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Productive and Financial Analysis and cost evaluation of the technological practices promoted by PROMEGAN in the Dominican Republic: Three case studies

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***MAGISTER SCIENTIAE* IN AGROFORESTRY AND SUSTAINABLE AGRICULTURE**

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Table of Contents

Acronyms

ADG	Average Daily Weight Gain
AI	Artificial Insemination
BS	Breeding Season
CASA	Computer Assisted Sperm Analisis
CIAT	International Center for Tropical Agriculture
CLEANED	Comprehensive Livestock Environmental Assessment for Improved Nutrition, and Secured Environment and Sustainable Development along Livestock and Fish Value Chains
CONALECHE	Consejo Nacional para la Reglamentación y Fomentación de la Industria Lechera
DIGEGA	Direccion General de Ganaderia
ED	Estrus Detection
FAO	Food and Agriculture Organization
FCR	Feed Conversion Ratio
GDP	Gross Domestic Product
ILRI	International Livestock Research Institute
MEGALECHE	Programa Mejoramiento de la Ganadería Lechera
NS	Natural Service
PROMEGAN	Proyecto de Mejoramiento Genética Ganadero
RD	República Dominicana
TAI	Timed Artificial Insemination
VRG	Voisin Rotational Grazing

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Resume

Animal husbandry is an ancient human practice that dates back to the Neolithic period, around 10,000 years ago, focusing on raising animals for human consumption. This activity provides essential resources, such as meat, milk, leather, and labor. Today, cattle are the most widely raised mammals globally, with an estimated population of 1 billion. Latin America plays a significant role in this sector, contributing 23% of the world's beef production, despite accounting for only 13.5% of the global cattle population. However, animal husbandry faces critical challenges, including greenhouse gas emissions, land degradation, and climate impacts, particularly in tropical regions.

In the Dominican Republic, agriculture is a vital economic sector, with animal husbandry contributing 3.9% to the Gross Domestic Product (GDP). In 2023, the country produced 841 million liters of fresh milk and 139 million kilograms of beef, with the livestock sector supporting both local consumption and exports. The government has implemented initiatives such as the MEGALECHE program and the PROMEGAN project to promote innovation, productivity, and sustainability in livestock farming. These initiatives focus on improved breeding, pasture management, and feeding systems to enhance economic growth while minimizing environmental impacts.

The purpose of this study was to analyze and diagnose the productive and financial performances of three farms participating in the PROMEGAN project in the Dominican Republic, as well as to assess the costs associated with the technologies promoted by the program. The technologies analyzed included Improved Pastures, Establishment of Energy Banks, Artificial Insemination, Rotational Grazing, and Silvopasture systems. The study examined the performance of three farms with different management practices (Confined, Semi-Confined, and Rotational Grazing) and production systems (Dual Purpose and Specialized Dairy) located in three regions (Puerto Plata, Santiago Rodríguez, and Bonao). Additionally, it aimed to understand the costs associated with these technologies in the respective regions. This was accomplished by analyzing the variable costs and income of each farm and calculating the gross margin for a year. The costs of the technologies were determined by having regional technicians calculate the inputs and services required and their prices in the given regions. Pasture coverage was also assessed in the Rotational Grazing and Semi-Confined systems to evaluate the condition of the pastures.

It was observed that farms with smaller sizes and higher levels of technification achieved a higher gross margin per hectare (RD$ 157,177.00) compared to the other farms. The region with the lowest technology costs was Bonao, attributed to local seed varieties and material costs, while Energy Banks, Silvopasture systems, and Rotational Grazing exhibited the greatest cost variability. The pastures in Puerto Plata were in the best condition, with 20–36% bare soil coverage. In conclusion, farms with moderate levels of technification demonstrated better productive and financial performance than larger farms with lower levels of technification and smaller farms with higher levels of technification.

1. Introduction

Animal husbandry is a human activity that consists of raising domestic animals for human consumption (Servicio de Información Agroalimentaria y Pesquera, 2018). The different benefits that humans can obtain from animal husbandry are meat, milk, leather, workforce, etc. Evidence suggests that these activities began approximately 10 thousand years ago, during the Neolithic period. It is estimated that cattle were first domesticated around 7,000 years before Christ (González et al., 2014). According to FAO (Food and Agriculture Organization), it is estimated that there are 1 billion cattle around the globe, making it the most produced mammal on earth (Van Niekerk, 2023).

The Latin American region is an important cattle producer, as 23% of the beef consumed globally is produced in there, despite representing only 13.5% of the world's cattle population. In 2009, Latin America produced an estimated 18.2 million tons of beef with a cattle population of 400 million. Brazil leads beef producing in the region, with a total production of 9.3 million tons of annually with a herd of 205 million cattle (Montaldo et al., 2012). Beef is not the only important product coming from cattle; milk is also essential for food security. In the Caribbean, 1.5 million metric tons of milk were produced in the year 2022, making it the fifth most produced commodity (FAOSTAT, 2022). Regarding livestock products demand, it has been estimated that beef and milk consumption will increase by 73% and 58% in the year 2050, relative to 2010 levels (FAO, 2011).

Animal husbandry in the tropics faces significant challenges, including high temperatures, elevated humidity levels, and intense solar radiation. In the Mesoamerican and Caribbean region, various factors impact animal husbandry efficiency, notably pasture degradation. Overgrazing, soil compaction, and erosion from poor management practices affect approximately 73% of pasturelands globally (Steinfeld et al., 2009).

Livestock production has been blamed for being one of the agricultural activities that produce elevated levels of greenhouse gases, which pollute the environment. It is estimated that 70% of agricultural land (30% of the surface of the earth) is occupied by animal husbandry. Because of the expansion of animal production, it has also been identified as one of the factors responsible for deforestation in Latin America. For example, 70% of the land in the Amazon that used to be forest is now under pastures and fodder crops. Cattle production is responsible for 65% of livestock sector emissions (4.6 Gigatons CO_2 –eq), making it the highest contributor to the total sector's emissions (Gerber et al., 2013). Additionally, the animal husbandry sector is responsible for 18% of the greenhouse gas emissions (GHG) globally, which is higher than the transport sector (Margulis, 2004; FAO, 2006). However, more recent studies indicate that animals contribute from 14.5% (Herrero et al., 2011) to 16.5% by (Twine, 2021) of GHG emissions. Livestock are also a major source of anthropogenic methane emissions (37%), primarily from rumen fermentation, followed by manure management and urine excretion. Additionally, the livestock sector is responsible for 64% of ammonia emissions, contributing to acid rain and ecosystem acidification (Steinfeld et al., 2009).

Latin America and the Caribbean are important contributors to the global anthropogenic GHG emissions (roughly 1.3 gigatons CO_2 eq.). These figures highlight the need for a radical change in the way cattle are produced; otherwise, environmental impacts will greatly grow over the years. It is also important to mention that beef and milk production generate higher emission levels on low-productivity farms due to less efficient management practices and lower reproductive performance. The primary source of these emissions is enteric fermentation, accounting for 46% in milk and 43% in beef supply chains (Gerber et al., 2013).

Several livestock interventions have been explored to mitigate GHG emissions, such as pasture quality improvement, improved animal health and husbandry, and intensive grazing management. The latter could also help to enhance soil carbon sequestration. A case study in South America demonstrated that improving such interventions could reduce current emissions by 18–29% (Gerber et al., 2013).

The Dominican Republic is a nation that shares the Hispaniola Island, in the Caribbean, with Haiti. The country's approximate area is 48,000 km^2, and it has a population of 10.6 million people as of 2022. Of these, approximately 1.7 million live in rural areas. Agriculture is an important economic activity, as 364,302 people depend financially on this sector.

Cattle farming is one of the most important agricultural sectors in the Dominican Republic, and animal husbandry in general is responsible for 3.9% of the Gross Domestic Product (GDP). In 2022, the animal husbandry sector in Dominican Republic generated 43 billion pesos (RD) in live cattle and 17 billion pesos (RD) in fresh milk. In 2023, the Dominican Republic produced 841 million liters of fresh milk and 139 million kilograms of beef (Valor Bruto Producción Agropecuaria, 2023; Producción Pecuaria, 2023).

The national cattle herd has 2.5 million heads, which are divided into 15% for milk, 20% for beef, and 65% for dual purpose production. The amount of land dedicated to cattle farming in the Dominican Republic is approximately 1,187,500 hectares. This land is occupied by 47,916 cattle farms. It is estimated that the average livestock farm size is 21.9 ha. The agricultural sector contributes 7.6% of the GDP, and 51.3% of it comes from livestock. It is estimated that the total amount of money generated from the cattle industry is RD$ 18 billion per year. For the first trimester of 2022, DIGEGA reported that about 1.3 million kilos of cattle products had been exported, referring to items such as beef, dairy products, leather, and veterinary products. The destinations of these products include USA, China, Guatemala, Canada, Spain, Mexico, Japan, Cuba, Jamaica, Puerto Rico, Curacao, Haiti, Trinidad and Tobago, and Antigua and Barbuda (*Ganadería dominicana, nada que envidiarle a las de otros países*, 2023).

To respond to the challenges faced by the livestock sector, the government of the Dominican Republic is looking for new alternatives to enhance production and improve livestock farming. The Minister of Agriculture created the General Directorate for Livestock (Direccion General de Ganaderia, DIGEGA), which has a program called "MEGALECHE", whose main objective is to apply innovations that help raise the profitability and strengthen farmers' management capacities. This program participates in every node of the milk chain to ensure that products respond to national and international quality and food safety requirements. The program has a professional team of specialists in pastures and fodder crops, animal nutrition, genetic improvement, milk processing, and economic analysis, among others (PROMEGAN, n.d.).

