Fundecooperación (FDS): Determining Impact of Small-Scale Sustainability Efforts

An Interactive Qualifying Project Report submitted to the faculty of WORCESTER POLYTECHNIC INSTITUTE in partial fulfillment of the requirements for the Degree of Bachelor of Science

Submitted by:

Juliana Fox

Sophia Lally

Maksymilian Robidoux

Vaughn Weston

Date:

March 2024

Proposal Submitted to:

Professors James Chiarelli and Holly Ault

Project Sponsors:

Estiven González Jiménez and Marianella Feoli of Fundecooperación para el Desarrollo Sostenible

Table of Contents

Authorship

Section	*Primary Author(s)*	*Editor(s)*
Abstract	Vaughn Weston	All
Acknowledgements	All	All
Chapter 1: Introduction	All	All
Chapter 2: Background (FDS and Sustainability)	Juliana Fox	All
Effects of Climate Change on Costa Rica	Sophia Lally	All
Fundecooperación	Vaughn & Maks	Juliana Fox
Agroclimatica	Maks	All
The Three Pillars of Sustainability	Juliana Fox	All
Environmental	Juliana Fox	All
Social	Sophia Fox	All
Economic	Vaughn	All
Key Indicators of Sustainability	Juliana Fox	All
Environmental Indicators	All	All
CO2 Emissions	Maks Robidoux	All
Waste Reduction	Sophia Lally	All
Water Usage	Juliana Fox	All
Agricultural Effects	Vaughn Weston	Juliana Fox
Energy Consumption	Maks Robidoux	All
Social Indicators	Sophia & Vaughn	All
Poverty Alleviation	Vaughn Weston	All
Equal Opportunities	Sophia Lally	All
Economic Indicators	Vaughn Weston	All
Profit	Vaughn Weston	All
Cost Reduction	Maks Robidoux	Juliana Fox
Risk	Maks Robidoux	Juliana Fox
FDS Data Tracking	Vaughn Weston	All
OBJ 1: Our Project Approach	Juliana Fox	All

Observation of Existing Data	Juliana Fox	All
Identifying Sustainability Indicators	Juliana Fox	All
Reviewing Existing Program Metric-Related Data	Juliana Fox	All
Database Findings	Vaughn Weston	Juliana Fox
OBJ 2: Define Specific Indicators to Measure and Evaluate the impact of FDS Practices		
Identifying Metrics to Indicate Sustainability	Juliana Fox	All
Assessing the Effectiveness of FDS Practices	Juliana Fox	All
Impact Evaluation Interviews	Sophia Lally	Juliana Fox
Comparing Interview Data	Sophia Lally	Juliana Fox
FINDINGS: Literature Review Outcomes	Juliana Fox	All
Fundecooperación and Client Relationship	Sophia Lally	All
Interview Results	Sophia Lally	Juliana Fox
Measurable Practices	Vaughn Weston	All
Comparing Data	Juliana Fox	All
OBJ 3: Create a Method of Data Collection to Accurately Display the impact of FDS Sustainability Practices		
Tracking Sheets	Juliana Fox	All
Metrics and Indicators	Maks Robidoux	Vaughn Weston
Implementation	Maks Robidoux	Vaughn Weston
Conclusion	Juliana Fox	Vaughn Weston
Recommendations	Juliana Fox	All
Acknowledgements	Juliana Fox	All
Appendix A: Interview Questions	Juliana, Vaughn, and Sophia	All
Appendix B: Consent Form	Juliana & Sophia	All

Abstract

The goal of our project was to create a methodology that would measure the impact of sustainable development practices in Costa Rica. The practices in question are used by the clients of Fundecooperación para el Desarrollo Sostenible (FDS), an NGO whose mission is to finance sustainable development by giving loans to micro, small, and medium sized enterprises in Costa Rica. FDS wants to know how to assess the impact of the sustainable development practices they've been financing so that they may make more informed decisions about their credit program in the future. Our team conducted extensive research and interviews on sustainable practices and indicators that show their impact. We also analyzed and worked inside FDS's database to consider the changes needed for our methodology.

Acknowledgments

Our sincere appreciation goes to our generous sponsor Estiven González Jiménez from the Fundecooperación team. His unwavering support and insightful guidance were instrumental in realizing the success of our project, adding immense value to our experience in Costa Rica. Working closely with the Fundecooperación team was a true pleasure, and we extend our best wishes for their continued success, including their endeavors with further advancing their sustainability practices and Salesforce database.

A special thank you to Fundecooperación for graciously providing us with a collaborative office space and embracing our team into their dynamic community. Finally, we express our profound gratitude to our esteemed advisors, Professors Holly Ault and James Chiarelli, for their invaluable counsel, expert perspectives, and unwavering encouragement throughout the past five months. Their mentorship has been pivotal in shaping our journey.

Introduction

Despite Costa Rica's commendable efforts in promoting environmental conservation and sustainability, the country is facing increasingly severe consequences of climate change. Rising temperatures, changing rainfall patterns, and more frequent extreme weather events are adversely affecting its rich biodiversity, ecosystems, and agriculture. Rising temperatures and altered precipitation patterns create favorable environments for the proliferation of disease-carrying mosquitoes, exposing the population to increased health risks[1]. Altered rainfall patterns and extreme weather events can also impact water quality, resulting in the spread of waterborne diseases, and affecting the health of those who consume contaminated water. The changing precipitation patterns and extreme weather events are disrupting agricultural activities, leading to food shortages and changes in the availability of certain food items, affecting the nutritional health of the population [2].

These climate-related occurrences pose a considerable threat to small-scale farmers and businesses in Costa Rica, as their livelihoods and community contributions depend on the revenue and output generated. Unfavorable climate events can significantly disrupt income and inflict harm until production is restored. To withstand such challenges, local farmers and enterprises must enhance their farming techniques and embrace sustainable practices. This involves building up reserves of assets and implementing improvements that alleviate the impact of unexpected climate events[3].

Fundecooperación para el Desarrollo Sostenible (FDS) is a non-governmental organization (NGO) dedicated to addressing these environmental challenges by providing credit to micro, small, and medium-sized enterprises (MSMEs), small farms, and other programs with a specific focus on supporting climate resilience and sustainability projects. Their credit programs not only facilitate the gaining of assets but also actively promote and allow for the implementation of sustainability practices. These practices, spanning livestock, agriculture, and green development in urban environments, are designed to enhance climate resilience and support sustainability initiatives[4].

FDS is currently evaluating the outcomes of its dedicated efforts toward fostering a more sustainable community and assessing the organization's impact on its clients and the environment. FDS has begun collecting financial reports, measures of CO_2 emissions, and other various data, as well as data presented by risk analyses of the MSMEs partnering with the organization. Our goal is to create a methodology for measuring and displaying the impact of FDS sustainability practices on their clients and the environment by creating a data collection tool to be utilized within their database.

FDS and Sustainability

The full scope of this project entails an in-depth review of relevant literature prior to addressing our team's objectives. First, we will delve into the profound impacts of climate change on Costa Rica and how it has affected the communities, businesses, and agricultural sectors. We will then observe how FDS is addressing the current issue by implementing sustainability practices and programs. The organization prides itself on addressing the UN sustainability goals in carrying out its initiatives. Finally, we will discuss metrics that will measure FDS's impact on vulnerable groups based on the outlined indicators [5].

Effects of Climate Change on Costa Rica

Climate change in Costa Rica poses significant challenges, with elevated temperatures and shifting weather patterns directly impacting the environment and residents' daily lives[6]. Despite progress in poverty reduction, 23% of households, equivalent to 380,000 homes, still live below the national poverty line[7]. Climate change exacerbates poverty levels, particularly affecting subsistence farmers and smallholders, making adaptation difficult[8].

Changes in precipitation patterns contribute to water scarcity, affecting agriculture and household water access. Communities reliant on agriculture face challenges due to reduced water availability[9]. The interconnected challenges emphasize the need for comprehensive climate change measures to protect community health and resilience.

Fundecooperación

FDS follows the United Nations' 17 Sustainable Development Goals (SDGs) to serve as a guideline for their own projects and practices. There are 17 goals including no poverty, zero hunger, clean water and sanitation, affordable and clean energy, climate action, and more [10]. On the path to accomplishing these goals, FDS has 54,000 beneficiaries in Costa Rica, and has given 400 million colones (over $750k USD), in grants, to families living in extreme poverty [11].

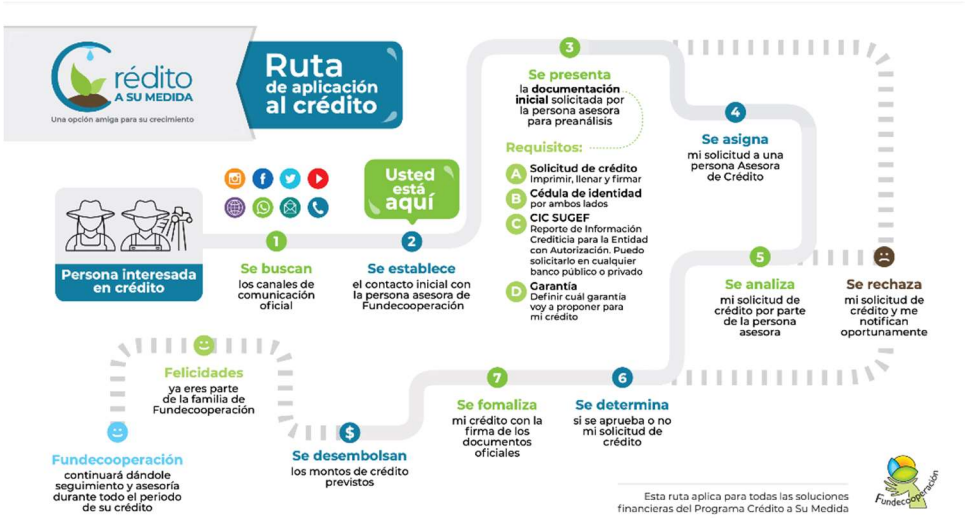

***Figure 1**: FDS's Credit Application Path*[4]

During the credit allocation process, displayed in Figure 1, clients can contact FDS through various channels, via phone or through their website (Step 1). Upon receiving the application, an advisor will verify the submission of all required documents (Step 2). Subsequently, the client is required to undergo a credit analysis from a bank and a risk analysis from Agroclimatic, a bioclimatic data platform based in Denmark that provides Risk Scores based on data from climate, soil, crop, livestock, and productivity readings (Steps 3 and 4)[12]. An

assigned analyst will conduct a technical analysis to assess the feasibility of credit allocation, (Step 5). Once the technical analysis is concluded and the credit details are finalized, the requested amount will be distributed to the client, (Steps 7 through 9). FDS will maintain communication and provide support throughout the entire payback period (Step 10). The support given can come in the form of FDS suggestions about what practices the client can implement to be more sustainable.

