves with the wealth that exists in the municipality, which illicit crops and activities have overshadowed due to armed groups and the lack of government support to invest in training and guiding farmers to see the great potential that cocoa cultivation could have in the municipality of Roberto Payán.

Some cocoa harvesters know and have experienced first-hand how to deal with the crops. These people will be beneficial in carrying out and developing excellent, highly reliable research.

On the social side, assessing cocoa harvesters and their perception of green innovations, such as good land use and caring for the environment by working responsibly, seeks to improve the quality of cocoa production and cultivation. The study is focused on farmers and aims to help them obtain better profits.

The intention of this research is personal, as there are cocoa harvesters in my family. I see that they cultivate this product with the aim of changing the region, but the obstacles, difficulties, devaluation of cocoa, and the lack of machinery, fertilisers, and labour mean that they do not give 100 % to their crops, which is secondary to their other work activities.

It should be noted that this will also be a professional endeavor, as the research will uncover new alternatives and solutions that will benefit the farmers, who will eventually come to see this activity as their primary source of income. The goal is to make them realize the productive viability of dedicating themselves 100 % to cocoa cultivation so that there are no longer just a few hectares of cocoa.

With the help of new investments and green innovation applications, replacing coca crops with cocoa will be possible. The focus is training farmers and changing their mindset towards cocoa, promoting its economic viability and sustainability. The aim is to make the region a leader in the cocoa market through collaboration between farmers and government support. Viability

Economic and human resources and reliable sources of information are available, as there are cocoa harvesters who know and have experience in dealing with the crops. These local people will be beneficial in carrying out and developing excellent research.

Delimitation

The research will be carried out in the municipality of Roberto Payán-Nariño, emphasizing cocoa collectors in the village of Loma Linda, and will be completed in 2024.

DEVELOPMENT

According to Mena et al[1] the department of Nariño is Colombia's fifth largest cocoa producer. The municipality of Tumaco accounts for more than 70 % of cocoa production in the department. The location of the city and its agroecological conditions mean that more than 95 % of the cocoa produced can be classified as fine aroma cocoa; however, its characteristics are affected by poor processing practices applied by producers, meaning that the physical and organoleptic qualities of the cocoa are lost during the fermentation and drying processes.

This research, therefore, aims to formulate strategies to improve the quality and sustainability of cocoa. The fieldwork was carried out with the support of the Association of Cocoa Producers of Tumaco, whose members identified that most producers are unaware or unconcerned about the importance of a proper cocoa processing process that preserves the qualities of the cocoa. The lack of processing centers and instruments for measuring variables in fermentation and drying are other factors that prevent producers in this region from obtaining high-quality cocoa.

Chocolate is one of the most widely used ingredients in gastronomy. Thanks to its versatility, although it has traditionally been used in confectionery, it also perfectly complements savoury dishes. To celebrate the existence of this food, at least two days a year are dedicated to this irresistible sweet treat: 13 September is International Chocolate Day, and 7 July is World Cocoa and Chocolate Day.

Most of the leading countries in the global trade of this product are European, as shown in the following graph from Statista, based on data from UN Comtrade. Germany is the world's leading exporter of chocolate and other food preparations containing cocoa, with nearly 916 million kilos exported in 2020.

Spain ranks tenth among the largest exporters of chocolate, with almost 117 million kilos exported. About the central importing countries, the United States ranks first, with 638 million kilos.

Spain also appears on the list of the ten leading countries in chocolate imports, with approximately 141 million kilos imported last year.[1]



Figure 1. Countries that export and import the most chocolate

Colombia is one of the world's leading cocoa producers. Cocoa has been recognized for its excellent qualities, earning it the "Fine Aroma Cocoa," which has given this product a high standing and increased international demand. This product is a benchmark within the country, grown in 29 of its 32 departments. However, 77 % of production is concentrated mainly in six departments: Santander (42,1 %), Antioquia (8,8 %), Arauca (7,6 %), Huila (6,8 %), and Tolima (6,6 %) and Nariño (5,5 %).[2]

Locally adapted agricultural materials are being replaced by universal materials, resulting in the loss of native varieties that are superior in quality and organoleptic attributes.

Resolution 329 of 2009 of the Ministry of Agriculture and Rural Development recognized the Cocoa Chain Organisation, the agro-industry, and the National Cocoa Council and its members as an advisory body to the National Government on policy for the cocoa subsector. It highlighted producers, academia, research, the national government, marketers, and industrialists.