Moreover, the government established the National Council for Regulating and Promoting the Dairy Industry (Consejo Nacional para la Regulación y Fomento de la Industria Lechera - CONALECHE) through Law 180-01. This institution is dedicated to promoting policies that support national milk self-sufficiency by enhancing the productivity and competitiveness of the sector (DIGEGA, 2023). The Presidency of the Dominican Republic and CONALECHE have joined forces to create the Livestock Improvement in the Dominican Republic Project (Proyecto de Mejoramiento de la Ganadería en la República Dominicana - PROMEGAN), aimed at improving the productivity and genetics of cattle herds to enhance the profitability of the animal industry (CONALECHE, 2024).

The government of the Dominican Republic has invested 15 million dollars in PROMEGAN to strengthen the commercial livestock sector by promoting several technologies, including: Artificial Insemination with improved quality animal germplasm, Improved Pastures, Fodder Crops (such as corn, sorghum, and sugarcane) to enhance animal feeding, Silvopastoral Systems, and Voisin-style Rational Grazing—all of which are actively promoted through training programs. However, there is a need to assess the effectiveness of these proposed technologies at the farm level. The objectives of the study are: 1) to diagnose the productive and financial performance of a sample of three participating farms, and 2) to determine the costs of implementing the technological interventions promoted by PROMEGAN across three different regions (PROMEGAN, n.d.).

2. Materials and methodology

2.1 Location of the study

The study was conducted in three farms covered by the PROMEGAN program located in the Northwest, (Cibao) Central, and the North Coastal Regions of the Dominican Republic.

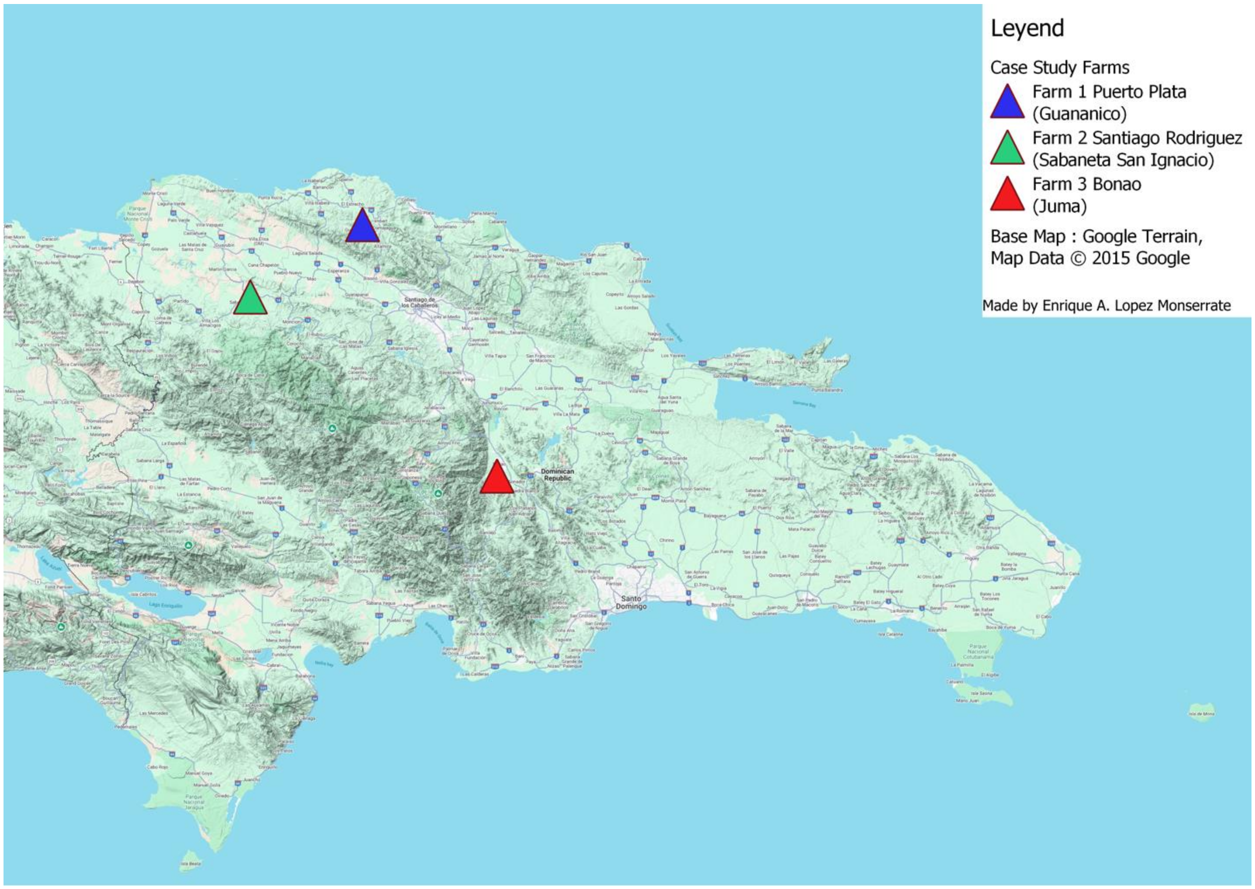

Figure 1 Map of the Dominican Republic where the case study farms are located.

The three farms considered for the case studies were chosen based on their location, management practices, and production systems as presented in Table 1. DIGEGA's technicians participated in selecting the farms, ensuring that they represent the predominant management and production systems in the region. For instance, the farms in the Northern coastal region are characterized by abundant levels of precipitation and are predominantly dual-purpose cattle systems managed under grazing. In contrast, in the Northwest region, which is semi-arid, farms are mostly dual-purpose but managed in a semi-confinement system, and in the Central region, there are mostly specialized dairy farms, managed more intensively under confinement, because of the proximity to feed manufacturing companies.

Three farms, one per region and system type, were chosen for carrying out this study. The regions and types of production systems practiced in the farms included in the study are described in Table 1.

Table 1. General characteristics of the three farms selected for the study.

Criteria	Farm 1	Farm 2	Farm 3
Region	Northern Coastal Region	Northwest Region	Central Region (Cibao)

Province	Puerto Plata	Santiago Rodríguez	Monseñor Nouel (Bonao)
Location	19º 44’38’’ North; 70º 53’25’’ West	19º 29’05’’ North; 71º 18’03’’ West	18º 89’00’’ North; 70º 41’57’’ West
Management system	Rotational Grazing	Semi-confinement	Confinement
Production system	Dual purpose	Dual purpose	Specialized dairy
Frequency of farms in the region with the production system (%)	80%	80%	2%

2.2 Data collection

In the selected farms, biophysical and economic information was gathered using the annexed questionnaire (Section 6.1), which includes topics such as herd management, farm size, milk production, total income, total farm costs per year, and components such as supplementation and labor, among others. The questionnaire was administered to either the farm owners or managers. Technicians of the DIGEGA national program assisted in contacting the people to be interviewed, as well as in the data collection process. The technicians accompanied the whole process and used their experience to define the five technologies promoted by the project (i.e., Rotational Grazing, Artificial Insemination, Improved Pastures, Energy Banks, and Silvo pastoral Systems), as well as to provide information about the price range for inputs, quantities used, services obtained, and the costs of implementation for the proposed innovations.

For the purposes of this study, soil cover by different components was used as a proxy for pasture degradation. These were estimated using the Botanal method (Tothill et al., 1978) and served as indicators of pasture degradation levels based on the scale proposed by Betancourt et al. (2007). This assessment was conducted for Farms 1 and 2, where pastures are utilized under grazing and semi-confinement systems, respectively. To apply this method, farmers were asked to identify what they considered to be the best, intermediate, and worst paddocks on their farms in terms of productivity and pasture health.

In each paddock, 60 samples were taken to estimate soil coverage by legumes, grasses, weeds and bare soil, expressed in percentage. The size of the sampling frames varied as a function of species present, using 0.5 x 0.5 m and 1.0 x 1.0 m frames for creeping and erect species, respectively. In each sample, the cover by different components was evaluated visually, and the percentages obtained in all samples taken in each paddock were averaged to assess the condition of the pastures present in the farm, using the scale proposed by Martínez Vega (2023). All samplings in Farms 1 and 2 were made in April of 2024, which is representative of a low precipitation period.

2.3 Data analysis

The analysis conducted to interpret the information gathered from the farms was a descriptive analysis. This method was chosen because it helps identify patterns in data that may not be immediately apparent, characterizes various attributes, develops strategies to diagnose problems for policymakers, and uncovers new issues worthy of study (Loeb et al., 2017). Based on the collected data and mathematical modeling, monthly total costs, production indicators, income, and financial metrics were projected for the year 2024. These projections include production indicators such as herd size, number of cows, length of the open-days period, calving intervals, calving rate, culling age, milk yield per hectare, and beef production per hectare. Financial indicators projected include total income, costs, gross margin, cost per liter of milk, cost per kilogram of beef, income per hectare, and net utility per hectare. Using the information gathered, productivity and costs were calculated to determine monthly production costs and income.

Herd size was calculated by including all the cattle present on the farm. The number of cows in lactation was provided by the producers and refers to the number of cows being milked on the day the interview was done. In this study, "Open days" are defined as the time elapsed between calving and the first insemination. Calving interval is the time that elapsed in between two consecutive calvings. Calving rate is the percentage of cows that have given birth in the last 12 months, with respect to the total number of cows older than two years. The age of first calving indicates the age in months when a cow gives birth for the first time. The culling age refers to the age in years when the cow is no longer deemed productive and is discarded from the farm.