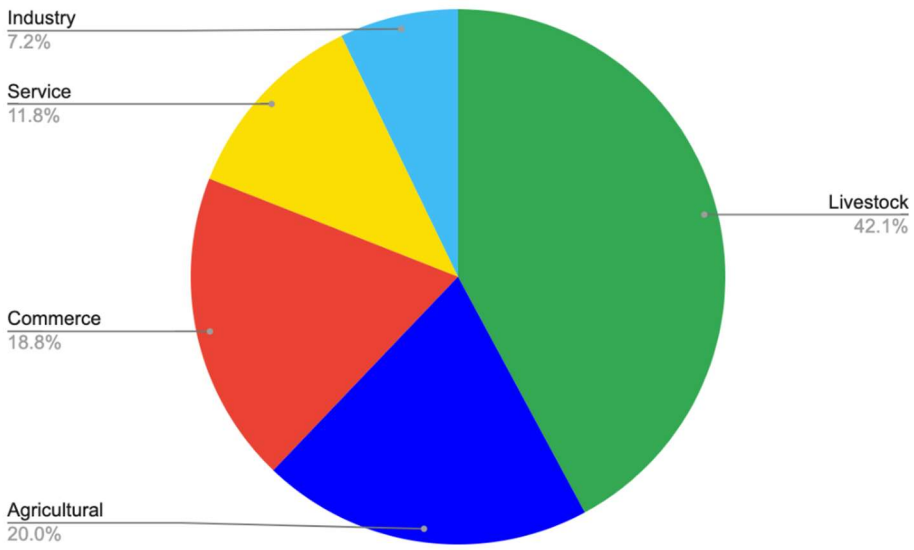

***Figure 2**: FDS client distribution by industry*[29]

As displayed in *Figure 2*, FDS has given loans to MSMEs across a wide spectrum of fields with livestock and agriculture being the most prominent, accounting for about 62% of their clients as of 2024, displaying a clear prioritization of livestock and agriculture. Developing the most impoverished regions of the nation is unattainable without ensuring that communities have

access to the resources they need, thus it is vital for FDS to provide the support necessary to develop livestock and agriculture sustainably.

FDS has supported numerous projects, notably initiatives involving coffee farmers in the Coto Brus region. Support from FDS has facilitated environmental enhancements, leading to heightened production and profitability for these farmers[3]. Indigenous farmers cultivating crops for personal use, such as corn, cocoa, sugar cane, wheat, pepper, and oranges, have embraced innovative farming techniques to boost production. This includes minimizing cultivated areas, providing focused care to existing crops, and planting trees on unused land to enhance resilience against droughts and heavy rains[13].

In the tourism sector, Florblanca, a resort in Provincia de Puntarenas, Santa Teresa, Costa Rica, supported by FDS, is committed to sustainable practices. Over the years they have implemented various projects including Solatube technology installed on many office roofs to illuminate the spaces with natural light. UV lamps were installed to purify the water, so all taps have clean drinking water, and an irrigation system allows Florblanca to reuse the treated water in their gardens avoiding the consumption of drinkable water in landscaping. Because of these projects Florablanca undergoes evaluation through the Costa Rica Tourism Institute's certification program for Sustainable Tourism (CST) [14].

Agroclimatica

The company Agroclimatica is a sustainability focused company based in Denmark. They started as a trading company in the year 2000, and in 2016 created a methodology that effectively correlates climate data with soil conditions, crop behavior, livestock specificities, and good agricultural practices. Agroclimatica is aligned with the UN's sustainability goals, and has an international influence in the Americas, Asia, and Europe. They provide data on CO_2 emissions and risk analysis for FDS clients.[12]

The Three Pillars of Sustainability

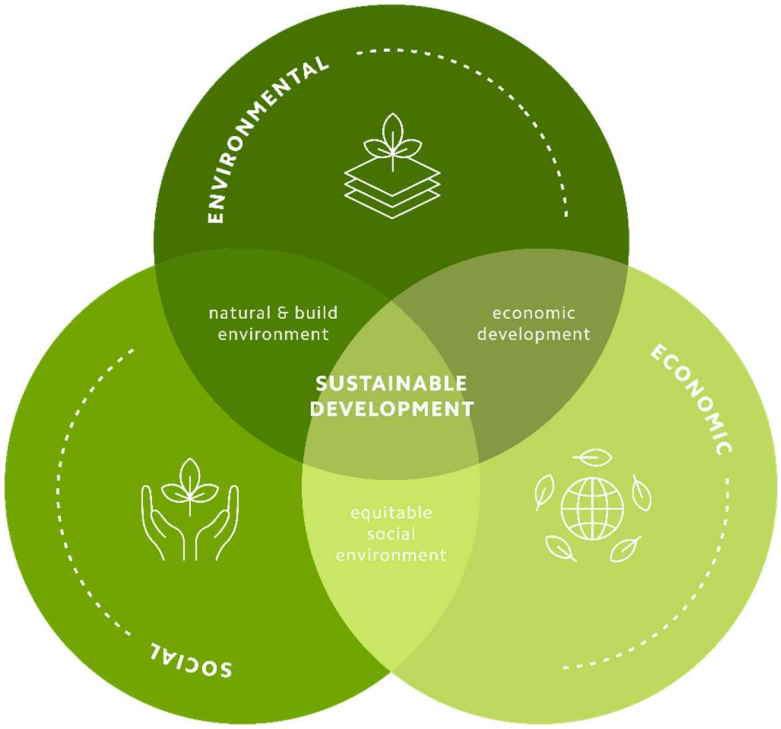

***Figure 3**: The interconnection of the Three Pillars of Sustainability*[1]

The concept of the three pillars of sustainability originates from the understanding that achieving sustainable development requires a holistic approach encompassing economic, social, and environmental dimensions. The significance of this concept to the UN Sustainable Development Goals (SDGs) lies in its alignment with being able to address global challenges appropriately and through a balanced approach. By creating and implementing the three-pillar framework, the UN can better structure efforts towards achieving the SDGs. This further helps to ensure that economic growth considers social equity and environmental protection. Ultimately the interconnection of these pillars, *Figure 3*, guides the formulation of policies and the implementation of actions that promote sustainable practices worldwide not only in an economical sense but in one that is also socially inclusive and environmentally responsible [15].

The **environmental** pillar of sustainability focuses on mitigating risks and assessing the environmental impact of business and our day-to-day operations, including efforts to save energy, preserve agricultural resources, assess carbon footprints, and reduce greenhouse gas emissions [17].

The **social** pillar prioritizes individual and community well-being, promoting social equity by addressing disparities based on gender, race, ethnicity, sexuality, and socioeconomic status. It emphasizes inclusive practices, fair labor conditions, community engagement, empowerment, and access to healthcare, education, and resources for improved well-being [17].

The **economic** pillar highlights businesses' role in addressing climate change, acknowledging their historical impact as major polluters. Sustainable practices, balancing social

and environmental considerations with profitability, are crucial for achieving long-term sustainability. Efficient and sustainable growth practices are key to finding the necessary balance[17].

A case study published by a team of researchers, who led a Solar Thermal Electricity project in Mexico, found that "assessing the three sustainability pillars" aided in "implementing the required actions and measures to improve the sustainability performance of the project" [18]. With this information we can confidently base our further research around these pillars.

Key Indicators of Sustainability

To assess the general impact of Fundecooperación's initiatives we have identified various indicators for each of the three pillars of sustainability. These indicators will measure the impact on their respective categories.

Environmental Indicators

Fundecooperación gathers various metrics from their clients, including data on **CO_2 emissions**. Carbon dioxide (CO_2) is a greenhouse gas that absorbs solar energy, contributing to climate change. Reducing CO_2 emissions has a positive impact, and MSME emissions are assessed by examining factors like energy consumption, fuel usage, waste management, recycling practices, livestock, and fertilizer usage [19]. Organizations often employ risk calculators, typically sourced from third-party companies, to determine these values. Currently, FDS utilizes

tools developed by Agroclimatica to aid in tracking CO_2, enabling comparisons between different organizations or industries and monitoring progress over time [20].

Costa Rica is a global example of **waste reduction** and environmental sustainability. The country employs a comprehensive approach, emphasizing recycling and responsible waste management. Significant investments in infrastructure, including waste separation and recycling facilities, facilitate environmentally friendly waste disposal. Government policies and educational programs also raise awareness about waste reduction [21]. Community engagement is crucial, encouraging citizens to participate in recycling programs and adopt eco-friendly practices. Costa Rica's commitment to environmental responsibility and innovative solutions has led to significant progress in creating a cleaner and more sustainable future.

Measuring waste reduction involves various methods, such as **tracking the use of multi-use sustainable products** instead of single-use items. Assessing the volume of recycled waste is another key metric. The U.S. Environmental Protection Agency offers guidelines for waste assessments, including the "Waste Sort" technique, which involves **sorting and weighing waste samples** [22]. Utilizing such methods can help evaluate the impact of Fundecooperación's programs on reducing waste.

FDS is actively involved in financing methods to reduce **water usage**, such as improved water distribution systems, encompassing water supply, efficient storage, irrigation, solid waste management, storage tanks, and other practices conducive to integrated and sustainable water management [11]. Understanding how much water is consumed and where it is allocated helps in implementing measures to conserve and sustainably use water resources, one of FDS's

sustainability initiatives. Thus, we find it crucial to recognize water usage as a metric for measuring FDS's success given its impact on the SDGs. Water usage can be measured through different forms of water meters or, for an open irrigation system, by multiplying the application rate by the duration of the irrigation or by measuring the drop in reservoir level [23]. This application rate can be determined differently depending on the irrigation method farmers use.

Agriculture is a huge focus of Fundecooperación (see figure 2), so our team also identified indicators of the **agricultural effects** of sustainable development practices. FDS can use indicators to measure the farm's productivity and the health of crops and livestock. For example, FDS has funded the establishment of foodbanks and a type of grass called Cuba 22 [11], which allowed agricultural producers to, in some cases double and triple the number of animals they could raise doing the same amount of work. Indicators have also been used to investigate how resilient farms are to climate change's effects on Costa Rica. Resilience in this context can be defined as how well in response to disturbance from climate change, farms can "maintain, recover, and improve their integrity and functionality" [24] There are many potential indicators for resilience alone such as crop diversity and herd fertility. Such indicators can be measured by counting the number of crops produced each year and for herd fertility the number of newborns (calves) birthed per year per productive female [25]. Agriculture is the basis for where our food comes from, thus we must know if sustainable development practices are resulting in higher or lower yields in the attempt to mitigate climate change, health, or other variables.

Projects dedicated to enhancing sustainable energy and energy efficiency use new technologies to diminish **energy consumption**, mitigate pollution, and foster the adoption of

alternative energy fuels and sources. Energy usage spans across various sectors, encompassing electricity for building operations, equipment, and agricultural necessities like power for facilities, air conditioning, and manufacturing equipment.

The assessment of energy consumption relies on the business's power meter, as reported by the utility in kilowatt hours and it is important to ensure that the energy is derived from sustainable sources[26.] This approach not only addresses energy efficiency but also emphasizes the importance of sustainable practices.

Social Indicators

A significant challenge faced by the nation is the substantial portion of the population living below the national poverty line, highlighting the pressing need for **poverty alleviation** efforts. The Research Institute in Economic Sciences of the University of Costa Rica (IICE-UCR) discovered that "by the end of 2022, the number of poor households in the country could have reached 24% or 25%" [7]. Hence, a primary objective for FDS has consistently been to elevate individuals out of poverty. Their core focus revolves around helping "people turn dreams into reality and improve living conditions hand in hand with sustainable development" [11]. To measure the effect FDS has on this aspect, metrics such as income levels, employment rates, and asset accumulation will be measured. The government program Fideimas provides information on poverty through a certification to guarantee the credit loaned out to impoverished clients will

be paid back through a bank if the clients can't pay[34]. FDS also has the option of getting a poverty report through the government.