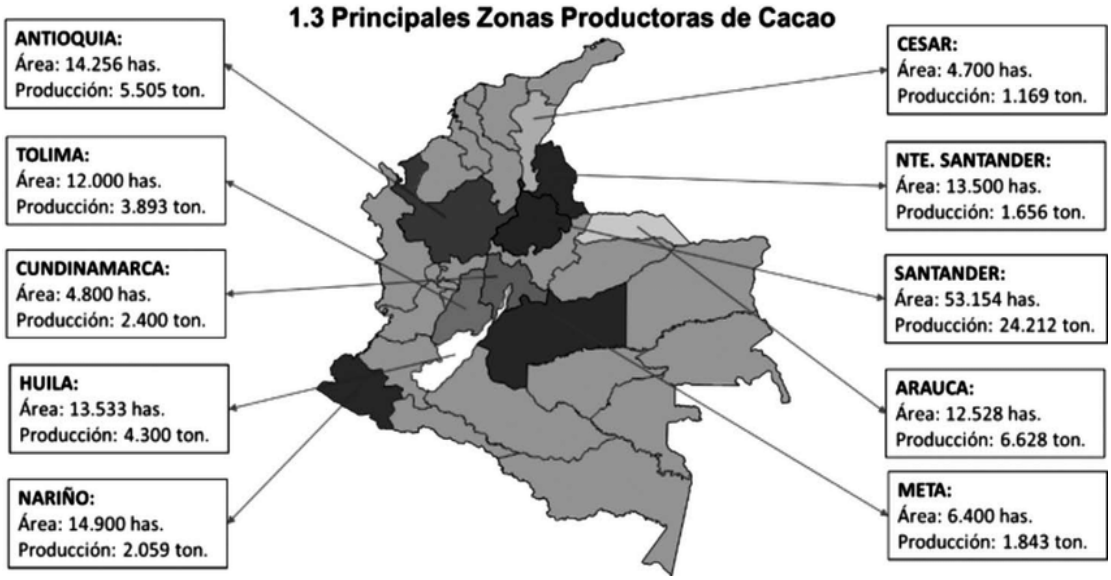


Figure 2. Distribution by department of areas planted with cocoa in Colombia

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Micro context

Cocoa cultivation covers an area of 355 hectares, with an average dry production of 87,6 tonnes. The municipality of Roberto Payán has cocoa collectors who need green innovation to increase their productivity. This research will focus on this area's key strengths to ensure that the Tumaco region is not the only powerhouse of cocoa production in Nariño (2012-2015 Development Plan for the Municipality of Roberto Payán).

This research seeks to strengthen the growth and development of cocoa farming in the municipality of Roberto Payán, where green innovation will facilitate and increase farmers' productivity. The department of Nariño has highly efficient municipalities for cocoa cultivation, such as Tumaco, which has 70 % productivity as the city values the product the most.

The research aims to increase cocoa production in the municipality of Roberto Payán and use the large hectares of land planted with illicit crops, which are being misused due to the actions of various armed groups.

It will also seek to make cocoa harvesting more profitable so that it is not seen as less profitable than other municipal activities



Figure 3. Tumaco chocolate

Historical overview

The municipality of Roberto Payan is located 254 kilometers northwest of the city of San Juan de Pasto. It borders Francisco Pizarro, Mosquera, and Olaya Herrera to the north, Barbacoas and Tumaco to the south, Olaya Herrera and Magüi to the east, and Tumaco to the west.[3]

It is located 24 meters above sea level, with an average temperature of 26,9 degrees Celsius, an average annual rainfall of 720 millimeters, and a municipal area of 1,342 square kilometers. This territory is flat to slightly undulating, characteristic of the Pacific region and has a warm climate. It is irrigated by the Alcalbi, Iguambi, Ispi, Patía, Patía el Viejo, Piri, Sande, and Telembi rivers, and also has the Albino, Chimbusa, Piri, Popa, Puérpera, Tamaje and Pangüi lagoons. The municipality of Roberto Payan is located 254 kilometers northwest of the city of San Juan de Pasto.[3]

This municipality has more than 10,473 inhabitants and 60 villages dedicated to fishing, agriculture, livestock, and mining. Mining and agriculture are the two most common activities in the territory.[4]

Mining gained momentum with the advent of machinery that increased mineral productivity. Knowing the profitability and potential of gold in the region, farmers saw this work as very profitable, regardless of the environmental damage it caused.

On the other hand, agriculture had strong potential, as there were massive hectares of banana plantations on the Patía River. It is also worth mentioning the number of families dedicated to planting rice, corn, cassava, and different fruits that can be grown in the municipality, such as cacao.

Cocoa has always been present in the municipality's history, as families grew it for their own consumption. It was harvested, tasted, and used, and the seeds were placed in the sun to dry for several days, then ground in small mills to make chocolate.

The evaluation of the cocoa sector in Roberto Payán has not been very positive. Since its inception, many people have grown this product, but not for commercial purposes, thus preventing it from developing as it did in other municipalities such as Tumaco, which today contributes more than 70 % of the cocoa in the department of Nariño.