The variables considered as costs to the farm included: animal purchases, veterinary services, medications and feeds purchased, manual labor, fuel, semen and insemination fees, and infrastructure and paddock maintenance. The sum of these expenses constituted the production costs for milk and beef. Conversely, the variables used to estimate income comprised milk sales, beef sales, and live animal sales, with net income calculated by subtracting total costs from total income. Subsequently, the cost per kilogram of milk and beef was determined by dividing the total cost for each product by the annual production of milk and beef. The percentage of feed costs was estimated by dividing the total feed consumed by the cattle in a month by the total number of animals in the herd. The cost per animal was calculated by multiplying the amount of feed each animal consumed by the feed cost, excluding pastures from the evaluation of feeding costs.

Milk production per cow was determined by dividing the amount of milk produced daily by the number of lactating cows. To estimate milk production/ha/year and beef production/ha/year, the total annual production of milk and beef was divided by the total area of the farm in hectares.

The price per kilogram of milk was provided by the producers, and the beef price per kilogram in the different regions was calculated dividing the amount of money paid per animal by the animal weight in kilos. The number of times the basic basket was covered annually was calculated dividing the net profit per year by the annual cost of the basic family food basket (INESPRE, 2024).

3. Results and discussion

3.1 Pasture systems

Table 2 presents data related to farm size, pasture types, and management details. Farm 1, located in Puerto Plata, has the largest area (105.02 ha), the biggest herd size (148.5 AU), and the lowest stocking rate (1.41 AU/ha). In contrast, Farm 3 in Bonao is the smallest (5.4 ha) but has the highest stocking rate (9.41 AU/ha) due to its exclusive reliance on high-yielding Elephant grass genotypes managed in a cut-and-carry system (Table 1). Although Farm 3 is small, it cannot be considered representative of typical small dairy farms in the country because it maintains a high stocking rate by utilizing high-yielding grass with substantial inputs. In comparison, other small farms (6–8 ha in size) studied by Alcántara (2023) in Santiago, Dominican Republic, managed under grazing, had a stocking rate of only 1.20 AU/ha. This cut-and-carry system may be a viable option for producers with limited land; however, it is crucial to evaluate the economic and ecological implications of such production systems. Under certain economic conditions, cut-and-carry systems may prove to be more profitable than those relying solely on mixed rations (Lee et al., 2015).

On the other hand, Farm 2, which is located in Santiago Rodríguez, showed intermediate values for farm size, herd size, and stocking rate. The prevalent pasture for grazing was *Bothriocloa pertusa,* which is a typical component in degraded pastures in the region, but it also uses Transvala (*Digitaria eriantha*) grass under a cut & carry system. The latter is commonly used for hay making in many places (Pitman *et al.*, 2004), and in some way it helps to maintain a higher stocking rate than in Farm 1, because it presents a combination of grazing and cut and carry forage systems.

Scattered trees in pastures were the main silvopastoral option practiced in Farms 1 and 2, whereas in Farm 3 trees were not present in the pasture production area. All three farms had some riparian forests, particularly Farm 3, where a significant portion of the total farmland (31.5%) was under such land use. A secondary forest was only found on Farm 1, which is the one with the largest land area (Table 2).

Table 2. Farm area and pastures system's attributes in the three study farms.

Variable	**Farm 1 (Puerto Plata)**	**Farm 2 (Santiago Rodríguez)**	**Farm 3 (Bonao)**
Farm area (ha)	105.02	27.09	5.4
Herd size (AU)	148.5	65	50.8
Stocking rate (AU/ha)	1.41	2.40	9.41
Type of forage system	Rotational Grazing	Cut and carry, and grazing	Cut and carry
Type of division between paddocks	Wire fencing with wooden posts	Wire fencing with wooden posts	None
Area used for cut and carry (ha)	5.08	1	3.7
Species used for cut and carry	Cameroon/ Maralfalfa[a]	Transvala (*Digitaria eriantha*)	King Grass/ CT-115[a]

Most abundant grasses on farm	African stargrass (*Cynodon plectostachyus*)	Merita (*Bothriocloa pertusa)*	CT-115[a]
Scattered trees in pastures	Yes	Yes	None
Other types of tree cover options	Riparian forest, secondary forest, and fruit bread plants (15%)	Riparian forest and fruit trees (7%)	Riparian forest (31%)

[a] Both are elephant grass (*Cenchrus purpureus*) cultivars or hybrids.

In general terms, the paddocks evaluated in Farm 1 (Puerto Plata) were classified as Slightly Degraded, whereas the ones in Farm 2 (Santiago Rodríguez) were Moderately/Severely Degraded, with few differences between the three pastures identified by the farmer as representative of the contrasting conditions, i.e., Best, Intermediate and Worst paddocks (Table 3). This suggests that farmers may not have a proper definition of the criteria used to categorize pastures in terms of level of degradation. In contrast, a study conducted by Martínez (2023) in the buffering area of the Río Platano Biosphere Reserve in Honduras found that the classification of pastures in terms of degradation level, as reported by farmer informants, closely aligned with that made by researchers using a similar methodology to the one applied in this study. However, it is likely that the farmers' perceptions in this study were influenced by their observations of pasture conditions throughout the year. In contrast, the evaluations in this study were conducted during a critical period characterized by limited water availability for pasture growth (Benites et al., 2007; Jayasinghe et al., 2024), as suggested by the rainfall data presented in Table 4.

Table 3. Soil cover (%) by different pasture components in representative paddocks of Farms 2 (Puerto Plata) and 3 (Santiago Rodriguez).

Paddock status	Soil cover (%)				
	Legumes	Grass	Weeds	Bare soil	Degradation status[a]
Farm 1 (Puerto Plata)					
Best	3	54	6	36	Slightly
Intermediate	6	66	8	20	Slightly
Worst	10	45	17	28	Slightly
Farm 2 (Santiago Rodríguez)					
Best	0	39	10	51	Moderately/ Severely
Intermediate	0	38	6	57	Moderately/ Severely

Worst	0	32	12	56	Moderately/ Severely

[a] Based on the degradation scale proposed by Betancourt et al. (2007)

Table 4. Rainfall (mm/month) in Santiago Rodríguez and Bonao, in the previous 4 months before pasture evaluation in Farms 2 and 3.

Locations	Farm 1 (Puerto Plata)	Farm 2 (Santiago Rodriguez)
Date of sampling	April 23, 2024	April 18–19, 2024
High temperature (ºF)	86	86
Low temperature (ºF)	71	71
Rainfall, mm/month		
January 2024	66.3	18.2
February 2024	42.9	31.5
March 2024	31.7	27.9
April 2024	130.8	98.3

It is important to emphasize that the evaluation period for pasture degradation was not necessarily optimal, as it followed a time of low rainfall (Table 3). This may have negatively impacted the cover of both valuable species (grasses and legumes) and weeds. It is likely that soil cover will increase in the coming months as plant species develop a higher leaf area index. However, the differences in grass cover—particularly with African star grass (Cynodon plectostachyus), which showed higher values (45–66%)—and the presence of legumes (3–10%) in pastures on Farm 1 (Puerto Plata) compared to Merita (Bothriocloa pertusa) pastures, suggest that African star grass may not need replacement by other pasture species, at least in terms of cover. Nevertheless, pasture productivity and quality could warrant PROMEGAN's recommendation to establish different species.

The high percentage of bare soil (51–57%) observed in the three paddocks evaluated on Farm 2 in Santiago Rodríguez (Table 2) indicates a significant level of degradation. Although these low values may have been influenced by the preceding three months of low rainfall, which limited plant growth and spread, the presence of over 50% bare soil is a clear sign of pasture degradation (Murgueitio et al., 2003). Furthermore, the substantial proportion of bare soil in Bothriocloa pertusa-dominated pastures on Farm 2 poses a heightened risk of soil erosion during intense rainfall events, which are becoming increasingly common due to climate change (Taylor et al., 2012). Therefore, there is an urgent need to renovate these degraded pastures by introducing improved species that provide better soil cover, such as those promoted by PROMEGAN. The dominance of Bothriocloa pertusa on Farm 2 may be attributed to the replacement of previously planted grasses that experienced degradation. Recent reports from Australia indicate that the invasiveness of this species allows it to take over areas of pastures that have suffered degradation due to poor management practices (Lebbink and Fensham, 2023).

There are different points of view on when the pasture condition should be evaluated. In Southern Australia, it is recommended that pastures should be monitored at its lowest level, to best assess the risk of potential soil losses due to erosion (Meat & Livestock Australia. n. d.). Conversely, Monteiro et al. (2018) suggest determining the level of degradation during the wet season. However, this approach may overlook critical dry periods when pastures have a poor soil cover, increasing the risk of erosion during the early rains of the wet season. It has been suggested that soils with 20% to 40% ground cover can experience water losses of 90–160 mm/year due to runoff and soil losses of 4.0–8.5 mm/year (Pasture.io, 2021).

Even though it is expected that the condition of the pastures will improve in the following months due to increased water availability promoting plant regrowth, the observations from the field evaluation and interviews with farmers indicate that overgrazing is occurring in these pastures, even during the wet season. This overgrazing prevents the establishment of optimal soil cover and pasture height necessary for proper recovery after grazing (Penn State Extension, 2022; U.S. Department of Agriculture, Natural Resources Conservation Service, 2020).

3.2 Animal reproduction parameters

Table 5 presents the herd composition, reproductive strategies, and reproductive parameters estimated for the three case study farms. Two of the farms—Farm 2 in Bonao and Farm 3 in Santiago Rodríguez—utilize artificial insemination, while Farm 1 in Puerto Plata, which has a larger herd size, relies on traditional management and natural mating. Farm 1 exhibited poorer reproductive efficiency, with a calving interval of 14 months, an age of first calving of 33 months, and a calving percentage of 54%. In contrast, Farm 3 achieved the highest calving percentage (72%), an intermediate calving interval (13 months), and the shortest age of first calving (27 months). Farm 2 had the shortest calving interval (11.5 months) but the lowest calving percentage (50%). However, the farmer's report—based on memory and lacking formal records—may be inaccurate, as a low calving percentage typically corresponds with a longer calving interval.