Equal opportunity is pivotal in Costa Rica for fostering a society where individuals from all backgrounds can thrive and contribute to national development. A commitment to equal opportunity allows the country to leverage its diverse population, promoting social cohesion and economic prosperity. Ensuring fair access to education, employment, and resources broadens the talent pool, fostering innovation and sustainable growth. This commitment aligns with Costa Rica's dedication to social justice and human rights, fostering an inclusive and harmonious society free from systemic barriers. To measure FDS's impact, metrics such as women's empowerment, gender equality, disability inclusion, accessibility, racial and ethnic diversity, LGBTQ+ inclusion, and immigrant inclusion can be considered.

Economic Indicators

While **profits** cannot be the sole deciding indicator with which we can see the effects of Fundecooperacion's practices, it cannot simply be ignored. If profits fall too far for the sake of being climate friendly, people will go out of business as their work becomes unsustainable. There are many factors that play varying roles in a business's profitability. It would be difficult to definitively prove changes in profit are a result of FDS and certain sustainable development practices being implemented. However, finding out if there is any correlation between taking the FDS loan and profit is valuable information that can indicate a positive or negative relationship between the two.

Some FDS programs are intended to help reduce the costs associated with operating small farms and businesses. **Cost reductions** can be realized in areas such as utility bills. With the purchase of updated equipment, the small farmer may see a reduction in maintenance costs and downtime. Upgraded and enhanced equipment could also help to increase the productivity of farms [27]. Additionally, using energy and water more efficiently will reduce costs. Examples of this may include implementing enhanced insulation for improved air conditioning and introducing irrigation systems that reduce water waste.

Costa Rica is subject to severe weather events that increase the **risk** of negative impact to MSMEs in terms of profitability and sustainability. FDS programs support funding improvements for irrigation, the adoption of new green technologies, and planting trees, all of which are directed towards helping to reduce the risk. These programs can also help increase income during times of low productivity. As a result, when a severe weather event occurs or if yields are lower than normal, the MSME and dependent communities have stored funds available to cover them during these periods of reduced income. FDS conducts these risk analyses through the company Agroclimatica as previously mentioned.

FDS Data Tracking

FDS currently utilizes **Salesforce** and **Excel** to store their data. Salesforce is a cloud-based Customer Relationship Management (CRM) database known for effective data management, tracking, organization, and analysis [28]. It organizes data using objects and records,

with objects akin to tables and records resembling rows in a spreadsheet. Fields, stored in columns, encompass data such as revenue or business owner names. The analytics cloud allows users to create insightful dashboards for data visualization.

Salesforce's account feature is crucial, representing the companies or individuals a user engages with. Each account has contacts and lists the individuals associated with that account. This linking of records across multiple accounts facilitates data organization and display, surpassing spreadsheet capabilities [28].

FDS employs Excel for the organization and compilation of their raw data. The technical analysis and credit assessment processes are entirely conducted within the Excel platform. The findings from those processes must be transferred to Salesforce. FDS then transfers their information from Salesforce and Excel to Power BI to produce comprehensive data analytics. Power BI, a business intelligence software specializing in data visualization, offers vigorous tools and dashboards.

Our Project Approach

Our project's main goal was to create a methodology to measure and demonstrate the impact of FDS's credit program on various stakeholders, including MSMEs, farmers, and local communities. Our plan consisted of developing a data collection tool and inputting that data into the existing database, offering quantitative insights into the economic, social, and environmental outcomes of FDS initiatives. The new data FDS will collect with our provided methodology enables them to make informed decisions, track progress, and showcase the positive transformations resulting from their dedicated efforts towards sustainable development in Costa Rica. To reach our goal, we organized our approach into fulfilling three different objectives:

1. Observe and identify what information FDS currently has in their database to establish a baseline.
2. Define specific indicators to measure and evaluate the impact of FDS practices.
3. Create a method of data collection to accurately display the impact of FDS sustainability practices.

OBJ 1: Observation of Existing Data

Reviewing Existing Program Data

Most of the FDS' information concerning their sustainability efforts is stored in Salesforce, their current database. Collaborating with the FDS team provided valuable insights into acquiring existing data for achieving the project's ultimate objective. We examined lists of clients, their industry types, and the practices they employed. Additionally, we thoroughly reviewed files supplied by FDS, including the Agroclimatica risk analysis, client credit reports, and technical analyses. Through observing these data and the accompanying documents, we identified a broader range of indicators. This expanded set of indicators allows for a meaningful comparison with those presented in our literature review.

Database Findings

Once we gained access to their database, we planned to use some of the information our sponsor had collected on their clients' sustainability. However, very little data in their database was quantifiable, making the goal of measuring the impact of sustainable development practices very difficult. The database was structured in such a way that many questions about sustainability had answers like very good, good, bad, very bad, or even just yes or no. This can be seen in Figure 4, displaying their technical analysis after we translated it. It had several questions with multiple choice or yes/no answers like one which asks if the client maintains a bank account to manage project income, to which the answer recorded was a simple yes.

Finance	Weight:	8.8%	Qualification:
Element to evaluate		Weight	Parameter
Do they affect external economic variables? (exchange rate, imports, FTA)?		15%	No
Clients: approximate number of clients		5%	More than 10 clients
Suppliers: approximate number of suppliers		5%	More than 4 suppliers
Does the client master/know the break-even point of the business?		15%	Yeah
What are the payment methods you offer to your clients?		15%	Counted
Do you maintain a bank account to manage project income?		15%	Yeah
Detail of the level of debt (formal and informal) of the business		15%	Between 0% and 10%
Accounting/Financial Statements		15%	Clear and regular records

Figure 4**: Example of FDS Client **Technical Analysis (translated from Spanish) [29]

Additionally, data was not always uniform across clients, even if they were in the same sector of business. In the data collection process, most questions analysts ask are specific to the individual client and are primarily asked to check up on how clients are doing and maintain good relationships with them. This isn't a bad thing necessarily, but it comes with the consequence of being unable to compare one client to another in terms of the effectiveness of their sustainable practices. To show changes in the sustainability of its clients, the database needs more fields and inputs that can be directly compared across multiple clients.

The most developed, organized, and quantifiable information in FDS's database was found in the credit analysis, risk analysis, and the data from Agroclimatica. The Agroclimatica report is a spreadsheet with data on all clients which includes the humidity and temperature of their locations, their business sector, and most notably their CO_2 emissions. The risk analysis is also done by Agroclimatica. This report assesses the risks posed to clients in the realm of

climate-related challenges and other areas.

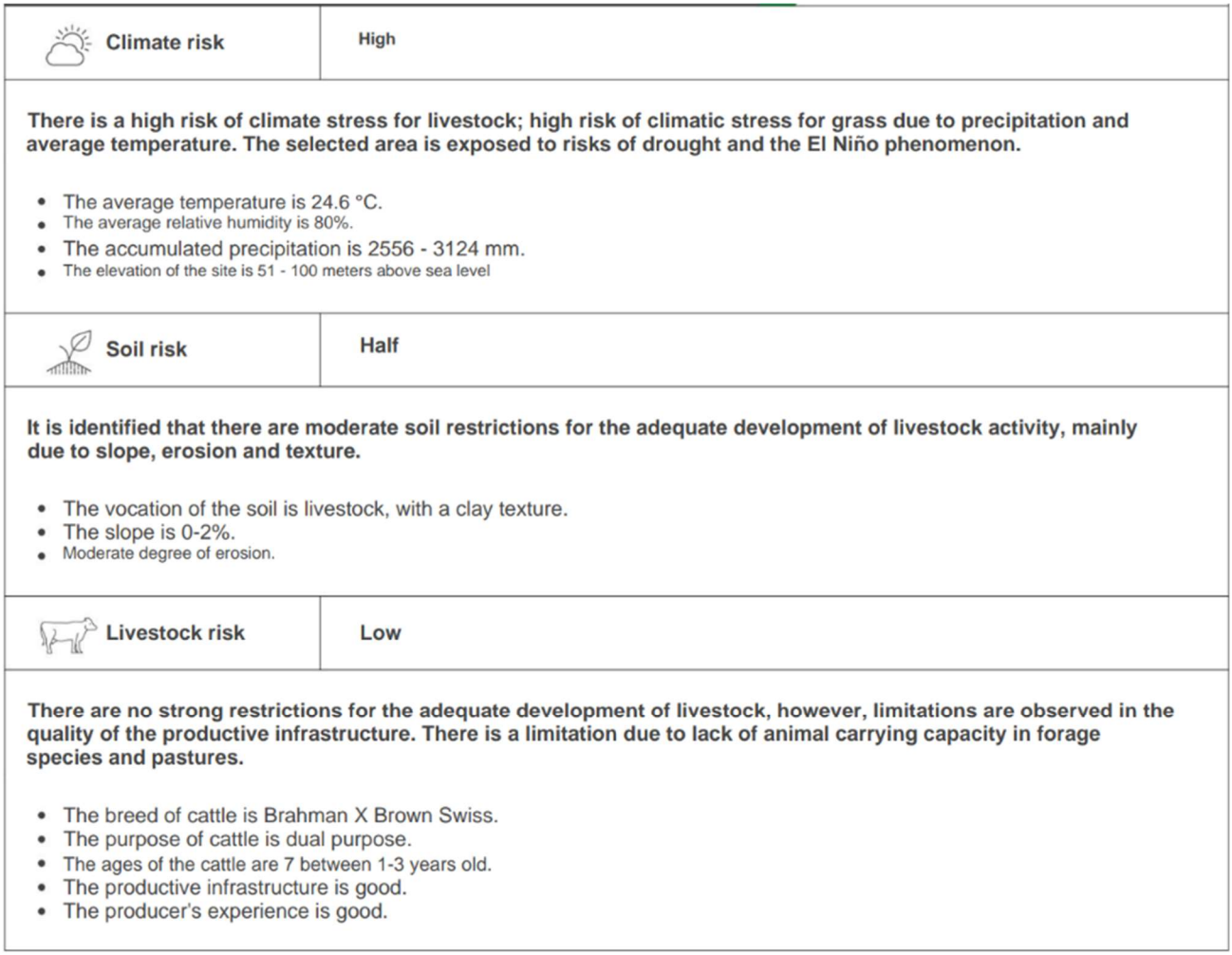

***Figure 5**: Agroclimatica **Risk Analysis**[29]*

In Figure 5, the analysis displays information on local weather patterns like heavy rain, high humidity, or droughts in a client's location. Entities such as livestock, soil quality, and specifically how they are affected by the climate are also listed. Additionally, the analysis records the carbon footprint of a client's activity and produces an overall risk score for that client

which is used to help FDS decide which practices their clients should implement. Figure 6 shows a client who had a high risk score of 7.22.