By 1997, small cocoa collectors began to emerge as small buyers appeared in the municipality of Barbacoas. With a buyer nearby, the farmers planted and cultivated this product. Few opted for this product because, with the arrival of armed groups in the area in 2003, illicit crops with higher profitability appeared, causing the inhabitants to choose to plant coca instead of other products.[5]

Table 1. Legal framework

The Law 1562 of 2012	Explains how the basic contribution income is calculated, along with the coverage provided to self-employed, informal and dependent workers. This new law is supported by three bills that emerged in the Congress of the Republic, which define what constitutes a work accident or occupational disease. Currently, in Colombia, there are a large number of independent, dependent, and informal workers who are not affiliated with the occupational risk system. That is why the Ministry has designed a work plan that seeks to correct these shortcomings through the efficient implementation of the SGSST in companies. This law is very important for cocoa harvesters, as they are independent workers. It provides them with security from the national government in the event of a work-related accident.
Decree 1485 of 2008	Article 1. Organisation. The Cocoa Export Price Stabilisation Fund, whose operation was authorised by Decree 1226 of 1989, regulated by Resolution No. 0529 of 1989 and Resolution No. 053 of 1990 of the Ministry of Agriculture and Rural Development, into the Cocoa Price Stabilisation Fund, which shall operate in accordance with the terms established in Chapter VI of Law 101 of 1993. Article 2.- Legal Nature. The Cocoa Price Stabilisation Fund shall operate as a special account, without legal personality. legal, in accordance with the provisions of Article 37 of Law 101 of 1993. Article 3.- Purpose. The purpose of the Cocoa Price Stabilisation Fund shall be to ensure a remunerative income for producers, regulate domestic production and increase exports by financing the stabilisation of the prices of the product referred to in Article 4 of this Decree. Article 4.- Product subject to stabilisation. For the purposes of this Decree, the agricultural products subject to stabilisation shall be those classified under tariff heading 18,01, in accordance with Decree 4589 of 2006, and which are obtained from the seed of the cacao tree.[6] Article 5.- Administration. The Cocoa Price Stabilisation Fund shall be administered by the entity designated by the Ministry of Agriculture and Development. These articles are favourable to cocoa collectors as they provide them with remuneration in the event of imports of their product and also offer them price fixing when entering international markets.
NTC 1252	The purpose of this standard is to establish the classification and requirements to be met by cocoa beans intended for industrial processing for human consumption. Well fermented beans. Cocoa beans whose fermentation process has been completed and which have the following characteristics: shell or tegument of brown, reddish or reddish-brown color, which is easily detached from the kernel. The almonds are brown or dark reddish-brown (chocolate color) with well-defined, kidney-shaped alveoli and a chocolate odor. Insufficiently fermented beans. Cocoa bean, incompletely fermented, with violet or violet-brown cotyledons (kernels), semi-compact structure, with a shell that is difficult to separate. Slate bean. Unfermented cocoa bean, which has a blackish-gray interior color and a completely compact structure.

Theoretical framework

Green innovation: Innovation is associated with creating new or improved products, processes, and methodologies essential for a better quality of life in the transition towards a cleaner global environment.

It is important to note that the term innovation refers not only to technological innovation but can also be present in economic, financial, and social systems and in lifestyle changes. Innovation is now an indispensable aspect of all sectors of society. The need to improve production and consumption methods, make institutional and organizational changes, and develop new services and new ways of consuming, living, and moving drives human beings to constantly innovate in order to improve consumption habits, production, and organizational processes, and, in general, quality of life.[7]

Likewise, green innovation is associated with the product of research and development or initiatives aimed at sustainable and environmentally friendly solutions.

This type of innovation has boomed in recent years, especially since the last decade of the 21st century, due to the need for organizations and countries to comply with the Sustainable Development Goals agreed in 2015 by the Member States of the United Nations.[8]

On the other hand, the authors Diaz et al.[9] explain that the literature mainly uses 'four terms related to innovation whose objective is to reduce environmental damage: green innovation, environmental innovation, sustainable innovation, and eco-innovation.'

However, Shiedering et al.[10] present a difference from the above, as they explicitly add the need to consider the life cycle approach in the environmental impact analysis.

The European Union's Eco-Innovation Observatory also defines eco-innovation as 'the introduction of any new or significantly improved product (good or service), process, organizational change or marketing solution that reduces the use of resources and decreases the release of harmful substances throughout the entire life cycle' (p.2).

Many companies are still not convinced of the benefits they would gain from venturing into green product development. Similarly, beyond contributing to environmental protection, companies also need other motivations to allocate resources and efforts to ecological innovation.

Today's globalized world demands innovation in all economic sectors, products, and services that align with market demands and meet sustainability and equity criteria. It also demands inefficient and clean processes, high-performance equipment, and low energy consumption. The agri-food sector is no exception. It faces the challenge of becoming more competitive by improving and taking advantage of innovations in processes, machinery, tools, methodologies, products, and services for its different production chains.[11]

The agri-food sector is of great importance as it provides daily consumption. Therefore, it must have or seek tools and equipment that help to increase production and make it more responsible for the care of the environment. Investments must be made in rural sectors to improve the economy and generate growth.