The age at first calving and calving intervals recorded for the three farms in this study were lower than those reported by Alcántara (2023) for specialized dairy and dual-purpose farms in the Plan Sierra region of Santiago de los Caballeros Province, Dominican Republic. Additionally, the calving rates for Farms 1 and 2 in this study were lower than those found by Alcántara (2022) in farms with similar management practices. Conversely, Farm 3 exhibited a higher calving rate than that reported by Alcántara for farms using specialized dairy systems. Overall, the findings suggest that the case study farms demonstrated better reproductive efficiency compared to other studies (Teyer-Bobadilla et al., 2002; Magaña et al., 2006; Vite-Cristóbal et al., 2007; Zárate-Martínez et al., 2010) that assessed various dual-purpose and specialized dairy systems in tropical regions. However, it is important to note that the estimates in those studies were based on herd records, while this study relied on farmers' recollections, which can often be inaccurate (Migose et al., 2020).

Regarding the culling age, the lowest value was obtained in Farm 3 (Bonao), which has a more intensive specialized dairy system; however, those values were higher than the ones obtained in similar systems in Costa Rica (Cedeño et al., 2004). This could be due either to the inaccuracy of the data provided by the farmers participating in this study, as they do not keep such type of records, or to real differences in terms of the criteria used by farmers to sell mature cows.

Table 5. Animal reproduction parameters for the three case study farms.

Variable	**Farm 1 (Puerto Plata)**	**Farm 2 (Santiago Rodríguez)**	**Farm 3 (Bonao)**
Herd size	221	95	71
Number of cows in lactation	65	30	26
Reproductive mature females	120	59	36
Type of reproduction	Uncontrolled natural mating	Artificial insemination	Artificial insemination
Open days	90	75	85
Calving interval (months)	14	11.5	13
Calving rate (%)	(54%)	(50%)	(72%)
Age of first calving (months)	33	30	27
Culling age (years)	10	11	7

3.3 Milk production parameters

The figures obtained for the milk production parameters reported in Table 6 are based on the data collected for the months of January through April, when field data collection was carried out. For the purpose of this study, these figures have been taken as representative of the whole year, although we recognize that they could be influenced by seasonality. Farm 2 (Santiago Rodriguez) showed the highest amount of milk production (400 liters/day), but it had the highest number of cows milked daily (30). In contrast, Farm 3 (Bonao) produced a little less milk (380 liters/day) with only 26 cows milked. The lowest amount of milk produced (360 liters/day) was obtained for Farm 1 (Puerto Plata), even though it had the highest number of milking cows (65).

In terms of milk production per cow ((Table 6), all three farms presented higher values than the national average (4–5 kg/cow/day) (Observatorio de la Cadena Láctea en República Dominicana, 2022), with Farms 2 and 3 well above the national average with (13.3 and 14.6 kg/cow/day, respectively), whereas Farm 1 had a value (5.5 kg/cow/day) slightly greater than the national average. The results obtained in the three study farms for milk production per cow per day are also higher than those reported by Alcántara (2023), who analyzed the data from 61 farms in the Plan Sierra's area of influence in Santiago de los Caballeros Province (Dominican Republic). The results presented here confirm the variability in milk production per cow in the cattle industry of the Dominican Republic, with some farms (2 and 3) exhibiting similar levels of milk yield to those obtained in Santa Cruz de Turrialba, a traditional dairy production area in Costa Rica, which has an average milk yield of 14.5 kg/cow/day (Ministerio de Agricultura y Ganadería, n.d.) in a pasture-based production system with some concentrate supplementation. In contrast, the level of production per cow obtained in Farm 1 is similar to the values found in more traditionally managed dairy systems in the tropics (Fariña et al., 2020).

Table 6. Milk production parameters and milk management for the three case study farms.

Variable	**Farm 1 (Puerto Plata)**	**Farm 2 (Santiago Rodríguez)**	**Farm 3 (Bonao)**
Milk production per farm (kg/day)	360	400	380
Average number of cows milked	65	30	26
Milk production per cow (kg/day)	5.5	13.3	14.6
Lactation length (months)	10	7	10
Type of milking	Manual	Manual	Mechanical
Frequency of milking	Once a day	Twice a day	Twice a day
On-farm milk cooling	No	Yes	Yes
On-farm milk processing	No	No	No

Another factor that likely influenced the level of milk production per cow is the genetic makeup of the cows, which varies among farms. Farm 1 predominantly has a Brahman crossbred herd, producing an average of 5.5 kg/cow/day, which is slightly lower than the 6.2 kg/cow/day average for the breed under tropical climates (Bailey, 1979). Farm 2 mainly consists of Holstein x Gyr crosses, producing 13.3 kg/cow/day, which is close to the 14–16 kg/cow/day range reported for that cross under tropical conditions (Arroyo-Aguiar, 2021). In contrast, Farm 3 primarily has Jersey crossbred cows, producing an average of 14.6 kg/cow/day, which falls on the upper side of the range of milk yields (5.5–16 kg/cow/day) reported under tropical conditions (Gandini et al., 2022).

In terms of milk productivity, significant differences were detected among the three farms under study, which were expected given the variation in the intensiveness of the dairy systems practiced. The lowest value (1,381.6 kg/ha/year) was recorded for Farm 1, the largest farm, which is characterized by poor-quality pastures and a small amount of concentrates. In contrast, the highest yield (24,462.6 kg/ha/year) was achieved at Farm 3, where animals are confined and receive cut-and-carry forages along with concentrates. Farm 2 exhibited intermediate productivity, with 5,169 kg/ha/year. These values are consistent with others reported under tropical conditions, with Farm 1's productivity falling within the range for non-fertilized grasses and Farm 3's yield reflecting more intensive systems based on grasses, irrigation, and concentrates (Pezo et al., 1992).

3.4 Economic analysis

The economic and productivity performance of the farms covered in this study is summarized in Table 7. Farm 3 (Bonao), which operates a specialized dairy cattle production system managed under confinement, achieved the highest gross margin of RD$ 157,177 per hectare per year. It is noteworthy that this farm had the best economic outcome per hectare, despite also incurring the highest expenditures relative to farm size. Farm 2 demonstrated a competitive gross margin of RD$ 61,988.93 per hectare per year, considering it produced more beef than Farm 3. Both of these farms outperformed others in Nicaragua with similar farm sizes (16.8–38.6 hectares) and numbers of producing cows (6–17). The gross margins for those farms ranged from RD$ 5,290.65 to RD$ 34,170.10 (Toruño, 2012).

Table 7. Economic and productivity performance in the three case study farms.

Variable	Farm 1 (Puerto Plata)	Farm 2 (Santiago Rodríguez)	Farm 3 (Bonao)
Total income (RD$/year)	5,032,925.00	5,083,640.00	4,480,666.00
Total costs (RD$/year)	4,038,665.00	3,404,360.00	3,631,912.00
Gross margin (RD$/farm/year))	994,260.00	1,679,280.00	848,755.00
Gross margin (RD$/ha/year)	9,467.34	61,988.93	157,177.00
Milk production (kg/ha/year)	1,381.64	5,169	24,462.59
Beef sold (kg/ha/year)	84.17	229.24	492.59
Income (RD$/ha/year)	47,923.49	187,657.44	829,753.04
Times basic basket is covered annually	1.82	3.08	1.55
Exchange rate Dominican peso to US dollar ($60.33= $1) (Xe, 2024).			

Table 7 also shows that Farm 2, which operates at an intermediate level of technification, outperformed Farm 1 in terms of gross margin per farm, despite Farm 1 having a larger area and a more extensive management approach. However, since the case study farms differ in size, it is more appropriate to make comparisons based on a common unit, such as per hectare. In this regard, Farm 3, although having the smallest land area, exhibited the highest gross margin (RD$ 157,177/ha/year), significantly higher than Farm 1, which had a gross margin of RD$

9,467/ha/year. The values obtained for Farm 1 were greater than those reported by Alcántara (2023) for small-sized specialized dairy farms in the Plan Sierra's area of influence in Santiago de los Caballeros (Dominican Republic).

These results confirm that differences in land use, the utilization of supplements, and management costs are critical factors influencing the economic outcomes of livestock farms. This provides valuable evidence for PROMEGAN to demonstrate to dairy farmers in the Dominican Republic that the technologies they are promoting could enhance the productive and financial performance of their cattle operations.

3.5 Overview of farm productivity and economic outcomes

In this section, we review the productivity and economic outcomes for the three evaluated farms. These evaluations are based on milk and beef production per hectare, income per hectare, gross margin, and the extent to which income covers the basic household basket costs.

Farm 1 (Puerto Plata) demonstrated the lowest productivity and economic performance compared to the other two farms. Milk productivity was 1,381.64 kg/ha, which was the lowest among the case study farms. However, these results are still higher than those obtained in Nicaragua, where farms with similar characteristics reported values ranging from 364 to 1,028 kg of milk/ha/year (Toruño, 2012). Additionally, Farm 1 presented the lowest gross margin (RD$ 9,467/ha/year), which is only twice the value of the annual basic basket (Table 7). In contrast, Farm 3 exhibited intermediate levels of productivity and economic performance. Despite having the most intensive management system, it achieved results similar to Farm 1, covering the annual basic basket 1.82 times. This raises the question: what should be the size of each case study farm to cover the annual basic basket cost? Applying the same logic, it is estimated that Farm 2 would achieve the same level of coverage (2.0 basic basket costs) if it had only 18.06 ha. These values are lower than those obtained in dairy farms within the Plan Sierra's influence area (Alcántara, 2023), suggesting that there is room for improvement in the farms participating in PROMEGAN by implementing some of the technologies promoted by the program.