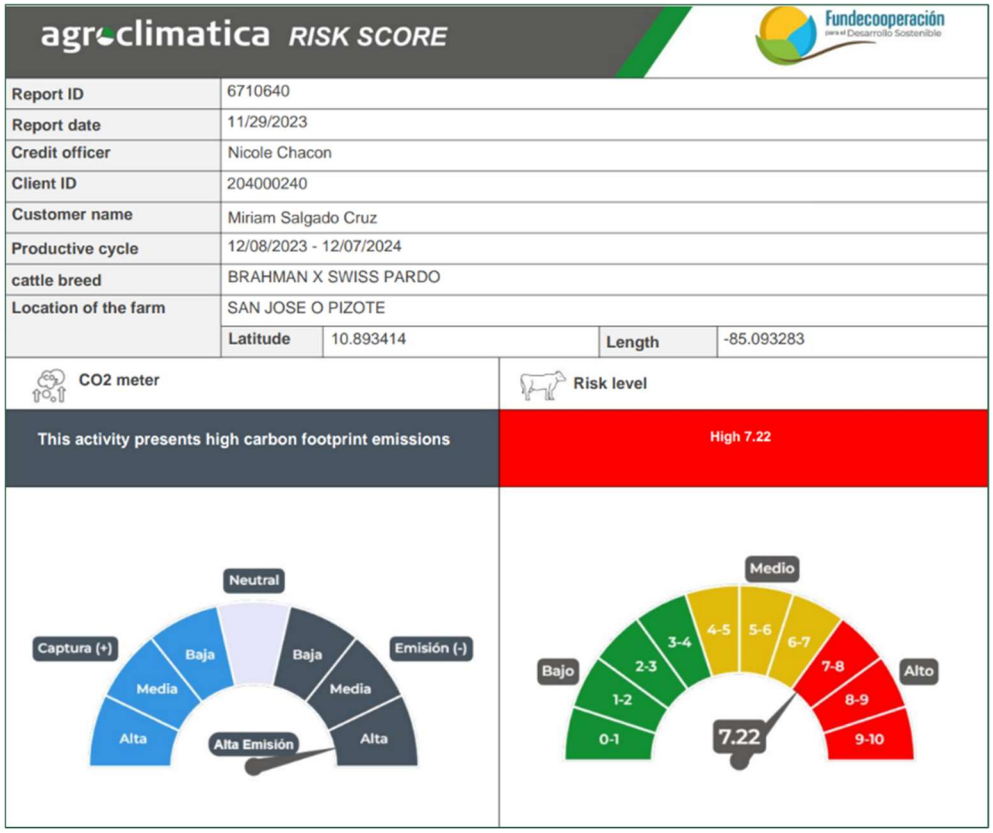

***Figure 6**: Agroclimatica **Risk Analysis**[29]*

Finally, FDS conducts a credit analysis for every client with the primary objective of figuring out how feasible it is for a client to pay back the FDS loan. In this analysis, information such as the client's income statement, assets, and credit history help in describing a client's economic standing. These data are updated regularly, however FDS does not track how much of the loan is distributed to each of the implemented practices. For example, they could not tell if

all their credit was being allocated to the specific sustainability practices recommended by the loan advisors or if some of the money was used for other purposes.

From our database review, we were able to confirm 4 indicators that could be measured and had the biggest effect on sustainability. Those indicators were CO_2 emissions, waste reduction, energy consumption, and water usage. Emissions are currently tracked using Agroclimatica, and energy and water can be generally tracked by any Costa Rican who pays an electricity bill or is connected to city water. Everyone generates waste and there are multiple ways to reuse or track that waste (recycling, composting, etc.).

OBJ 2: Define specific indicators to measure and evaluate the impact of FDS practices.

Identifying Metrics to Indicate Sustainability Initiatives' Impacts

Through a comprehensive literature review, we examined existing reports on environmental, social, and economic sustainability to identify indicators of impact on these three pillars. We conducted a thorough review of the existing FDS programs' metric-related data. This involved examining data and reports presented within their database, analyzing tracked metrics, and identifying any gaps for new data collection. This approach was crucial as FDS possessed a substantial amount of available data that enabled us to address where there was any missing data.

Identifying Sustainability Indicators

In our specific project with FDS, we recognized the importance of grounding our impact assessment metrics in established literature related to the three pillars of sustainability. Utilizing scholarly articles, reports, and publications specifically pertaining to sustainable development initiatives within the context of small farmers and MSMEs, like FDS's beneficiaries, allowed us to focus on the assessment of these types of programs. Thus, when looking at information FDS currently has it was crucial to keep this in mind when trying to establish a baseline.

FINDINGS: Literature Review Outcomes

Upon completing our comprehensive literature review, we pinpointed four concrete indicators that effectively depict the impact of sustainability practices. These measurable indicators include CO_2 emissions, water usage, waste reduction, and energy consumption. They offer quantifiable insights into the contributions of FDS clients to their carbon footprint, resource conservation, waste minimization, and energy efficiency. By monitoring these factors, FDS can gauge the effectiveness of suggested practices in addressing risks for their clients and their impact on the environment. This monitoring not only contributes to the overall environmental well-being but also fosters cost savings through heightened efficiency, thereby reinforcing the economic viability of sustainable practices. These indicators will also provide a quantifiable means of assessing the effectiveness of FDS's sustainability initiatives and serve as crucial tools aligning with the economic, social, and environmental pillars of sustainability.

Assessing the Effectiveness of FDS Programs

To create an effective tool to identify and measure the impact of FDS's sustainability programs, specific data collection and analysis methods were performed by our team. By conducting interviews and comparing all the presented data, we assessed the feasibility of collecting the desired data from the clients.

Impact Evaluation Interviews

Impact evaluation provides insights into each of Fundecooperación's practices, and assists in decision-making on whether to continue, discontinue, replicate, or increase their involvement [30]. This involved systematically assessing the outcomes of Fundecooperación's intervention. We interviewed three clients with varying relationships with FDS from long-time partners to newcomers who are only just beginning to receive FDS's support. We began by defining the purpose and scope of the specific practice implementations, defining relevant indicators, looking into data collection methods, and formatting specific evaluation questions (seen in Appendix A in the Supplementary Materials file). These questions served to find out how easy and accessible measuring our proposed indicators would be for the clients.

Comparing Interview Data

We conducted three interviews as part of our research methodology, aiming to enhance our understanding of the practical aspects surrounding the measurement of our proposed sustainability indicators. Through these interviews, we searched for insights into the feasibility and accessibility of implementing these indicators from the perspective of potential clients. By comparing the feedback gathered during these interviews with the findings from our previous research and database analysis, we aimed to gain a holistic understanding of the challenges and opportunities associated with measuring and implementing these indicators in real-world scenarios.

FINDINGS

Fundecooperación and Client Relationships

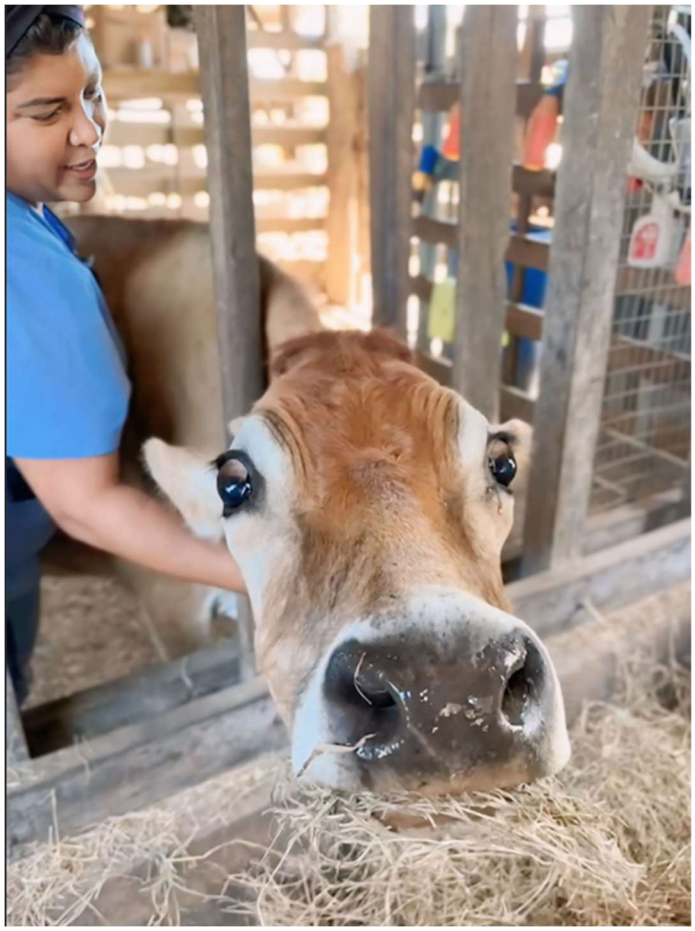

***Figure** 7: Karla and Her Cow Margarita on her Farm Finca La Providencia*

In the interview with Karla, as shown in *Figure 7*, the owner of Finca La Providencia, the collaboration between Fundecooperación and the farm emerges as a crucial aspect of their operations. Fundecooperación's involvement extends beyond financial support, including technical assistance and guidance aimed at improving the farm's sustainability practices. Karla

highlights the importance of this collaboration, emphasizing how it has facilitated the implementation of innovative approaches to dairy production.

One notable area of collaboration between Fundecooperación and Finca La Providencia is in the realm of environmental conservation. Karla discusses how Fundecooperación has supported the farm in implementing strategies to minimize its environmental footprint, such as promoting sustainable land management practices and biodiversity conservation. This partnership underscores Fundecooperación's commitment to fostering environmentally responsible agricultural practices within the region.

Moreover, Fundecooperación's collaboration with Finca La Providencia extends to initiatives aimed at improving community livelihoods. Karla mentions how Fundecooperación has facilitated training programs for local community members, providing them with valuable skills and knowledge related to sustainable agriculture. This emphasis on community engagement reflects Fundecooperación's holistic approach to development, which seeks to empower local stakeholders and foster inclusive growth.

Overall, Fundecooperación’s support for Finca La Providencia represents a mutually beneficial partnership aimed at promoting sustainable development within the agricultural sector. By leveraging technical expertise and financial resources, Fundecooperación has been an important operation in supporting the farm's efforts to enhance its sustainability practices and contribute to the well-being of both the environment and the local community.

Interview Results

In the context of Karla's interview at Finca La Providencia, data collection plays a crucial role in monitoring the farm's sustainability practices and assessing the impact of Fundecooperación's collaboration. Karla mentioned several key indicators that they track, including water usage, waste management, and energy usage. These indicators provide valuable insights into the farm's environmental footprint and its commitment to sustainable practices such as rotational grazing, living fences, and rainwater collection. Additionally, Karla emphasizes their use of biodegradable, natural, chemical-free products for cleaning and cow pest control, prioritizing their commitment to eco-friendly, sustainable practices.

***Figure 8**: Milk Collection/Storage Technology purchased with FDS Loan*

***Figure 9**: Milking Technology purchased with FDS Loan*

Fundecooperación's support has enabled Finca La Providencia to implement various technologies and practices aimed at enhancing sustainability, such as improved milking technologies, as shown in Figure 8 and 9, and investments in livestock. These specific milking technologies have permitted Karla to efficiently collect milk while having less negative impact on her cows' health and decreasing the chances for the milk to become contaminated with bacteria. Karla keeps diligent records of all expenses, and activities related to these initiatives, maintaining written documentation in binders. However, in the aspect of measuring the efficiency of the practices, challenges will be faced in attributing changes in various indicators to specific loans or practices due to the farm's implementation of multiple interventions.

Contrasting with Karla's meticulous record-keeping, the beauty salon owner interviewed does not engage in any data collection or tracking of indicators. The salon, which operates as a home-based business, received funding from Fundecooperación for infrastructure improvements but cannot differentiate between energy or water usage for the salon versus the household. This lack of data collection obstructs the salon's ability to assess its environmental impact or measure the effectiveness of its investments.

Figure 10: *El Trapiche (Sugar Mill) Owned by currently onboarding FDS Clients*

Similarly, El Trapiche, a sugar mill enterprise (*Figure 10*), has yet to officially partner with Fundecooperación and does not engage in any data collection practices. Despite operating for twenty years, the mill does not track any indicators related to sustainability or environmental impact. However, the mill's utilization of waste cane material to fuel its operations aligns with sustainable practices, although without formal documentation or measurement.