However, it is essential to be aware of the high level of competitiveness in the agri-food sector, which requires field improvements to facilitate and increase farmers' production. Today, the role of innovation in improving a country's productivity and, therefore, its long-term economic growth is clear.

Promoting innovation is one of the IDB's key strategies for regional development, and we have produced numerous publications and blogs on the subject.[12]

A study of 31 countries analyses the relationship between greener start-ups and innovation, confirming that these types of companies are more likely to engage in product and process innovation. This highlights the role of innovation in entrepreneurship and economic value creation, which is why recent literature has delved deeper into the contribution of new companies to environmental challenges.[13]

In this analysis of entrepreneurship and innovation in green companies, Hoogandoorn et al[13] affirms that in different countries, these organizations seek product innovation, i.e., they bring out new products that are competitive and of higher quality. So, they implement innovations to achieve these objectives and, in turn, facilitate tasks using technologies within the organization.

From a business perspective, five thematic categories of green entrepreneurship have been identified: conceptualization, facilitators, practices, opportunities, and the relationship between this type of entrepreneurship and innovation.

The worrying current global environmental situation has led companies in the manufacturing sector and their customers to reflect on the need to develop and acquire innovative green products (IGPs).

Some of the reasons consumers are expressing are greater environmental awareness, ethical concerns, moral motives, and awareness of what kind of planet will be left for future generations.[13]

Many companies are still not convinced of the benefits they would gain from venturing into green product development. Similarly, besides contributing to environmental protection, companies need other motivations to drive them to allocate resources and efforts to ecological innovation.

The aim is to advance companies' and customers' understanding of the need to articulate both their requirements and their desires while also encouraging academics to further research into PIV. Based on the literature, this article explores alternatives for addressing the PIV paradigm at the organisational level and what inspires companies and customers to pursue it.

The study's results identified a series of drivers related to orientations for understanding the needs of the ecological customer, dynamics to be implemented at the organizational level, and motivations of both customers and companies in pursuit of PIV. These drivers present an association that establishes a framework for achieving and purchasing PIV.[14]

In light of the above, researchers and corporate and operational managers can contribute to this topic through their different lines of action in academia and management.

Today's globalized world demands innovation in all economic sectors, products, and services that align with market demands and meet sustainability and equity criteria. It also demands inefficient and clean processes, high-performance equipment, and low energy consumption. The agri-food sector is no exception. It faces the challenge of becoming more competitive by improving and taking advantage of innovations in processes, machinery, tools, methodologies, products, and services for its different production chains.

The current worrying global environmental situation has led companies in the manufacturing sector, as well as their customers, to reflect on the need to develop and acquire, respectively, innovative green products (IGPs). Consumers' reasons are based on greater environmental awareness, ethical concerns, moral motives, and awareness of what kind of planet will be left for future generations.

Many companies are still not convinced of the benefits they would gain from venturing into green product development. Similarly, beyond contributing to the care of the environment, companies also need other motivations to drive them to allocate resources and efforts to ecological innovation.

The aim is to advance companies' and customers' understanding of the need to articulate both their requirements and their desires while also encouraging academics to advance PIV research.

Types of green innovation Green process innovation

The use of certain polluting materials is reduced or eliminated, or alternative energy is used in production processes.

The definition and application of green innovation indicators represent an essential step forward for the sustainable development of countries, as they make it possible to monitor the most critical variables that need to be controlled and then plan and implement strategies to increasingly reduce the environmental pollution gap and thus improve the quality of life of the population. They also provide crucial information for decision-makers and resource planners to define and establish short-, medium-- and long-term policies aimed at designing the best strategies for developing and implementing new technologies and technological improvements to optimize countries' performance in terms of environmental sustainability.[15]

Agriculture and food are also undergoing green innovations. Sustainable agricultural techniques, such as precision agriculture

and permaculture, seek to reduce the use of chemicals, optimize resources, and promote biodiversity. In addition, alternatives to conventional meat, such as lab-grown meat and plant-based foods, are being developed to reduce emissions associated with livestock farming.

Intelligent water management is another crucial aspect of green innovation. Water recycling and reuse technology is helping to conserve this vital resource. Smart irrigation systems and leak detection technologies also contribute to more efficient water use.[16]

Green management

This involves creating and developing green awareness by creating profitable and environmentally sustainable businesses. [17] It also involves a systematic and complex process based on product design and formulating business strategies that promote environmental care and protection while generating the expected profits for companies. Conventional management is a thing of the past, and green management is the present and the future. Consumers demand new strategies and innovations in products and services today.[18]

Green accounting

The terms environmental accounting, green accounting, and ecological accounting refer to elements that refer to the environmental impact of a company's actions in its accounting. In this way, the profits or losses referred to in the accounting results will not be strict.