3.6 Production costs and pricing

The production cost and pricing of milk and beef for each farm are presented in Table 8. The cost of milk production varies significantly across the three farms, with Farm 2 having the lowest cost (RD$ 21.88/kg) and Farm 3 the highest (RD$ 26.67/kg). Correspondingly, the highest price per liter of milk was paid in Farms 2 and 3 (RD$ 32.80), while Farm 1 received the lowest price (RD$ 27.37). The higher milk prices in Farms 2 and 3 compared to Farm 1 can be attributed to the former selling their milk to a processing plant with higher quality requirements, whereas Farm 1 sells to a small milk processor.

Table 8. Production costs (RD$/kg) and prices (RD$/kg) for the three case study farms.

Location	Farm 1 (Puerto Plata)	Farm 2 (Santiago Rodríguez)	Farm 3 (Bonao)
Milk produced (liters/year)	145,100	140,050	132,098
Beef sold (kg/year)	8,840	6,210	2,660
Milk price (RD$/liter)	27.75	32.80	32.80
Milk production costs (RD$/liter)	22.27	21.88	26.67
Gross margin for milk (RD$/kg)	5.48	10.92	6.13
Beef price (RD$/kg)	113.85	78.90	55.58
Beef production costs (RD$/kg)	91.37	54.82	40.96
Gross margin for beef (RD$/kg)	22.48	24.08	14.62
Total income milk (RD$)	4,026,525	4,593,640	4,332,814
Total income beef (RD$)	1,006,434	489,969	147,842
Total cost milk (RD$)	3,230,932	3,063,924	3,522,955
Total cost beef (RD$)	807,733	340,436	108,957
Income from beef (%)	20	10	3.4
Income from milk (%)	80	90	96.6

For comparison purposes, milk price in Costa Rica ranges from RD$ $39.37 to 42.29 (*Precios de la leche nacionales pagados al productor*, 2023), which is higher than the one paid in all three case study farms in the Dominican Republic. In Costa Rica, a study was carried out to determine the cost per liter of milk, revealing that one farm had a cost of RD$ 16.20 per liter. The highest percentage of this cost was attributed to supplementation (54%), which is lower than the percentage in Farm 2 (67%) but higher than in Farms 1 and 3 (28% and 50%, respectively) (Table 9). This cost per liter of milk is lower than those reported in the case studies visited in the Dominican Republic (Hernandez, 2021). The farm in Bonao had the highest cost per kilogram of milk due to expenses associated with higher feed usage, providing 662 pounds of concentrates per animal per month at a cost of RD$ 1,640.64 (Table 8). In contrast, the farm located in Santiago Rodriguez, despite having the highest expenditure on feeds (RD$ 2,741.33), had the lowest cost of milk (RD$ 21.88/kg).

Beef production displayed a more significant cost gap, with the lowest cost per kilogram (RD$ 40.96) at the farm in Bonao and the highest cost (RD$ 91.37) at the farm in Puerto Plata (Table 8).

Although Farm 1 (Puerto Plata) incurs higher costs for beef production, it also commands a higher price per kilogram of beef (RD$ 113.85). For comparison, the price of beef in Costa Rica (CORFOGA, 2024) is three times higher (RD$ 403.80). In contrast, the costs per kilogram of beef in Mexico ranged between RD$ 78.11 and RD$ 81.12 (Martinez et al., 2016), which are still higher than those of Farms 2 and 3 but lower than those of Farm 1. The better prices for beef and its higher contribution to total income from the cattle enterprise (20%) compared to Farms 2 and 3 (10% and 3.4%, respectively) can be attributed to the type of animals raised, primarily Brahman cattle, which are in demand among buyers due to their genetics and appearance. For all three case study farms, milk production serves as the main source of income, with the highest proportion (97.59%) for Farm 3 located in Bonao (Table 8).

Milk production costs at Farm 3 in Bonao significantly affect its overall profitability, as it has the highest milk production costs among the three farms. The primary contributor to these costs is the expenditure on supplements, which accounts for 50% of the total expenses. An opportunity to reduce costs lies in decreasing the amount of feed provided to the animals. In contrast, Farm 2 (Santiago Rodriguez) has lower milk production costs than Farm 3, producing 9% less milk per cow (Table 6) while utilizing only two-thirds of the feed used at Farm 3 (Table 9), resulting in a corresponding reduction in production costs. However, it is important to note that the cost per kilogram of concentrate used in Farm 2 is higher than that in Farm 3, likely due to differences in quality. This factor is crucial for enhancing productivity. At Farm 3, the concentrate is prepared by the farmer by blending separately purchased ingredients to reduce costs. Nevertheless, it is advisable to revisit the concentrate formula to achieve better production results. While this may increase the cost per kilogram of concentrates, it will likely yield better-quality feed. Across the three case studies, it is clear that the rational use of concentrates—both in terms of quality and quantity—should be considered as an intervention to enhance the gross margins of cattle enterprises.

Table 9. Amount and costs of feeds consumed per animal.

Feed intake and cost per animal					
Location	Total cost of concentrates (RD$/month)	Costs related to feed (%)	Concentrates consumed (lb/animal/month)	Cost per animal (RD$/month)	Hay bales
Farm 1 Puerto Plata	87,840.00	28	38	553.62	0
Farm 2 Santiago Rodriguez	188,980.00	67	412	2,741.33	0.6
Farm 3 Bonao	139,070.00	50	662	1,640.62	1.48

Comparing the results obtained in this study with those from other regional studies, the costs associated with feed in Farms 2 and 3 (67% and 50% of total costs, respectively) are higher than the costs observed in farms within the Plan Sierra area of influence, where feed costs ranged from 37% to 42% (Alcántara, 2023). According to the USDA Economic Research Service, 22% of the total cost for beef farms is attributed to supplementation (U.S. Department of Agriculture, Economic Research Service, 2023). In New Zealand, it was found that feed constitutes the largest expense, approximately 30% of total farm costs (DairyNZ, 2023). In Costa Rica, the cost of feed accounts for 51.82% of expenses in cattle farms (Rodriguez et al., 2016). These results collectively indicate that feed remains the most significant expense for cattle farms.

3.7 Income and costs associated with milk and beef production

Table 8 provides a detailed breakdown of total income and costs associated with beef and milk production for the three farms. Farm 3 (Bonao) generated over 97% of its income from milk production, totaling RD$ 4,332,814.40. However, it also incurred the highest cost of milk production at RD$ 3,522,955. In contrast, Farm 2 (Santiago Rodríguez) also derived its highest income from milk production (RD$ 4,593,640) but had the lowest total costs per liter of milk, amounting to RD$ 3,063,924 and a cost of RD$ 21.88 per liter. Milk accounted for 90% of Farm 2's total income, although it had the second-lowest annual milk production at 140,050 liters.

Despite having the highest operational costs for milk production (RD$ 459,031), the highest cost per liter (RD$ 26.67), and the lowest annual milk production (132,098 liters), Farm 3 (Bonao) remains competitive and productive, achieving the highest gross margin per hectare compared to the other two farms (see Table 7). Conversely, Farm 1 (Puerto Plata) generated the lowest income from milk production (RD$ 4,026,525), with only 80% of its total income derived from this source. This farm produced the highest amount of milk at 145,100 liters per year; however, its production costs per kilogram of milk were the second highest, and the gross margin per kilogram was the lowest at RD$ 5.48. This is attributed to the low price paid by buyers (RD$ 27.75 per liter) and low production levels of 5.5 liters per cow per day (see Table 6).

When it comes to beef production (see Table 8), Farm 1 (Puerto Plata) has the highest proportion of income (20%) coming from beef, despite having the highest cost of production (RD$ 91.37/kg). It also obtains the highest market price (RD$ 113.85), resulting in an adequate gross margin (RD$ 22.48/kg), which is higher than that of Farm 3 (Bonao), which is RD$ 14.62. Beef production accounts for 10% of the total income in Farm 2 (Santiago Rodríguez), where it has the highest gross margin per kilogram of beef (RD$ 24.08) due to lower production costs (RD$ 54.82). This allows Farm 2 to maintain a good profit margin, even with the second-lowest market price for beef (RD$ 78.90/kg).

3.8 Comparative analysis and economic implications

This analysis reveals significant differences in milk and beef production costs, pricing, and income distribution across the three case study farms. Farm 2 (Santiago Rodríguez) stands out due to its low production costs and high profitability in milk production, despite having the second-highest annual milk production and per cow per day. Its performance makes it a model for cost-effective dairy farming in the Dominican Republic, highlighting the positive impact of the technologies promoted by PROMEGAN. Farm 2 outperformed larger intensive farms and smaller specialized farms evaluated by Alcántara (2023) in the Santiago de los Caballeros area, producing between 9.4 and 12.5 kg of milk per cow per day. In contrast, although Farm 3 (Bonao) produced the most milk per cow, it did not achieve the best economic performance due to higher production costs. These costs stem from elevated expenses related to energy, manual labor, and the second-highest cost for supplementation, all of which contributed to reduced overall profitability compared to Farm 2 (Santiago Rodríguez). Farm 1 (Puerto Plata), despite having the potential to generate a higher income from beef due to premium pricing, suffers from the highest beef production costs, significantly impacting the gross margin obtained from beef operations and making it the second least economically effective operation. However, there is room for improvement, and it is expected that implementing the technologies promoted by PROMEGAN will help reduce costs related to pasture maintenance, labor, and feeds while also improving milk yield.