These contrasting examples highlight the importance of in-depth data collection applications in evaluating the effectiveness of sustainability initiatives and financial investments.

While Finca La Providencia demonstrates diligent record-keeping and monitoring of key indicators, the beauty salon and El Trapiche emphasize the challenges posed by a lack of data collection structure. Moving forward, efforts to promote sustainable development should prioritize development and support for data collection and monitoring tools to ensure informed decision-making and accountability.

Measurable Practices

To accomplish the goal of measuring the impact of the practices FDS prescribed to its clients, we needed to know exactly what those specific practices were. FDS had a list of all the practices their clients use with their credit program, from tracking fish, to using seed banks, and organic fertilizers just to name a few. After translating all 82 of them, our team individually researched every practice to get an understanding of how they function, how they can be measured, and most importantly how they affected our indicators for sustainability. For example, organic farming is a plant and animal-based farming method to provide the nutrients necessary for crops to grow without chemical fertilizers or pesticides. This results in healthier and more fertile soil but a 25% decrease in crop yield. It also sequesters carbon and allows for a 30% increase in biodiversity when compared to conventional farming[31]. This research allowed us to determine the effects these practices had on our sustainability indicators. The second question we needed to answer was whether these indicators could be measured by FDS or their clients. In this example, we determined biodiversity and carbon emissions to be unrealistic for the clients who use this practice, many of whom are small farmers, to measure. However, any farm can calculate

their crop yield, and there are inexpensive soil tests which can determine their health or fertility[32].

For further organization of these practices, we looked at what sector of business FDS's clients fall into. The 5 major sectors are livestock, agriculture, service, commerce, and industry. The previous organic farming practice was an example of a practice implemented by clients operating in the agricultural sector. Livestock farmers would use practices related to pasture management, improved feed, or aquaculture. Livestock and agriculture make up the bulk of FDS's clients and that is also reflected in where most of the practices are targeted. Industrial sector practices would relate to turning raw materials into consumable goods, so an example of an industrial practice was adopting a seafood traceability program. Ecotourism is a service sector practice that focuses on tourism which supports local business and culture while also being mindful of carbon footprint and energy consumption. In the Commerce sector, waste management and rain harvesting are the prominent practices. It is also important to note some practices can be used across multiple sectors. For example, solar panels for generating electricity and heating water can be used by restaurants in the service sector or stores in the commerce sector. Figure 11 below demonstrates how we organized some of the practices across sectors. The process of organizing these practices by sector and how they affect sustainability was the basis for our method to track and collect data from FDS clients.

Sector	Practices
Livestock	Fog collectors, Forage Pastures, Forage Banks, Pasture Management and Rotational Grazing, Permaculture, Protected Environment for Livestock, Respect for the minimum maturity sizes of species, Silage, Sustainable Forest Management, Trees in Pastures, Aquaculture, Beekeeping
Agriculture	Agricultural Drainage, Agricultural Terraces, Agrosilvopastoral System, Coffee Fertilization Practices, Biodigestors, Conservation Agriculture, Crop Diversification, Crop Rotation
Commerce	Waste management, water harvesting
Industry	Seafood Traceability Program,, Filter Presses, Fire Break Strips, Fishing Methodology Without Hooks, Fishing Only Non-Endangered Species
Service	Ecotourism

Figure 11: *Example of Practices (not all 82) organized by Sector*

Our team aimed to provide FDS with a tool they can use to measure the impact of their sustainability practices, which means the next step in our project was to devise a method for collecting the necessary information and storing it in their database. This involved researching FDS funded practices to figure out which sustainability indicators are most directly affected by each practice and organizing them in accordance with their effect on the three pillars of sustainability as well as the sector of business in which they were used. When FDS fills out a tracking sheet with information on their client, they will need to store it in their database. This means we also made sure to create a format by which data collected from the tracking sheets

could be stored in their Salesforce database. We worked very closely with FDS's analysts and IT personnel to figure out how to best organize the tracking sheets in Salesforce in a manner that remained efficient for analysts to regularly input data.

Comparing Data

We compared the current data supplied by FDS with the data our team collected through our interviews. Once these results were recorded and analyzed, we presented them to Fundecooperación and allowed them to use the findings for decision-making, program development, or policy decisions. By involving the stakeholders, our evaluation's validity and relevance will be enhanced.

OBJ 3: Create a method of data collection to accurately display the impact of FDS sustainability practices.

Tracking Sheets

To effectively track the quantitative data that would indicate the impact of FDS' sustainability practices, our solution was to develop data collection sheets that would serve as the basis for data collection going forward as FDS acquires new clients. The format of the sheets was outlined after conducting interviews with clients and FDS staff, looking at client credit allocation, sample files, the Agroclimatica risk analysis data, and the FDS Salesforce database. In doing so, we identified key points of information that should be considered and noted when trying to track data that will indicate sustainability impact. We found this was the most applicable solution given FDS did not have a regulated method of data collection, as discussed in our database findings section.

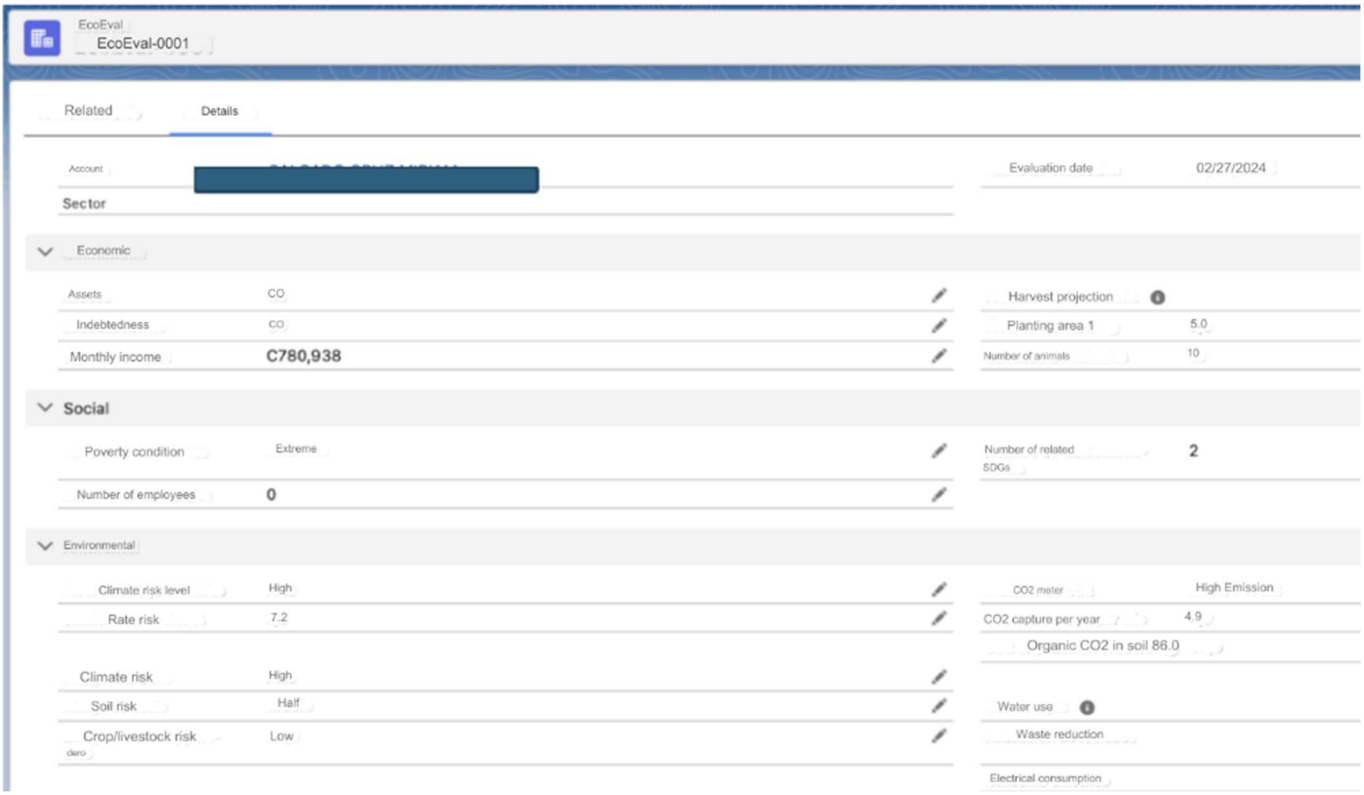

Figure 12: *Example EcoEval Salesforce Profile (Translated)*[29]

We created two data collection sheets. The first, Figure 12, is for the initial data intake of a new client, called EcoEval, with information regarding their finances, risk analysis, and our four main indicators: CO_2 emissions, Water Usage, Waste Reduction, and Energy Consumption. The second tracking sheet lists the FDS employed sustainability practices and their indicators, which will be measured yearly. This new data collection process is designed to streamline information gathering over time, allowing FDS to observe and note changes consistently during the loan. After advisors fill the sheets with the required information, it will be easily entered into Salesforce with our new profile outline. This approach not only maintains efficiency in visits between advisors and clients, as the questions to be asked are clearly outlined, but also can

facilitate meaningful comparisons with data from other clients who share similar characteristics, such as the type of organization, their risk types, or practices, as displayed and accessed from our new Salesforce profiles.

Metrics and Indicators

The metrics and indicators were derived from researching the practices and the 3 pillars of sustainability. Some metrics are used to determine the change in the sustainability indicators of the clients through the EcoEval and others to determine the impact of the practices.

FDS will use the **EcoEval,** shown in *Figure 12*, to determine the change in the sustainability indicators of the clients. The EcoEval will record their name, industry type, and size of land. Income, assets, and debts will be tracked through information from their bank and the general records they keep. Carbon dioxide emissions and their risk assessment will be done through the company Agroclimatica. The clients keep records of energy and water usage through the utility companies. Water usage is more difficult to track if the client isn't on city water and is getting their water through a reservoir or a well. FDS will also be tracking the clients' waste generation if they maintain records of this information. Animal quantity is another indicator on the EcoEval and is determined by counting the number of animals on a farm. The last thing that will be tracked is their economic standing through a bank, and how it changes over the period of the FDS loan. The EcoEval is broken up into 3 categories: economic, social, and environmental to go along with the 3 pillars of sustainability. One issue we have run into is many businesses are

run out of the client's home, so they have no way of separating home and business usage of energy, water, and waste.