'monetary,' but also environmental. This reflects the increasingly noticeable effort by companies to be more involved in respecting the environment, even in their internal accounts.

To achieve this, it is extremely important for business strategy to be involved in so-called green projects, which involve the company in activities that respect or promote the use of natural resources in society. Green projects also refer to practices that allude to good corporate behavior towards the environment (such as reducing the use of plastics in its products, not testing on animals, etc.).[19]

Supply chain

More than just a process, the supply chain is an interconnected network of companies, people, activities, information, and resources that work together to bring a product or service from its origin to the end consumer. It ranges from the sourcing of raw materials to final delivery, including processing, storage, and distribution.

- Anticipate demand, manage inventories, and optimize resources.
- Select suppliers, negotiate prices, and purchase materials.
- Transform raw materials into finished products.
- Manage product stock efficiently.
- Transport products to the point of sale.
- Deliver the product to the end consumer.
- Respond to customer needs and queries.[20]

Green innovation strategies

Growing concern for the planet's sustainability due to unbalanced economic growth drives demand for a more environmentally friendly growth model. That is why, at the industrial level, green innovation is being discussed as a feasible solution for striking a balance between the economy and environmental responsibility. Several companies have already begun implementing methods and strategies to create new market opportunities. Examples include "cradle to cradle" and the sale of eco-friendly products or services. In particular, green innovation can be applied through incentive and life cycle models.[21]

The effect of eco-efficiency on competitive advantage

Companies will gain social legitimacy if they emphasize their activities by prevailing social norms by implementing eco-efficiency as a form of sound environmental management. Eco-efficiency is a production strategy to reduce the environmental impacts and risks to human health associated with products. When planning production for the future, today's companies must consider that future generations have access to the natural resources used today and are moving towards environmentally friendly production activities.

The eco-efficiency strategy aims to reduce the use of water, energy, and raw materials during all stages of production. Processes are regularly reviewed to minimize pollution and waste, which helps protect the environment and make companies more competitive. Implementing eco-efficiency as a production strategy can generate additional revenue and reduce production costs for companies Zturk et al.[21] A company's eco-efficiency strategy reflects good environmental performance.[22]

When a company practices eco-efficiency and performs well in the environment, it is more appreciated by the public and maintains positive relationships with stakeholders. It can even lead to long-term relationships.

Green human management

This refers to efforts to improve energy efficiency or reduce pollution produced by our homes, businesses, and lifestyles. The main objective of being environmentally friendly is to reduce the potential negative impact of energy consumption and pollution on the environment.[16]

Green finance is a broad term that refers to increasing the level of financial flows (from banking, microcredit, insurance, and

investment) from the public and private sectors toward sustainable development priorities. Green finance includes climate finance but is not limited to it.

- Components of the financial system that deal specifically with green investments, including their specific legal, economic, and institutional conditions;
- Public and private financing of green investments in different areas, including:
- Provision of environmental goods and services
- Prevention, minimization, and compensation for damage to the environment and climate
- Financing public policies that promote implementing environmental projects and initiatives and mitigating or adapting environmental damage.[10]

Business Diagnosis

There are different approaches to defining business diagnostics, which is why Romangoli[12] states, ‘ Business diagnostics is a simple and useful tool for understanding the current situation of an organization and the problems that prevent its growth, survival or development.’ Diagnostics identify symptoms that are causing problems for organizations to focus efforts and strategies to mitigate the negative impacts that may be caused by both controllable and uncontrollable variables that may arise.

Furthermore, Caraballo[23] states that ‘Diagnosis allows for the study, analysis, and evaluation of companies’ strengths, weaknesses, threats, and opportunities. It serves as a tool for analyzing and evaluating an organization’s environment, structure, policies, and general management. Diagnoses provide a snapshot of the negative aspects that need to be improved and the positive aspects that should be promote in order to address them and assess the importance and impact of each variable on each company’s particular interests.

Likewise, García[22] states, ‘ The main objective of the Diagnosis is to quantify the current state of maturity of the organization with the national or international standards that the company should meet, quickly, accurately and concisely identifying potential areas for development within it.’ It is clear that a diagnosis provides general information about an organization, and it is up to the organization to convert this into practical knowledge that can be used to manage, understand, and modify decisions that may be taken for business development, taking into account references provided by successful companies with similar characteristics.