The livestock on the three farms produced more milk than the national average. Farm 3 produced an average of 14 liters per cow per day, while the farm in Santiago Rodríguez produced an average of 13.3 liters per cow per day. In contrast, the farm in Puerto Plata produced an average of 5.5 liters per cow per day. The national average for milk production is 5 liters per cow per day (U.S. Department of Agriculture, Foreign Agricultural Service, 2019). In Nicaragua, a study conducted on farms with a similar herd composition reported an average milk production of 6 kg per cow per day (Toruño, 2012). These findings indicate that the farms in this study have a production system that is above average.

The data obtained in this study reflects only three case study farms; however, it would be beneficial to conduct the same analysis on a larger sample of farms that represent the various types of milk production systems addressed in this research. The findings from this study, along with those from Alcántara (2023), which examined nine farms in the Plan Sierra's Area of Influence, could serve as a foundation for a more comprehensive study that includes all farms involved in the PROMEGAN program at a national level. Both studies have tested methodologies that could be applied to other farms as part of a network, potentially generating crucial information on productivity and economic performance indicators for specialized and dual-purpose dairy farms. This information would provide valuable insights for policymakers in designing data-driven strategies for livestock development in the country.

3.9 Cost of technologies promoted by PROMEGAN

A brief description of the technologies promoted by PROMEGAN for improving the productivity and financial performance of the farms is presented in the following paragraphs.

Improved Pastures: A set of pasture species has been identified to enhance productivity and resilience, considering the prevalent constraints in the various regions covered by PROMEGAN. The costs associated with these innovations encompass machinery and labor for purchasing seeds, tilling the land, planting, and all agronomic practices necessary for the successful establishment of new pastures to replace degraded ones.

Establishment of Energy Banks: It is the establishment of selected species, such as sugarcane and *Pennisetum purpureum* cv. King Grass, which are planted and maintained to be harvested and fed to cattle when pastures are insufficient, especially during periods of feed scarcity like the dry season. This process involves tilling the land, planting the seeds, and hiring workers for manual labor, including weed control and eventual harvesting.

Artificial Insemination: It is a reproductive technique that helps farmers improve the genetic composition of their herd by using the semen of selected bulls. A technician introduces the semen into the cervix or uterus of a cow in heat. The resources required include a cooling tank, nitrogen, insemination guns, semen straws, gloves, pipettes, and boots, among others. Often, these costs are included in the insemination fee charged by the inseminator.

Silvopastoral Systems: It is the introduction of woody perennials into a paddock, either as scattered trees, live fences, or forage banks, to provide benefits to the pasture and cattle. The establishment of living hedges involves planting live stakes chosen from plants that root easily, allowing them to establish and last longer than regular wooden stakes. Forage banks consist of the planting, management, and harvesting of pasture in a designated area to feed livestock. Scattered trees are left throughout the pastures to provide shade for the animals.

Rotational Grazing: It is the division of improved pasture into paddocks, which is essential for implementing a rotational grazing scheme that helps maintain the productivity of pastures in the long run by preventing degradation. The costs associated with this innovation include inputs such as posts, barbed wire, nails, electric fencing generators and batteries, isolators, and other necessary supplies, as well as the labor required for installing the fencing system.

Table 10 summarizes the costs associated with implementing the technologies promoted by PROMEGAN in the Dominican Republic. This includes the prices for all equipment, materials, and services required for their implementation. The area used for estimating the introduction of the different technologies was 10 tareas (0.63 hectares). The price range for these technologies was determined with the professional guidance of DIGEGA technicians, who accompanied the entire process and leveraged their experience to estimate costs for each region. These estimates were based on a representative farm from each region.

Table 10. Implementation cost of the technologies being implemented by PROMEGAN in farms located in the areas included in this study (RD$/ ha).

Cost of the technologies promoted by PROMEGAN			
Locations	**Puerto Plata**	**Santiago Rodriguez**	**Bonao**
Improved Pastures	57,628.73	47,060.32	53,330.16
Energy Banks	158,571.41	47,060.32	53,330.16

Artificial Insemination (per cow)	110,338.10	105,425.40	100,577.78
Silvopastoral Systems	162,837.30	127,047.62	94,317.46
Rotational Grazing	331,459.35	300,364.11	267,633.95

3.9.1 Improved Pastures

The costs associated with the improved pastures innovation vary greatly depending on locations, due to differences in climate, soils and other agroecological conditions, which will determine the seeds to utilized, manual labor, and the institutional support required. The region with the lowest cost for the implementation of improved pastures was Santiago Rodríguez ($47,060.32/ha); whereas the highest cost was in the Puerto Plata region (36,325/0.63ha), where the costs of fertilizers and labor were more expensive. It is difficult to do comparisons of costs between countries; however, just as a reference, in Australia the cost of establishing improved pastures goes from RD$ 10,021.80 - 32,068.80/ha (Rymill, 2018), and in another study in Costa Rica (Ministerio de Agricultura y Ganaderia, 2023), the cost for establishing a Transvala pasture was RD$ 186,541.20/ha. The costs estimated for the three regions, are close to the most expensive case in Australia, but a lot less expensive than the case reported in Costa Rica.

3.9.2 Energy Banks

The costs associated with this technology varied significantly across regions. The lowest cost was in Santiago Rodriguez (RD$ 47,060.32), while Puerto Plata had the highest cost at RD$ 158,571.41, nearly three times the amount in Bonao (RD$ 53,330.16). A primary reason for these substantial price differences is the species used for energy banks. In the Puerto Plata region, sugarcane was utilized, whereas Guinea grass var. Zuri was the preferred option in the other two regions. It is important to note that, as of now, none of the three case study farms have implemented this technology.

In Costa Rica, the cost of establishing 1.0 hectare of sugarcane was RD$ 74,201 (Mora, 2020), indicating that, except for Puerto Plata, it is less expensive to establish energy banks in the other two regions of the Dominican Republic. Another study in Costa Rica (Sanchez et al., 2010) evaluated the costs for establishing sugarcane energy banks for cattle, which amounted to RD$ 39,060 per hectare. This value is lower than the cost obtained for the Santiago Rodriguez region, which reached RD$ 47,060.32 per hectare.

3.9.3 Artificial Insemination

This technology presented the most consistent price range among all the technologies promoted by PROMEGAN that are being evaluated in this study. Farm 1 in Puerto Plata was the only case study not practicing this technology due to the level of intensification applied. In contrast, Farm 2 in Santiago Rodriguez (RD$ 105,425.40) and Farm 3 in Bonao (RD$ 100,577.78) are actively implementing this technology, with only a RD$ 4,847.62 difference between the two locations. It is important to note that PROMEGAN covers the cost of this service at both locations, meaning the producers do not have to pay out of pocket for these services. The differences in prices reflect the various materials that producers would need to purchase if they were to implement this technology without PROMEGAN's intervention. These variables are detailed in ANNEX 6.2. When expressed on a per-cow basis for comparison with other literature, the cost of artificial insemination in Bonao was approximately RD$ 2,674, which is lower than the estimated costs in other countries, such as Greece (RD$ 3,870) (Valergakis et al., 2007) and Canada (RD$ 7,800) (Beef Cattle Research Council, 2018). The Canadian cost was specifically for beef cattle, and the higher genetic quality of bulls in Canada compared to those in the Dominican Republic accounts for the increased expense.

3.9.4 Silvopastoral Systems

This technology also exhibited a wide variation in costs. The lowest cost was in the Bonao region, followed by Santiago Rodriguez, with the highest costs recorded in Puerto Plata (RD$ 94,317.46, RD$ 127,047.62, and RD$ 162,837.30 per 0.63 hectares, respectively). Farm 3 in Bonao did not utilize this technology because the management practice involved keeping the cattle confined most of the time, with the exception of two hours daily when they were released to a nearby river.

The potential differences in the adoption of such interventions between the two regions can be attributed to the cost of lumber, which is significantly cheaper in Bonao (RD$ 30) compared to Puerto Plata (RD$ 150). In Esparza, Costa Rica, an ex-ante analysis calculated the cost of establishing a silvopastoral system on a 30-hectare farm. This system included pastures with trees, regenerating zones, protein banks, living hedges, and trees planted in existing improved pastures. The total cost for this was RD$ 156,129.60, or RD$ 5,204.40 per hectare (Gobbi et al., 2003). This indicates that the cost of implementing silvopastoral systems in the Dominican Republic is higher than in Costa Rica and Colombia.

3.9.5 Rotational Grazing

This innovation was the most expensive among the technologies promoted by PROMEGAN, primarily due to the inclusion of electric fencing, which significantly elevates the implementation costs. The region of Puerto Plata had the highest cost (RD$ 331,459.35), followed by Santiago Rodriguez (RD$ 300,364.11) and Bonao (RD$ 267,633.95).

The costs associated with implementing the fencing should be reviewed by PROMEGAN technicians, as the cost in Costa Rica is 17 times cheaper. The differences in costs can be attributed to the higher prices of materials used in Puerto Plata and Santiago Rodriguez. Additionally, PROMEGAN technicians included all components needed for the implementation of an electric grid, meaning that the costs associated with electric fencing are concentrated in a relatively small area of land (0.63 hectares) rather than distributed across multiple hectares, as seen in other studies. For more accurate results, costs should ideally be assessed for larger land sizes.

In comparison, the cost to establish a hectare for rotational grazing in Costa Rica is approximately RD$ 11,764 for the installation of electric fencing, excluding materials such as manual labor, stakes, and other supplies available on the farm (Pezo, 2018). While the Dominican Republic shows a higher cost, further investigation is needed to determine the costs of implementing this technology on other farms and in different regions, particularly assuming that farmers must purchase most materials.

4. Limitations

The farms selected for this study exhibit different levels of technological advancement. To better understand the distinctions among farms, it would be beneficial to select those with similar levels of technology within the same region. This study analyzes case studies; therefore, inferences cannot be drawn due to the variability of the results. However, it provides valuable insights into the structure, income, and costs of cattle systems in the country. It is important to note that the gross margin does not account for financial costs, the owner's salary, capital used for operational costs, or inventory adjustments of livestock over the year. To generate more reliable information, establishing a network of farms with permanent monitoring would enable the measurement of variations across regions, seasons, and years.