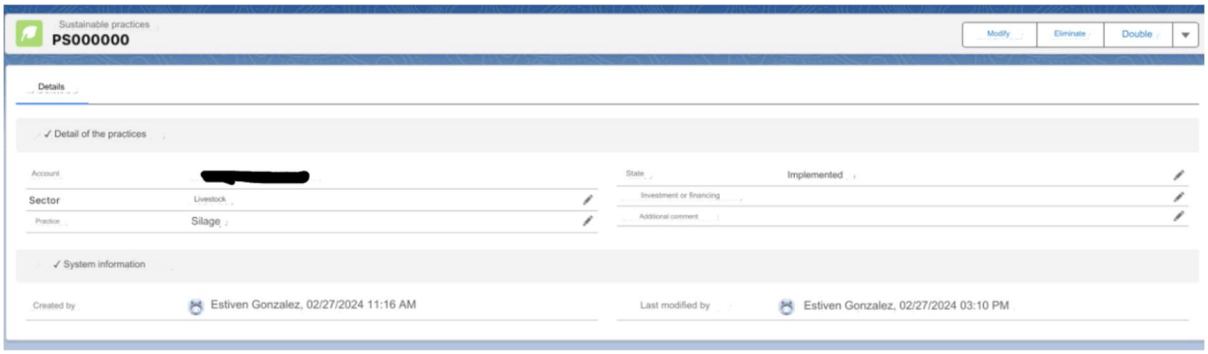

Figure 13 *Salesforce Profile for Practices*[29]

In the second tracking sheet, shown in Figure 13, the indicators identified as relevant to the **sustainability practices** FDS has funded will be tracked. Only the practices FDS helped implement will be looked at. Some of the practices include crop rotation and irrigation systems. The indicators we have selected include crop yield, which is determined by the quantity of crops per acre. Livestock yield involves products produced from, for example, cows or sheep including milk, wool, and meat. Poultry yield tracks eggs produced and meat. Aquaculture yield includes products produced by fish and all farmable aquatic life including fish, shellfish, and caviar. Soil quality can be determined through tests to measure the health and fertility of the soil where the crops are grown. This includes nitrogen, phosphorus, and potassium levels. Erosion and topsoil retention can be determined by measuring the thickness and depth of the topsoil layer. It can also

be determined visually. Pests and disease are important metrics to track as they strongly affect crop yield and crop health. Pests also affect livestock health with mosquitos, ticks, and disease outbreaks that can wipe out entire herds and fields. Pest can be tracked by counting the number of pests present on the crops visually or by using a trap. Disease can be determined by visually looking at symptoms of the crops, such as wilting, discoloration, or the presence of fungal growth. There are also innovative technologies that use digital imaging and remote sensing to determine the health of a crop[33]. Herd fertility is directly linked to animal health and is determined by how many pregnancies a herd has in a year.

For the purpose of assigning these indicators, we researched how specific practices impact sustainability. In the livestock sector practices like forage pastures and creating silage have indicators such as herd fertility, animal quantity, and livestock yield. We assigned these indicators because both practices involve improvements to what animals eat, allowing for clients to have more animals, that have more meat or milk, and have enough nutrition to remain fertile. For agriculture, practices like crop rotation and organic farming have the following indicators: crop yield, soil health, soil fertility, and water usage. These practices are focused on making changes in the structure and treatment of soil and its contents, which have a range of effects from making it easier for water to travel in soil to decreasing crop yield as compared to traditional farming. These changes in soil also affect its health and fertility. Adopting a seafood traceability program is a practice used in the fishing industry and its impact is seen with fish yield and diseases. Tracking fish from the ocean through the supply chain will allow businesses to make sure they aren't losing fish and that they're being handled properly during the process.

Ecotourism is used in the service sector which focuses on supporting local business and culture while being mindful of energy consumption and carbon footprint, hence we selected CO2 emissions and energy consumption to be indicative of the practice's effectiveness. Finally in the commerce sector, waste management is indicated by waste reduction, water usage, and CO2 emissions. Depending on how waste is recycled or disposed of water could be used, emissions may increase if trash is burned.

An observation we made which would prove very useful in the future was that when we separated practices into the 5 sectors, practices within the same sectors shared many of the same indicators. In livestock, we found that some combinations of livestock yield, poultry yield, animal quantity, aquacultural yield, and herd fertility were indicative of multiple practices. For example, creating silage shares the same indicators with forage pastures. Similarly, forage pastures and silage practices in the agricultural sector shared the same indicators of crop yield, soil fertility and health, and water usage. The agricultural sector also included topsoil retention and crop diversity, while some indicators were useful across multiple sectors like water usage. With the focus of FDS's practices on these two sectors, there were few indicators exclusive to industrial, commerce, and service sectors.

It was a challenge to determine the changes caused by the practices with no outside factors affecting the indicators which could have been affected by unusual weather or a compounding effect from multiple practices. Another issue was that a lot of the credit allocated was linked to infrastructure and didn't have any effect on sustainability like improvements and the acquisition of equipment or the repair and creation of new buildings.

Implementation

Fundecooperación will be directly inputting the information collected from the clients on the indicators into Salesforce. The tracking sheets for EcoEval and the practices will be linked to the accounts as objects. Inside of the objects representing practices, a new object was created for tracking the indicators. We originally organized practices by sector to create an overlap in the indicators to help facilitate analysis and to filter out the indicators that are not related. However, during the implementation process we realized it would be very tedious to have analysts filter through over 80 practices to get indicators they need. We made a slight alteration in which we instead grouped indicators into the 5 sectors using the common indicators for practices implemented in the same sectors. These sectors include livestock, agriculture, commerce, service, and industry. Inside the EcoEval object, the indicators and the metrics used to measure them are recorded in fields. This time we separated the fields into social, economic, and environmental indicators as seen in Figure 12 (Social Economica, and Ambiental in Spanish).

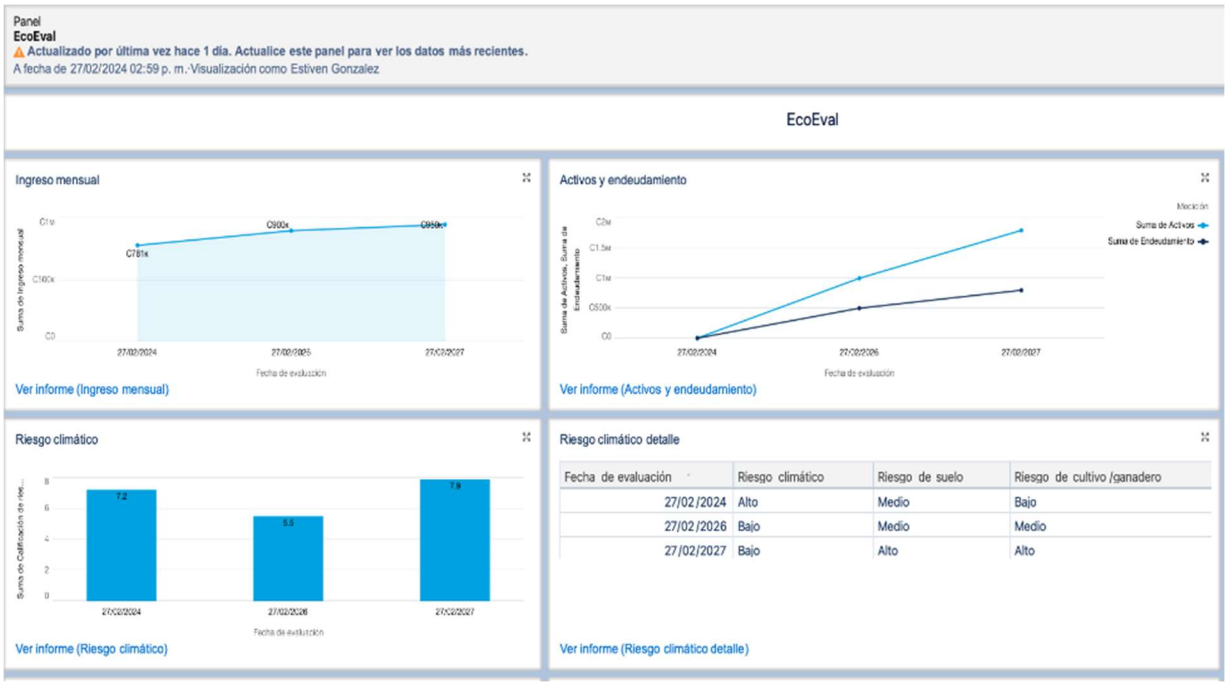

Figure 14 *EcoEval Dashboard29*

Analysis will be done over the payback period of the credit, with new tracking sheets for the EcoEval and the practices being created annually. Two new dashboards will be created for each client to visually show how the indicators change over time. The sample dashboard in Figure 14 shows tables, bars, and line graphs demonstrating changes over time in indicators such as assets, debt, water usage, climate risk, electrical consumption, and more. There will be separate dashboards to display the data from the EcoEval and the data from the practices, with the general format being the same.

Conclusion

Over the course of this project, our team conducted extensive research on FDS, climate changes effects on Costa Rica, FDS, and how the Salesforce database works. We identified all the information FDS had in their database relevant to the project. Then we researched all of FDS's practices to understand how they impact sustainability and how to measure that impact. We went on to create meticulously organized data FDS collection sheets and formatted them into FDS's database. This would permit FDS to effortlessly navigate through the statistics reflecting the impact of their initiatives. They will also be able to efficiently enter the data into the Salesforce client profile given the required information has become streamlined across all five sectors. With a well-organized data collection sheet, we provide FDS with an improved data collection method enabling them to better assess the impact of their sustainability practices.

Recommendations

After creating the tracking sheets, we recognized areas for further development and analysis of the data collected using these methods.

We recommend that after FDS collects enough profiles' required information, they conduct analyses using various Salesforce tools. As presented in the example EcoEval dashboard, FDS will be able to visualize the data and track trends in the displays. In doing so they will be able to make informed decisions on whether practices are effective or if they should add more practices to reduce a client's risk or improve their level of sustainability. Additionally, they can compare the data from multiple clients in similar sectors who are utilizing similar practices.

To continue tracking CO_2 emissions and to identify any new risks associated with clients, we would advise FDS to run Agroclimatica risk analyses on a yearly basis so they can keep collecting this data crucial to identifying the impact of their practices.

Educating their clients on the importance of employing these sustainability practices and what sustainability is in general would tremendously aid in their impact on the community given the lack of knowledge presented by some of the interviewees. In turn, FDS would minimize future risks posed to clients and would further ensure FDS stays compliant with a long-term commitment to acting responsibly in the realm of sustainability.

We would also recommend FDS to reevaluate the effectiveness of the data collection methods for the indicators. For example, to improve the measurement of waste, it would

behoove FDS and their clients to weigh trash bags rather than their current method of counting the number of trash bags filled monthly.

Finally, we advise FDS to add a map to dashboards to see the impact of their practices on a geographic scale. We believe this is important as location is already a factor considered when assessing the clients' risk and determining what practices they should implement. Therefore, seeing how indicators change from region to region will keep FDS more informed on the role geography plays when trying to be sustainable.