Green Marketing: The objective is to showcase respectful and harmonious products with the environment. Green marketing arose from the concerns, worries, and demands of specific movements regarding the consequences of marketing on the environment. Thus, some companies decided to take sides with emerging environmental movements. Businesspeople, in general, have been increasing their ecological awareness. The first actions on this issue took place in the 1970s. At that time, environmental marketing began, although entrepreneurs only became officially aware of it in the 1980s and began implementing ecological marketing strategies in the late 1980s and early 1990s, integrating respect for the environment into their processes.[24]

Conceptual framework

Green areas

According to Reyes[3] cited by the Chilean Ministry of the Environment[4], green areas are spaces where vegetation and unpaved natural elements predominate. Another broader definition of green space is provided by Chile’s National Environment Commission (CONAMA), which defines green spaces as: “urban or peri-urban spaces predominantly occupied by trees, shrubs or plants, which may have different uses, whether for leisure, recreation, ecological, ornamental, protection, recovery and rehabilitation of the environment or similar” (National Environment Commission[8] cited by the Chilean Ministry of the Environment[4]). Therefore, green areas refer to all-natural open spaces such as beaches, sports fields in educational facilities, and recreational areas.

Cocoa

Cocoa is a neotropical crop of global economic importance, used since ancient times in pre-Columbian cultures. It is considered a shade-loving species, although some hybrid genotypes can grow in full sunlight. This ability to tolerate different light levels varies and can be exploited to optimize crop yields.[25] Considering the above, cacao is a key product in Colombia, grown at a temperature that allows for better seed development and higher productivity, as it is currently a commercial product.

Consequences of armed groups for cocoa harvesters: In some regions of the country, where the influence of both guerrilla groups and drug trafficking intersect, new conditions and power correlations have been created that make it difficult to envisage a solution to the guerrilla phenomenon by addressing it individually and separating it from the effects of the drug industry.[22] Drug trafficking and its possible solutions are even further removed from the realm of internal solutions, as they involve critical international actors, and there seems to be no quick fix. Although there is still uncertainty about a peace process with the guerrillas, this paper explores some of their roles in controlling drug-related violence in the department of Guaviare, which they and some sectors of the population play.

Growers

A farmer or gardener participates in a knitting project as a citizen scientist. Participating growers must be both women and men. The administrator or field agents can recruit growers.[15] To participate, producers only need to allocate a small plot of their farm or garden to cultivate their three technological options.

Growers receive initial training, individual trial packages, and assistance during the trial from field agents.

Illegal crops: This is how a comprehensive intervention policy for the reduction of illicit crops was proposed, with a differentiated approach that recognizes regional differences and is tailored to the specific characteristics of each territory as a necessary shift in

intervention strategies to respond to new dynamics, challenges, and lessons learned in the implementation of programs to reduce illicit crops in the country.[24]

Eco-innovation: introducing any new or significantly improved product (good or service), process, organizational change, or marketing solution that reduces the use of resources and decreases the release of harmful substances throughout the entire life cycle. Porter and Vander et al[6] distinguished green innovation from conventional innovation in that the latter is not developed to address environmental challenges, while the former is designed to meet the ecological requirements of a regulatory body or the environmental concerns of target customers. Similarly, Oltra et al[20] define environmental innovation as innovations consisting of new or modified processes, practices, systems, and products that benefit the environment and thus contribute to environmental sustainability.

Environmental innovation: innovations consisting of new or modified processes, practices, systems, and products that benefit the environment and thus contribute to environmental sustainability. For their part, Driessen et al[11] explain that green innovation does not have to be developed to reduce the environmental burden, but it must produce significant environmental benefits. Chen et al[10] refer to green innovation as hardware or software innovations related to green products or processes, including innovations in energy saving, pollution prevention, waste recycling, green product design, and corporate environmental management.[3]

Green innovation

'Green' innovations are all new ideas that aim to continue giving us more options for communication, movement, and even comfort without harming nature, respecting the environment, and being ecological in their design, construction, use, and disposal. Increasingly, the new brains of innovation are turning to options that emit fewer gases, are environmentally friendly, do not consume fossil fuels, etc. These green innovations are already on the market.[25]

The green economy: A green economy is based on three main strategies: reducing carbon emissions, increasing energy efficiency and using natural resources, and preventing the loss of biodiversity and its ecosystem services.[4]

Illegal mining

Exploratory or extractive activity of minerals, whether owned by the nation or by private individuals, carried out without the corresponding mining title in force or without the authorization of the owner of the private property where the project is located.[24]

Efficient and sustainable use of resources for the production of goods or services: The rational use of inputs used in the manufacture of products, taking into account that the production cycle makes use of natural resources; implementing cleaner technologies that allow for the sustainable use of directly affected ecosystems.

Agri-food system: The Agri-food System (SAA) is "the set of activities that contribute to the formation and distribution of agri-food products and, consequently, to the fulfillment of the function of human nutrition in a given society.[25]

CONCLUSIONS

The development of cocoa cultivation in the municipality of Roberto Payán represents a viable and strategic alternative to the structural problems that have plagued the region for decades: the expansion of illicit crops and the impact of armed groups on the local economy. This research has highlighted the urgent need to revalue cocoa production as a means of subsistence and as a driver of economic, social, and environmental transformation for the municipality.