5. Conclusion

The three farms visited in the Dominican Republic under the PROMEGAN program employed three different management systems: Confined, Semi-Confined, and Rotational Grazing. Each system exhibited variability in both productive and economic indicators.

The farms have productive and economic differences attributable to factors such as herd size, farm size, climate, management practices, milk production, productive focus, and the technologies they have adopted from PROMEGAN.

Farm 2 in Santiago Rodriguez, which utilizes a semi-confined management system, has adopted three of the five technologies promoted by PROMEGAN: Rotational Grazing, Improved Pastures, and Artificial Insemination. Although Farm 2 is less intensive than Farm 3 in Bonao, it achieves the highest net profit. In contrast, Farm 3 incurs the highest production costs, making it the least profitable operation, despite being the most productive per hectare of land.

Farm 1, which employs a dual-purpose rotational grazing system, achieved the best prices associated with beef production but had the lowest milk production compared to Farms 2 and 3. Farm 2, utilizing a semi-confined management system, generated higher net profits from both beef and milk than the rotational grazing system of Farm 1. In contrast, Farm 3, which operates under a confined management system, has higher milk production and higher operational costs, resulting in lower net profit, though it achieves a higher profit per hectare compared to Farms 1 and 2. Factors such as location, climate, breed selection, pasture conditions, and management systems can significantly influence farm productivity and financial performance.

This study provides evidence for PROMEGAN regarding the productive and economic outcomes of farms employing different management practices, technology levels, and land areas. It highlights the expected results for farms with various management systems that implement the promoted technologies by presenting the productive and financial indicators of those that have adopted them.

The technologies being promoted vary widely in cost depending on the region. Factors influencing these costs include climatic conditions, such as precipitation; transportation issues, such as accessibility; and support from institutions like PROMEGAN, which covers the costs of certain technologies, such as Artificial Insemination. This analysis provides a better understanding of the significant challenges faced by communities and identifies limiting factors that make technology adoption more difficult. Ultimately, it aims to find solutions to help improve the livestock sector in the Dominican Republic.

6. Bibliography

Alcántara Luciano, C.M. (2023) Caracterización de los sistemas de producción lechera en la zona de intervención del Plan Sierra, Republica Dominicana. Tesis MSc., Centro Agronómico Tropical de Investigación y Enseñanza (CATIE), Turrialba, Costa Rica.

Arroyo-Aguiar, L. (2021). *Evaluación del impacto del sistema de producción intensiva en la calidad de carne bovina*. Archivos Latinoamericanos de Producción Animal, 29(1), 5-20. https://ojs.alpa.uy/index.php/ojs_files/article/view/2817

Bailey, C.B. (1979). *Water: Its Role in Animal Agriculture*. Journal of Animal Science, 48(1), 1. https://doi.org/10.2527/jas1979.4811

Balcão, L.F., Longo, C., Costa, J.H.C., Uller-Gómez, C., Filho, L.C.P.M. & Hötzel, M.J. Characterization of smallholding dairy farms in southern Brazil. *Anim. Prod. Sci.* 2017, *57*, 735. http://dx.doi.org/10.1071/AN15133

Beef Cattle Research Council (2018, March 8). *Costs of siring calves: Artificial insemination compared to natural service*. BeefResearch.ca. https://www.beefresearch.ca/blog/costs-of-siring-calves-artificial-insemination-compared-to-natural-service/

Benítez, D.I., Fernández, J.L., Ray, J., Ramírez, A., Torres, V., Tandrón, I., Díaz, M. & Guerra, J. (2007). Factores determinantes en la producción de biomasa en tres especies de pastos en sistemas racionales de pastoreo en el Valle del Cauto, Cuba. Revista Cubana de Ciencia Agrícola 41(3), 231-235.

Betancourt, H., Pezo, D., Cruz, J. & Beer, J. (2007). Impacto bioeconómico de la degradación de pasturas en fincas de doble propósito en El Chal, Petén, Guatemala. *Revista Pastos y Forrajes "Indio Hatuey" (Cuba)*, 30(1), 169-175.

Calvo Hernández, O. M. (2021). Estimación del costo de producción de un kilogramo de leche y sus variables más influyentes. *E-Agronegocios*, 7(2), 44–62. https://doi.org/10.18845/ea.v7i2.5682

Cedeño, D.A. & Vargas, B. (2004). Optimización de políticas de descarte en ganado bovino lechero de Costa Rica. *Archivos de zootecnia*, 53(203), 249-260. https://www.redalyc.org/pdf/495/49520302.pdf

CONALECHE (2024). Gobierno De La República Dominicana. Retrieved October 9, 2024, from https://ganaderia.gob.do/index.php/de-interes/itemlist/tag/Ganaderia#:~:text=Hay%20un%20estimado%20de%2047%2C916%20fincas%20dedicadas%20a,estima%20un%20promedio%20de%20350%20tareas%20por%20finca.

CORFOGA (2023). Corporacion Ganadera CORFOGA. Retrieved October 23, 2024, from https://www.corfoga.org/estadisticas/precios/

DairyNZ (2023). *DairyNZ economic survey 2022-23*. DairyNZ. https://www.dairynz.co.nz/media/5jsinkf1/dairynz-economic-survey-2022-23-online-version.pdf

FAO (2006). Livestock's Long Shadow. *Environmental Issues and Options*. Food and Agriculture Organization of the United Nations, Rome, Italy

FAO (2011). World Livestock 2011 – Livestock in food security. Rome.

Crops and livestock products (2022). FAOSTAT. Retrieved February 3, 2024, from https://www.fao.org/faostat/en/#data/QCL/visualize

Fariña, S.R., Baudracco, J. & Bargo, F. (2020). Dairy production in diverse regions: Latin America. In McSweeney, P.L.H., McNamara, J.P. (eds.), *Encyclopedia of Dairy Sciences*, 3, 244-252. https://doi.org/10.1016/B978-0-12-818766-1.00052-0

Ganadería dominicana, nada que envidiarle a las de otros países (2023). Gobierno De La República Dominicana. Retrieved October 9, 2024, from https://www.ganaderia.gob.do/index.php/noticias/item/579-ganaderia-dominicana-nada-que-envidiarle-a-las-de-otros-paises

Gandini, G., Hlophe-Ginindza, S. N., Mkhize, N. R., Khumalo, N. P., Mpofu, T. J. & Banos, G. (2022). From a documented past of the Jersey breed in Africa to a profit index linked future. *Frontiers in Genetics*, 13, 881445. https://doi.org/10.3389/fgene.2022.881445

Gerber, P.J., Steinfeld, H., Henderson, B., Mottet, A., Opio, C., Dijkman, J., Falcucci, A & Tempio, G. (2013). Tackling climate change through livestock: a global assessment of emissions and mitigation opportunities. Rome, Italy, Food and Agriculture Organization of the United Nations (FAO).

Gobbi, J. A. & Casasola Coto, F. (2003). Comportamiento financiero de la inversión en sistemas silvopastoriles en fincas ganaderas de Esparza, Costa Rica. Agroforestería en las Américas, 39-40.

Gobierno de Mexico (2018, March 8). La ganadería: Símbolo de fortaleza del campo mexicano. Retrieved January 18, 2024, from https://www.gob.mx/siap/articulos/la-ganaderia-simbolo-de-fortaleza-del-campo-mexicano

González, M. & Guzmán, J. (2014, November 16). *Inicios de la agricultura y la ganadería.* Historia Universal. https://mihistoriauniversal.com/prehistoria/inicios-de-la- agricultura-y-la-ganaderia

González, M. & Guzmán, J. (2014, November 16). *Inicios de la agricultura y la ganadería.* Historia Universal. https://mihistoriauniversal.com/prehistoria/inicios-de-la-agricultura-y-la-ganaderia

Hernández, O. M. C. (2021). Estimación del costo de producción de un kilogramo de leche y sus variables más influyentes. *e-Agronegocios*, 7(2), 44-62.

Herrero, M., Gerber, P., Vellinga, T., Garnett, T., Leip, A., Opio, C., ... & McAllister, T. A. (2011). Livestock and greenhouse gas emissions: The importance of getting the numbers right. *Animal Feed Science and Technology*, 166, 779-782.

Instituto de Estabilización de Precios (INESPRE) (2024). Gobierno de la Republica Dominicana. Luis Abinader dice RD posee la tercera canasta básica "más económica" de Centroamérica y el Caribe. (website). Visited 28 October 2024. https://inespre.gob.do/luis-abinader-dice-rd-posee-la-tercera-canasta-basica-mas-economica-de-centroamerica-y-el-caribe/

Jayasinghe, J.M.P., Pembleton, K.G., Donaghy, D.J., Ramilan, T. & Barber, D.G. (2024). Long-term evaluation of pasture production, seasonality, and variability: An application of the DairyMod pasture model for three tropical species. European Journal of Agronomy, 156, 127103. https://doi.org/10.1016/j.eja.2024.127103

Lebbink, G. & Fensham, R. (2023). The 'lawnification' of Australia's eastern grassy woodlands: the past, current and likely future spread of an invasive perennial grass, *Bothriochloa pertusa*. Biological Invasions, 25(6), 1779-1794. https://doi.org/10.1007/s10530-023-03010-w

Lee Mark A. & Roberts David J. (2014, November). *Cut and carry: Investigating the effects of increasing the proportion of grass in the diets of high yielding dairy cows*. DairyCo.

https://www.greenforage.co.uk/wp-content/uploads/2015/03/project_report_-_increasing_the_proportion_of_grass_in_high_yielding_cow_diets.pdf

Loeb, S., Dynarski, S., McFarland, D., Morris, P., Reardon, S. & Reber, S. (2017). Descriptive Analysis in Education: A Guide for Researchers. NCEE 2017-4023. *National Center for Education Evaluation and Regional Assistance*.