References

1

Campbell-Lendrum, D., Manga, L., Bagayoko, M., & Sommerfeld, J. (2015). Climate change and vector-borne diseases: What are the implications for public health research and policy? *Philosophical Transactions of the Royal Society B: Biological Sciences*, *370*(1665), 20130552. https://doi.org/10.1098/rstb.2013.0552

2

How climate change affects water resources in costa rica. (2018, October 19). [Text].

https://www.iaea.org/newscenter/news/how-climate-change-affects-water-resources-in-costa-rica

https://www.wri.org/insights/coffee-farmers-costa-rica-are-brewing-solutions-climate-change-and-competition

3

Tye, S., & Grinspan, D. (2019). *Coffee farmers in costa rica are brewing up solutions to climate change and competition*. https://www.wri.org/insights/coffee-farmers-costa-rica-are-brewing-solutions-climate-change-and-competitionhttps://www.wri.org/insights/coffee-farmers-costa-rica-are-brewing-solutions-climate-change-and-competition

4

Fundecooperación. (n.d.).

https://fundecooperacion.org/en

5

Our projects. Fundecooperación. (2022, April 22).

https://fundecooperacion.org/en/our-projects/

6

World bank climate change knowledge portal. (n.d.). Retrieved December 18, 2023, from https://climateknowledgeportal.worldbank.org/https://climateknowledgeportal.worldbank.org/

7

Times, T. (2023, April 19). Beyond the scenery: The harsh reality of poverty and inequality in costa rica. *The Tico Times | Costa Rica News | Travel | Real Estate*. https://ticotimes.net/2023/04/19/beyond-the-scenery-the-harsh-reality-of-poverty-and-inequality-in-costa-ricahttps://ticotimes.net/2023/04/19/beyond-the-scenery-the-harsh-reality-of-poverty-and-inequality-in-costa-rica

8

Harvey, C. A., Saborio-Rodríguez, M., Martinez-Rodríguez, M. R., Viguera, B., Chain-Guadarrama, A., Vignola, R., & Alpizar, F. (2018). Climate change impacts and adaptation among smallholder farmers in Central America. *Agriculture & Food Security*, *7*(1), 57. https://doi.org/10.1186/s40066-018-0209-xhttps://doi.org/10.1186/s40066-018-0209-x

9

Water Scarcity – One of the greatest challenges of our time. (n.d.). Food and Agriculture Organization of the United Nations. Retrieved December 18, 2023, from http://www.fao.org/fao-stories/article/en/c/1185405/http://www.fao.org/fao-stories/article/en/c/1185405/

10

The 17 goals | sustainable development. (n.d.). Retrieved February 5, 2024, from https://sdgs.un.org/goals

11

Fundecooperación. (2019). 25 Years Promoting Sustainable Development Report. Fundecooperación. https://fundecooperacion.org/wp-content/uploads/2023/11/Memoria-25-Aniversario-ingles.pdf

12

Agroclimatica. (n.d.). Retrieved February 5, 2024, from https://www.agroclimatica.com/en/products

13

In costa rica, indigenous farmers change along with the climate—Costa rica | reliefweb. (2019, September 21). https://reliefweb.int/report/costa-rica/costa-rica-indigenous-farmers-change-along-climate

14

Ecotourism and sustainability at florblanca resort, costa rica. (n.d.). Florblanca. Retrieved December 18, 2023, from https://florblanca.com/sustainability/

15

Purvis, B., Mao, Y., & Robinson, D. (2019). Three pillars of sustainability: In search of conceptual origins. *Sustainability Science*, *14*(3), 681–695. https://doi.org/10.1007/s11625-018-0627-5

16

Defining sustainability: Our perspective on the catch all term | better future factory. (n.d.). Retrieved February 28, 2024, from https://betterfuturefactory.com/insights/definition-sustainability/

17

What are the three pillars of sustainable development? (n.d.). Retrieved December 18, 2023, from https://greenly.earth/en-us/blog/company-guide/3-pillars-of-sustainable-development

18

Rodríguez-Serrano, I., Caldés, N., Rúa, C. de la, & Lechón, Y. (2017). Assessing the three sustainability pillars through the framework for integrated sustainability assessment (Fisa): Case study of a solar thermal electricity project in mexico. *Journal of Cleaner Production*, *149*, 1127–1143. https://doi.org/10.1016/j.jclepro.2017.02.179

19

The farm carbon calculator. (n.d.). Retrieved February 6, 2024, from

https://calculator.farmcarbontoolkit.org.uk/

20

Gopal, S. (n.d.). *Carbon emissions kpis – floodlight*. Retrieved December 18, 2023, from https://floodlightinvest.com/carbon-emissions-kpis/

21

Times, T. T. (2021, March 18). Waste management "one of biggest environmental problems," Costa Rica says. *The Tico Times | Costa Rica News | Travel | Real Estate*. https://ticotimes.net/2021/03/18/waste-management-one-of-biggest-environmental-problems-costa-rica-says

22

US EPA, O. (2016, January 7). *Waste reduction model(Warm)* [Collections and Lists]. https://www.epa.gov/warm

23

Broman, B., & Shukla, S. (2019). *Water measurement for agricultural irrigation and drainage systems*. (n.d.). Ask IFAS - Powered by EDIS. Retrieved December 18, 2023, from https://edis.ifas.ufl.edu/publication/CH153

24

How to do Measuring climate resilience. (n.d.). https://www.ifad.org/documents/38714170/40193941/htdn_climate_resilience.pdf/fd0b42b0-3fc1-41e2-bd45-c66506fa5004

25

Farm-level indicators for resilience to climate change stressors. (n.d.). Retrieved February 29, 2024, from https://edepot.wur.nl/586850

26

How to read your electric meter | SRP. (n.d.). Retrieved February 28, 2024, from https://www.srpnet.com/customer-service/residential-electric/how-to-read-your-meter

27

Replacement strategies for farm machinery | ag decision maker. (n.d.). Retrieved February 5, 2024, from https://www.extension.iastate.edu/agdm/crops/html/a3-30.html

28

The number 1 crm software. (n.d.). Salesforce. Retrieved February 28, 2024, from https://www.salesforce.com/uk/

29

FDS internal data

30

Impact evaluation | better evaluation. (n.d.). Retrieved December 18, 2023, from https://www.betterevaluation.org/methods-approaches/themes/impact-evaluation

31

So, Is Organic Food Actually More Sustainable? – State of the Planet. 5 Feb. 2020, https://news.climate.columbia.edu/2020/02/05/organic-sustainable-food/.

32

Gerhardt, Nick. "How Much Does Soil Testing Cost?" *Forbes Home*, 28 Feb. 2024, https://www.forbes.com/home-improvement/lawn-care/soil-testing-cost/.

33

Gómez-Camperos, J. A., Jaramillo, H. Y., & Guerrero-Gómez, G. (2022). Digital image processing techniques for detection of pests and diseases in crops: A review. *Ingeniería y Competitividad*, *24*(1). https://www.redalyc.org/journal/2913/291371829028/html/

34

Sobre el fideicomiso | fideimas. (n.d.). Retrieved March 1, 2024, from https://fideimas.cr/sobre-el-fideicomiso

Appendix A: Interview Questions

SMALL FARMERS

Overall Obj: Want to understand their process and how they implement practices, ask questions about the effects of FDS practices and how it is affecting their farm

This will help us identify gaps in data and allow us to better understand what can be measured and tracked in the tracking sheets

GENERAL

1) Can you please introduce yourself and your role in the organization?

   ¿Puede presentarse y cuál es su papel en la organización?

2) What is your definition of being sustainable? What is its importance to you and your farm?

   ¿Cuál es su definición de ser sostenible? ¿Cuál es su importancia para usted y su granja?

3) How would you describe the way your farm operated before working with FDS?

   ¿Cómo describiría la forma en que operaba su granja antes de trabajar con FDS?

4) What problems did you experience that encouraged you to seek a partnership with an organization like FDS?

   ¿Qué problemas experimentó que le animaron a buscar una asociación con una organización como FDS?

5) Why did you decide to partner with FDS specifically?

¿Por qué decidiste asociarte específicamente con FDS?

INDICATOR Q's

1) What is your main source of energy?

¿Cuál es su principal fuente de energía?

2) Do you track your energy usage? How? Where?

¿Realiza un seguimiento de su consumo de energía? ¿Cómo? ¿Dónde?

3) Where does your water come from?

¿De dónde viene tu agua?

4) Do you keep track of how much you use? How? Where?

¿Llevas un registro de cuánto usas? ¿Cómo? ¿Dónde?

5) Do you keep track of your waste?

   ¿Llevas un registro de tus residuos?

6) Do you keep track of how much fuel you use?

   ¿Llevas un registro de cuánto combustible utilizas?

7) Do you keep a record of your income and expenses?

   ¿Mantiene un registro de sus ingresos y gastos?

8) Do you perform soil tests? If not, what would you be willing to pay for one?

   ¿Realizan pruebas de suelo? Si no, ¿cuánto estaría dispuesto a pagar por uno?

9) How difficult/easy is it to track your yearly quantity of animals, herd fertility, and crop?

¿Qué tan difícil/fácil es realizar un seguimiento de la cantidad anual de animales, la fertilidad del rebaño y la cosecha?

10) Are you able to track the health of your crops and livestock?

¿Puede realizar un seguimiento de la salud de sus cultivos y ganado?

6) How do changes in weather affect your current day-to-day farming?

¿Cómo afectan los cambios climáticos a su agricultura diaria actual?

7) What kind of changes affect CROPS and how?

¿Qué tipo de cambios afectan a los CULTIVOS y cómo?

8) What kind of changes affect LIVESTOCK and how?

¿Qué tipo de cambios afectan al GANADO y cómo?

PROJECT SPECIFIC

9) Tell us about some of the practices that FDS has advised you to use (Specify practices that the client uses)

Cuéntenos sobre algunas de las prácticas que FDS le ha aconsejado utilizar (Especifique prácticas que utiliza el cliente)

10) Do you track these changes? (Specify the indicators we expect to see)

¿Realiza un seguimiento de estos cambios? (Especifique los indicadores que esperamos ver)

11) How do you determine pasture health?

¿Cómo se determina la salud de los pastos?

12) How do you determine herd size, pasture size, herd rotation speed?

¿Cómo se determina el tamaño del rebaño, el tamaño de los pastos y la velocidad de rotación del rebaño?

13) What specific benefits have come about as a result of implementing living fences?

¿Qué beneficios específicos se han obtenido como resultado de la implementación de cercas vivas?

14) Have there been any challenges in implementing FDS practices? If so, please describe them.

¿Ha habido algún desafío en la implementación de las prácticas de FDS? Si es así, descríbalos.

15) Tell us about any improvements that have happened from using FDS practices.(crop yield, livestock, efficiency)

Cuéntenos sobre cualquier mejora que se haya producido gracias al uso de prácticas de FDS (rendimiento de cultivos, ganadería, eficiencia).

16) What factors outside of FDS cause these improvements?

¿Qué factores fuera de FDS causan estas mejoras?

17) How do you believe the current programs implemented with FDS impact the sustainability of your farm?

¿Cómo cree que los programas actuales implementados con FDS impactan la sostenibilidad de su finca?

18) How have operating costs changed after the implementation of FDS projects?

¿Cómo han cambiado los costos operativos después de la implementación de los proyectos FDS?

19) What is considered when hiring new employees? (if they have employees)

¿Qué se tiene en cuenta a la hora de contratar nuevos empleados? (si tienen empleados)

20) Does your farm prioritize diversity?(during the hiring process)

¿Su finca prioriza la diversidad? (durante el proceso de contratación)

21) Has FDS had any impact on this prioritization, and if so, how?

¿Ha tenido el FDS algún impacto en esta priorización? De ser así, ¿cómo?

22) How do you feel about our project? / How do you feel about tracking/taking down the information FDS requires?

¿Cómo te sientes acerca de nuestro proyecto? / ¿Qué opina del seguimiento y registro de la información que requiere FDS?

23) Is there any more information you would like to let us know about?

¿Hay alguna información más que le gustaría dejarnos saber? Commentarios?

Gracias!

Appendix B: Consent Form

Thank you for participating in this interview. The objective is to gain insights into your farming or enterprise activities and to explore how Fundecooperacion's funding can support your implementation of sustainable development initiatives. Your involvement in this interview is entirely voluntary, and any information you provide will be treated confidentially and used solely for research and analytical purposes.

Your continued participation indicated your informed consent to participate in this interview. If, at any point, you feel uncomfortable or decide to discontinue, you are free to do so without facing any consequences. Do you have any questions or concerns you'd like to address before we proceed?

By signing below, I confirm my consent and acknowledge that I understand and accept the terms and conditions outlined above.