One of the most important findings of this research is the lack of motivation among farmers to devote themselves entirely to cocoa cultivation, motivated by the devaluation of the product, low profitability compared to illicit crops, and limited government intervention to strengthen the agricultural sector. However, it was also identified that there is valuable empirical knowledge among harvesters who have experience in crop management and a cultural link to cocoa that can be leveraged to strengthen this production chain. The presence of farmer associations and the support of family members and communities are key resources for the success of any transformation strategy.

Green innovation is fundamental to achieving sustainable, profitable, and competitive production in this context. Through responsible farming techniques, improvements in fermentation and drying processes, and the efficient use of natural resources, it is possible to raise the quality of cocoa and obtain a product that meets international marketing standards, such as 'fine aroma cocoa,' which is highly valued on the world market. Implementing green innovation in Roberto Payán would not only improve production processes but also position the region as a benchmark for sustainable cocoa, generating job opportunities and improving the quality of life of its inhabitants.

Likewise, training and technical education for farmers, the strengthening of local associations, and investment in infrastructure are necessary conditions to ensure the success of the transition. The study suggests that if processing centers are developed, producers are provided with measuring instruments, and incentives are created for adopting good agricultural practices, the region could overcome its dependence on illegal economies and become a model of the green economy in southwestern Colombia.

Regarding the legal and political context, the national government must implement more robust agricultural incentive policies, producer protection, and marketing guarantees. If adequately enforced, regulations such as Law 1562 of 2012 and Decree 1485 of 2008 can protect and motivate small producers through employment insurance and price stabilization. It is also key to incorporate sustainability criteria into regional development plans, with a territorial focus and in consultation with communities.

Finally, this research is an academic or institutional proposal and a personal and collective commitment to cocoa-producing families. The vision of a future where cocoa is the axis of development for Roberto Payán is not only possible but also necessary. Through farmer empowerment, the implementation of green innovation, and coordinated work between communities, the state, and

the private sector, a territory ravaged by violence can be transformed into an example of progress based on legality, sustainability, and social justice.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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REFERENCES

1. Miñarro M. Innovación tecnológica, organización del trabajo y sostenibilidad ambiental: ¿es el teletrabajo una forma de empleo verde? Estud Financ Rev Trab Segur Soc. 2021;(454):5-16. Available from: https://repositori.uji.es/xmlui/handle/10234/192859

2. Procolombia. El cacao en Colombia está presente en sus departamentos [Internet]. 2020 [cited 2025 May 28]. Available from: https://www.colombiatrade.com.co/noticias/el-cacao-en-colombia-esta-presente-en-sus-departamentos

3. Escrucería JH, Gil OL, Velasco R. El municipio de Roberto Payán [Internet]. 2006 [cited 2025 May 28]. Available from: https://www.cctumaco.org/images/Archivos/censo_ROBERTO_PAYAN.pdf

4. Colombia turismo. Reseña histórica del municipio Roberto Payán [Internet]. [date unknown] [cited 2025 May 28]. Available from: http://www.colombiaturismoweb.com/DEPARTAMENTOS/NARINO/MUNICIPIOS/ROBERTO%20PAYAN/ROBERTO%20PAYAN.htm

5. Daza Cacao. Historia del cacao en Colombia [Internet]. Federación Nacional de Cacaoteros y Universidad Industrial de Santander; 2023 [cited 2025 May 28]. Available from: http://www.dazacacao.com/blog/historia-del-cacao-en-colombia/

6. Osorio M, Rodríguez L, Sierra R, Terán W. Curvas de respuesta fotosintética a la luz en plantas de cacao (Theobroma cacao L.) aclimatadas a luz solar plena en Cundinamarca. Bot Sci. 2023;101(2):435-48. Available from: https://www.scielo.org.mx/scielo.php?script=sci_arttext&pid=S2007-42982023000200435&lang=es

7. Organisation for Economic Co-operation and Development (OECD). Oslo Manual 2018: Guidelines for Collecting, Reporting and Using Data on Innovation [Internet]. 2018 [cited 2025 May 28]. Available from: https://www.oecd-ilibrary.org/docserver/9789264304604-en.pdf

8. Organización de las Naciones Unidas (ONU). La Agenda para el Desarrollo Sostenible [Internet]. 2021 [cited 2025 May 28]. Available from: https://www.un.org/sustainabledevelopment/es/development-agenda/

9. Rovira S, Patiño J, Shaper M. Eco-innovación y producción verde: una revisión de las políticas de América Latina y el Caribe [Internet]. CEPAL; 2017 [cited 2025 May 28]. Available from: https://repositorio.cepal.org/bitstream/handle/11362/40968/1/S1700072_es.pdf