Print Name. _____
Date_____

Signature. _____

Translated Consent Form (Spanish)

Gracias por participar en esta entrevista. El objetivo es obtener información sobre sus actividades agrícolas o empresariales y explorar cómo el financiamiento de Fundecooperación puede respaldar la implementación de sus iniciativas de desarrollo sostenible. Su participación en esta entrevista es completamente voluntaria, y cualquier información que proporcione será tratada de manera confidencial y utilizada únicamente con fines de investigación y análisis.

Su continuada participación indica su consentimiento informado para formar parte de esta entrevista. Si en algún momento se siente incómodo o decide interrumpir, tiene la libertad de hacerlo sin enfrentar ninguna consecuencia. ¿Tiene alguna pregunta o inquietud que le gustaría abordar antes de continuar?

Al firmar a continuación, confirmo mi consentimiento y reconozco que comprendo y acepto los términos y condiciones mencionados anteriormente.

Nombre Impreso: _____ Fecha: _____

Firma: _____

Appendix C: List of Practices and Indicators by Sector

EcoEval:

Name, Industry Type, Size of Land, Income, Assets, Debts, CO2 Emissions, Waste Reduction (count the number of bags for every garbage pickup), Water Usage (in litres), Energy Consumption (in Kilowatts), Agroclimatica (risk assessment), Economic Standing, Animal quantity

List of Indicators:

Crop yield, Livestock yield (products made from the livestock like milk or eggs), Poultry yield, aquaculture yield, Soil health (nitrogen ppm), Soil fertility (potassium, phosphorus, pH, and Nitrogen levels) Flooding, Topsoil retention, Crop diversity, Pests (number of plants/animals affected), Diseases (number of plants/animals affected), Herd fertility,

Sectors

Livestock

- Agrosilvopastoral system
  Sistema agrosilvopastoril
  - Crop yield
  - Water usage
  - CO2 Emissions
  - Soil health
- Fog collectors
  Captadores de niebla
  - Energy usage
  - Water usage
  - Waste
- Forage Pastures
  Pastos forrajeros
  - Herd fertility

    - Animal quantity
    - Livestock yield
- Forage Banks

  Bancos Forrajeros
    - Herd fertility
    - Animal quantity
    - Livestock yield
- Pasture Management and Rotational Grazing

  Manejo de Pasturas y Pastoreo Rotacional
    - Pasture health
- Permaculture

  Permacultura
    - Waste reduction
    - Water usage
    - Energy usage
    - Biodiversity
    - Community development
- Protected Environment for Livestock

  Ambiente Protegido para el Ganado
    - Herd fertility
    - Animal quanity
    - Live yield
- Respect for the minimum maturity sizes of the species

  Respeto en las tallas mínimas de madurez de las especies
    - Waste
- Silage

  Ensilaje
    - CO2 emissions
    - Energy
    - Livestock yield
    - Herd fertility
    - Animal quantity
- Sustainable forest management

  Manejo Forestal Sostenible
    - Crop yield
    - Water usage

    - Biodiversity
    - CO2 Emissions
    - Energy consumption
- Trees in Pastures
    Árboles en Potreros
    - Soil fertility
    - CO2?
- Aquaculture
    Acuicultura
    - Water usage
    - Aquacultural yield
    - Energy usage
    - CO2 Emissions
    - Waste
- Beekeeping
    Apicultura
    - Crop yield
    - Biodiversity
    - livestock yield

Agricultural

- Agricultural drainage
    Drenaje Agrícola
    - Crop yield
    - Soil health
    - Flooding
- Agricultural terraces
    Terrazas Agrícolas
    - Crop yield
    - Water usage
    - Soil health
    - CO2 Emissions
- Best Coffee Fertilization Practices
    Mejores Prácticas de Fertilización de Café
    - Biodiversity

    - Crop yield
    - Soil fertility
- Biodigesters

  Biodigestores
    - Crop yield
    - Soil fertility
    - Waste reduction
- Blind inks

  Tintas ciegas
    - Soil health
    - Topsoil retention
- Conservation agriculture

  Agricultura de Conservación
    - Crop yield
    - Water usage
    - Soil health
- Crop diversification

  Diversificación de Cultivos
    - Crop yield
    - Water usage
    - Biodiversity
    - Soil condition
- Crop rotation

  Rotación de Cultivos
    - Crop yield
    - Water usage
    - Soil health
    - Soil fertility
- Gasifier in coffee mills

  Gasificador en beneficios de café
    - Energy
    - Waste
    - Co2
    - Water
- Greenhouses

  Invernaderos

    - Crop yield
    - Water usage
    - Biodiversity
    - Energy
    - Waste

- Hydroponic Green Forage
  Forraje Verde Hidropónico
    - Crop yield
    - Energy consumption
    - Water usage
    - Soil condition
    - Livestock yield
- Hydroponics
  Hidroponía
    - Crop yield
    - Energy consumption
    - Water usage
    - Soil condition
- Integrated nutrition management
  Manejo integrado de nutrientes
    - Crop yield
    - Water usage
    - Soil fertility
    - CO2 Emissions
- Integrated pest management
  Manejo Integrado de Plagas
    - Crop yield
    - Water usage
    - Pests
    - Diseases
    - CO2 Emissions
    - Waste reduction
- Mixed nursery
  Vivero mixto

    - Crop yield
    - Water usage
    - Biodiversity
    - Waste reduction
    - CO2 Emissions
- Organic agriculture
  Agricultura Orgánica
    - Crop yield
    - Water usage
    - Soil health
    - Soil fertility
    - Waste
- Organic farming
  Agricultura ecológica
    - Crop yield
    - Soil health
    - Soil fertility
    - Waste reduction
- Organic fertilizer *Abonos Orgánicos*
    - Crop yield
    - Soil health
    - Soil fertility
    - Waste reduction
- Oxidation Lagoons
  Lagunas de Oxidación
    - Water
    - Waste
    - energy
- Preparation and Use of Compost
  Elaboración y Uso de Compost
    - Soil fertility
    - Crop yield
    - CO2 emissions
- Production of Bioferments or Bioles
  Elaboración de Biofermentos o Bioles

    - Soil fertility
    - Crop yield
- Production of Biopesticide (Acaricide)
    Elaboración de Biopesticida (Acaricida)
    - Crop yield
- Production of Mountain Microorganism (MM) Liquid
    Elaboracion de Microorganismo de Montaña (MM) Líquido
    - Soil health
    - Crop yield
- Production of Mountain Microorganism (MM) Solid
    Elaboracion de Microorganismo de Montaña (MM) Sólido
    - Soil health
    - Crop yield
- Seed bank
    Banco de Semillas
    - Crop yield
    - Biodiversity
    - Energy
- Silvoagricultural system
    Sistema silvoagrícola
    - Crop yield
    - Water usage
    - Soil fertility
    - Waste reduction
    - CO2 Emissions
- Silvopastoral system
    Sistema silvopastoril
    - Crop yield
    - Water usage
    - CO2 Emissions
- Slurry
    Purines
    - Waste
    - Crop yield
    - Soil health

- Soil conditioning
  Acondicionamiento de Suelo
  - Crop yield
  - Water usage
  - Soil health
  - Waste reduction
- Soil Conservation in Coffee Plantations
  Conservación de suelos en Cafetales
  - Soil health
- Soil restoration
  Restauración de suelos
  - Crop yield
  - Water usage
  - Soil health
  - CO2 Emissions
  - Waste reduction
- Solar hydroponics
  Hidroponía solar
  - Crop yield
  - Water usage
  - Energy consumption
  - Waste reduction
  - Soil condition
- Solar dehydrators
  Deshidreatadores solares
  - Energy consumption
  - Water usage
  - Waste reduction
- Vermicompost
  Lombricomposta
  - Crop yield
  - Water usage
  - Waste reduction
  - Soil fertility
- Waru-Waru / Raised planter Beds
  Waru-Waru / Camas elevadas

    - Crop yield
    - Water usage
    - Biodiversity
    - Waste reduction
    - CO2 Emissions
- Windbreak barriers

  Barreras Rompe Vientos
    - Crop yield
    - Water usage
    - Biodiversity
    - Erosion
- Compost with Coffee Brus

  Compost con Broza de Café
    - Soil fertility
    - Crop yield
    - Waste reduction
- Drip irrigation

  Riego por Goteo
    - Crop yield
    - Water usage
    - Soil quality
    - CO2 Emissions
- Family gardens

  Huertos Familiares
    - Crop yield
    - Water usage
    - Biodiversity
    - Waste reduction
    - Energy

Commerce

Service

- Ecotourism
  Agroturismo
  - Energy consumption
  - CO2 emissions

Industry

- Adopts a seafood traceability program
  Adopta un programa de trazabilidad del producto pesquero
  - Fish yield
  - Diseases
  - Animal quantity
- Boat and engine are duly registered
  Su embarcación y motor están debidamente inscritos
  -
- Carrying out proper handling of the fishery product
  Realiza adecuada manipulación del producto pesquero
  - Fish yield
  - Herd fertility
  - Animal quantity
- Efficient stoves
  Estufas eficientes
  - Crop yield
  - Water usage
  - Biodiversity
  - Energy
  - Waste

- Filter presses
  Presas filtrantes
  - Waste reduction
  - Water usage
- Fire Break Strips
  Franjas Corta Fuego
  - Crop yield

    - Water usage
    - Biodiversity
    - Soil quality
- Fishing methodology without hooks
  Metodología de pesca sin anzuelos o ganchos
    - Biodiversity
    - Fish yield
    - Herd fertility
- Fishing only non-endangered species
  Pesca únicamente especies no-amenazadas
    - Fish yield
    - Herd fertility
- Harvesting and Use of Rainwater
  Recolección y uso del agua de lluvia
    - Water usage
- Having the current navigability permits and fishing license
  Dispone de los permisos de navegabilidad y licencia de pesca vigentes
    -
- It has the necessary implements for the safety of the boat and crew
  Cuenta con los implementos necesarios para la seguridad de la embaración y tripulantes
    -
- Laurel and Avocado Trees and High Canopy Shade in Coffee Plantations
  Árboles de Laurel y Aguacate y Sombra de Alto Dosel en Cafetales
    -
- Living Fences
  Cercas Vivas
    -
- Natural retaining walls
  Muro de Contención Natural
    - Erosion
    - CO2 Emissions
    - Waste
- Natural shade
  Sombra natural
    - Crop yield

    - Water usage
    - Biodiversity
    - CO2 Emissions
- Rain Harvesting
    Cosecha de lluvia
    - Water usage
    - energy
- Rainwater reservoirs
    Reservorio para agua de lluvia
    - CO2 Emissions
    - Water usage
    - Waste reduction
- Respect for the VEDAS
    Respeto por las VEDAS
    -
- Rotational Machine System
    Sistema rotacional de apartos
    -
- Side ditches
    Zanjas-bordo
    - Erosion
    - Flooding
- Septic Tank *Tanque escéptico*
    - Waste
    - Energy
    - Water usage
- Solar Panels for Electric Power and Water Heaters
    Paneles Solares para Energía Eléctrica y Calentadores de Agua
    - Energy usage
    - CO2 Emissions
    - Waste
- Solids Separation
    Separación de sólidos

- Use of Drying Bed on Pasture
  Uso de lecho de secado en pasto
  -
- Use of Responsible Fishing Gear
  Uso de artes de pesca responsables
  -
- Waste management
  Gestión de residuos
  - Waste
  - Co2
  - Water
- Water Source Protection
  Protección de Fuentes de Agua
  - Water usage

- Community development