10. Sáenz S, Helfgott S. Los profesionales del agro en la difusión de innovaciones agrícolas sustentables en la región oriental de Colombia [Internet]. 2009 [cited 2025 May 28]. Available from: https://ciencia.lasalle.edu.co/eq/vol1/iss11/4/

11. Driessen P, Hillebrand B. Innovación verde: innovaciones que consisten en procesos nuevos o modificados, prácticas,

sistemas y productos que benefician al medio ambiente [Internet]. 2002 [cited 2025 May 28]. Available from: http://portal.amelica.org/ameli/jatsRepo/134/1342338002/html/index.html#redalyc_1342338002_ref33

12. Roa M. Los mayores exportadores e importadores de chocolate del mundo [Internet]. Statista; 2021 [cited 2025 May 28]. Available from: https://es.statista.com/grafico/25259/principales-exportadores-e-importadores-de-chocolate-y-alimentos-que-contienen-cacao/

13. Agrosavia. Innovación Agropecuaria (SNIA - Ley 1876 de 2017), se crearon las entidades prestadoras de servicios de extensión agropecuarios (EPSAGROS) [Internet]. 2020 [cited 2025 May 28]. Available from: https://www.colombiamascompetitiva.com/wp-content/uploads/2021/09/CC_Guia-diagnostico-de-la-cadena-de-cacao-140721.pdf

14. Serrano J, Bikfalvi A, Llach J, Arbeláez J, García J. Orientaciones, dinámicas y motivaciones para la obtención del producto innovador verde. Rev CEA. 2022;8(17):e2138. Available from: https://revistas.itm.edu.co/index.php/revista-cea/article/view/2138

15. Ar IM. El impacto de la innovación de productos ecológicos en el desempeño y la competitividad de las empresas Capacidad: el papel moderador de la preocupación ambiental gerencial. Procedia Soc Behav Sci. 2012;62:854-64. doi: https://10.1016/j.sbspro.2012.09.144.

16. IMMAP. Roberto Payán [Internet]. 2023 [cited 2025 May 28]. Available from: https://colombia.immap.org/evaluacion-necesidades-narino-2022/roberto-payan/

17. Cooperación Económica y Desarrollo (SECO). Diagnóstico de la Cadena de cacao en Colombia, con énfasis en CFA orgánico y sostenible [Internet]. 2019 [cited 2025 May 28]. Available from: https://www.colombiamascompetitiva.com/wp-content/uploads/2021/09/CC_Guia-diagnostico-de-la-cadena-de-cacao-140721.pdf

18. Mortis S, Rosas R, Chaires E. Paradigma de Investigación Cuantitativa [Internet]. Instituto Tecnológico de Sonora; [date unknown] [cited 2025 May 28]. Available from: http://biblioteca.itson.mx/oa/educacion/oa3/paradigmas_investigacion_cuantitativa/index.htm

19. Moreno JA. El proceso del beneficio en la poscosecha del grano de cacao [Internet]. 2021 [cited 2025 May 28]. Available from: https://repository.unimilitar.edu.co/server/api/core/bitstreams/d91ece23-c537-4f3a-a021-5ea37753ea6b/content

20. Minagricultura. Cadena de cacao [Internet]. 2021 [cited 2025 May 28]. Available from: https://sioc.minagricultura.gov.co/Cacao/Documentos/2021-03-31%20Cifras%20Sectoriales.pdf

21. Sistema agroalimentario. Teoría del sistema agroalimentario [Internet]. 2021 [cited 2025 May 28]. Available from: https://elenjambresinreina.eu/sites/default/files/2017-06/teoriasa.pdf

22. García M. Coca, guerrilla y sociedad civil en el Guaviare: regulación de conflictos y otros controles [Internet]. [date unknown] [cited 2025 May 28]. Available from: file:///C:/Users/LENOVO/Downloads/colombiaint29.1995.02.pdf

23. Morales M. Después de obtener el abono orgánico se recomienda emplearlo en plantaciones [Internet]. 2018 [cited 2025 May 28]. Available from: https://repository.agrosavia.co/bitstream/handle/20.500.12324/1195/Ver_Documento_1195.pdf?sequence=1&isAllowed=y

24. Congreso de Colombia. Ley 1562 de 2012. Por la cual se modifica el sistema de riesgos laborales y se dictan otras disposiciones en materia de salud ocupacional [Internet]. 2012 [cited 2025 May 28]. Available from: https://steel.net.co/ley-1562-de-2012/

25. Congreso de Colombia. Ley 2163 de 2021. Por medio del cual se aprueba el "Convenio Internacional del Cacao", adoptado en Ginebra el 25 de junio de 2010 [Internet]. 2021 [cited 2025 May 28]. Available from: https://vlex.com.co/vid/ley-2163-2021-medio-879132786