Magaña Monforte, J., Ríos Arjona, G. & Martínez González, J.M. (2006). Los sistemas de doble propósito y los desafíos en los climas tropicales de México. *Archivos Latinoamericanos de Producción Animal*, 14(3), 105-114.

Margulis, S. (2004). *Causes of deforestation of the Brazilian Amazon* (Vol. 22). World Bank Publications.

Martínez, J.H., Rebollar, A.R., Ancelmo, J.M., Soria, E.G. & Rebollar, S.R. (2016). Costos y competitividad en la producción de bovinos carne en corral en el sur del Estado de México. *Investigación y Ciencia de la Universidad Autónoma de Aguascalientes*, 69, 13-20.

Martínez Vega, E.J. (2023). Evaluación de la degradación en pasturas, prácticas ganaderas y percepciones sobre servicios ecosistémicos en fincas de la Reserva del Hombre y la Biosfera del Río Plátano, Honduras. Tesis MSc, Centro Agronómico Tropical de Investigación y Enseñanza (CATIE), Turrialba, Costa Rica.

Meat & Martinez Livestock Australia. (n.d.). *Tool 22: Assessing groundcover*. Meat & Livestock Australia. (online, website) Retrieved September 10, 2024, from https://mbfp.mla.com.au/pasture-growth/tool-22-assessing-groundcover/

Migose, S.A., van Der Linden, A., Bebe, B.O., de Boer, I.J.M. & Oosting, S.J. (2020). Accuracy of estimates of milk production per lactation from limited test-day and recall data collected at smallholder dairy farms. *Livestock Science*, 232, 103911. https://doi.org/10.1016/j.livsci.2019.103911

Ministerio de Agricultura y Ganadería (2023). *Costos de producción: Pasto transvala en secano, Región Chorotega*. https://www.infoagro.go.cr/EstadisticasAgropecuarias/CostosProduccion/Documents/Pasto-transvala-secano_Chorotega_2023.pdf

Ministerio de Agricultura y Ganadería (n.d.). *Caracterización agrocadena de leche, Región Central Oriental*. https://www.mag.go.cr/bibliotecavirtual/E70-10747.pdf

Montaldo, H.H., Casas, E., Sterman Ferraz, J.B., Vega-Murillo, V.E. & Román- Ponce, S.I. (2012). Opportunities and challenges from the use of genomic selection for beef cattle breeding in Latin America. United States Department of Agriculture-Agricultural Research Service / University of Nebraska-Lincoln: Faculty Publications, 2(1), 23-29.

https://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1827&context=usdaarsfacpub

Monteiro, E.D.C., Burak, D.L., Cunha, A.D.M., Passos, R.R. & Mendonça, E. D. S. (2018). Visual assessment of pasture degradation: Validation by ground cover and seasonal variation. *Revista Ciência Agronômica*, 49, 174-182.

Mora Calvo, V. (2020). *Costos de producción de caña de azúcar en la región del Pacífico Central*. Ministerio de Agricultura y Ganadería, Coordinador de la Comisión de Seguros Agropecuarios y la Dirección de Desarrollo Agropecuario Pacífico Central. https://www.infoagro.go.cr/EstadisticasAgropecuarias/CostosProduccion/Documents/CANNA-AZUCAR_PacificoCentral_2020.pdf

Murgueitio, E., Ibrahim, M., Ramírez, E., Zapata, Á., Mejía, C. E. & Casasola, F. (2003). Usos de la tierra en fincas ganaderas: guía para el pago de servicios ambientales en el Proyecto Enfoques Silvopastoriles Integrados para el Manejo de Ecosistemas.

Observatorio de la Cadena Láctea en República Dominicana (2022). *Panorama de la cadena láctea de la República Dominicana 2022*. Retrieved from https://observatoriolacteo.com.do/panorama-de-la-cadena-lactea-de-la-republica-dominicana-2022/

Penn State Extension (2022). *Evaluating and maintaining pastures in dry conditions*. https://extension.psu.edu/evaluating-and-maintaining-pastures-in-dry-conditions

Pasture.io (2021, June 2). *Grazing management to reduce soil damage*. *Pasture.io*. Retrieved 28 Oct. 2024. From https://pasture.io/grazing-management/reduce-soil-damage

Pezo, D. (2018). Establecimiento y manejo de sistemas intensivos de pastoreo racional. Proyecto EC-LEDS II, USDA/MAG/MINAE. CATIE. *Serie Técnica, Informe Técnico no. 96*. CATIE, Turrialba, Costa Rica.

Pezo, D., Romero, F. & Ibrahim, M. (1992). Producción, manejo y utilización de pastos tropicales para la producción de leche y carne. En: S. Fernández-Baca (ed.), Avances en la Producción de Leche y Carne en el Trópico Americano. FAO, Oficina Regional para América Latina y el Caribe, Santiago, Chile, 47-98.

Pitman, W.D., Chambliss, C.G. & Hacker, B. (2004). Digitaria grass and other species of Digitaria. In L.E. Moser, B.L. Burson, L. E. Sollenberger (eds), *Warm-Season (C4) Grasses*. American Society of Agronomy, Madison, WI. USA. pp. 715-743. ISBN:9780891181569.

Rymill, L. (2018, February 9). *Pasture renovation basics*. Small Farms Magazine & Book Shop. https://www.smallfarms.net/pasture-renovation-basics/

Precios de la leche nacionales pagados al productor (2023). Camara Nacional De Productores De Leche. Retrieved October 23, 2024, from https://proleche.com/wp-content/uploads/2024/01/Precios-nacionales.-Leche-al-productor.pdf

Produccion pecuaria (2023). Gobierno De La República Dominicana. Retrieved October 9, 2024, from https://view.officeapps.live.com/op/view.aspx?src=https%3A%2F%2Fagricultura.gob.do%2Fwp-content%2Fuploads%2F2024%2F04%2F5.2.1-Produccion-Pecuaria-En-QQ-Unid.-y-Litros-2002-2023.xlsx&wdOrigin=BROWSELINK

PROMEGAN (n.d.). Gobierno De La Republica Dominicana. Retrieved October 9, 2024, from https://ganaderia.gob.do/index.php/sobre-nosotros/promegan

Rodríguez, F.R.A. (1985) Producción de biomasa de Poró gigante (E. Poeppigiana) y king grass (P. purpureum * P. thypoides) intercalados en función de la densidad de siembra y la biomasa de poda del Poró. CATIE. Thesis Mg. Sc.

Rodríguez Lizano, V. & Montero Vega, M. (2016). The impact of biodiversity in sustainable agriculture. *International Journal of Development Research*, 6(10), 9644-9648. https://www.journalijdr.com/sites/default/files/issue-pdf/6572.pdf

Sánchez Sarmiento, L.Y., Andrade Castañeda, H.J. & Rojas Molina, J. (2010). Demanda de mano de obra y rentabilidad de bancos forrajeros en Esparza, Costa Rica. *Acta agronómica*, 59(3), 363-371.

Steinfeld, H., Gerber, P., Wassenaar, T., Castel, V., Rosales, M. & de Haan, C. (2009). La larga sombra del ganado problemas ambientales y opciones. FAO. a0701s.pdf (fao.org)

Taylor, M.A., Stephenson, T.S., Chen, A.A. & Stephenson, K.A. (2012). Climate change and the Caribbean: Review and response. *Caribbean Studies*, 40(2), 169-200. https://www.redalyc.org/pdf/392/39226915007.pdf

Teyer-Bobadilla, R., Magaña, J.G., Santos, J. & Aguilar, C. (2002). Comportamiento productivo y reproductivo de vacas Holstein manejadas en un sistema de lechería especializada y otra de doble propósito en el sureste de México. *Livestock Research for Rural Development*, 14(4), 31. https://www.lrrd.cipav.org.co/lrrd14/4/teye144.htm

Thomas, C. (2021, June 30). *Milk cost of production*. Michigan State University Extension. https://www.canr.msu.edu/news/milk_cost_of_production

Toruño, I. (2012). Análisis financiero-económico de fincas con varias actividades productivas y el rol de la familia en la Producción y toma de decisiones en el Centro Norte de Nicaragua.

Centro Agronómico Tropical De Investigación Y Enseñanza (CATIE), 40. https://repositorio.catie.ac.cr/handle/11554/358

Tothill, J.C., Jones, R.M. & Hargreaves, J.N.G. (1978). BOTANAL - a comprehensive sampling and computing procedure for estimating pasture yield and composition. 1. Field Sampling. *CSIRO Aust. Div. Trop. Crops & Past. Trop. Agron. Tech. Mem.*, 8.

Twine, R. (2021). Emissions from animal agriculture—16.5% is the new minimum figure. *Sustainability*, *13*(11), 6276.

U.S. Department of Agriculture, Economic Research Service (2023). *Food price outlook*, *2023*. U.S. Department of Agriculture. https://www.ers.usda.gov/data-products/chart-gallery/gallery/chart-detail/?chartId=78283

U.S. Department of Agriculture, Natural Resources Conservation Service (2020). *National pasture condition scoring guide and score sheet*. https://www.nrcs.usda.gov/sites/default/files/2022-06/National_Pasture_Condition_Scoring_Guide_and_Score_Sheet_-_January_2020.pdf

Valergakis, G. E., Arsenos, G. & Banos, G. (2007). Comparison of artificial insemination and natural service cost effectiveness in dairy cattle. *Animal*, 1(2), 293-300.

Valor Bruto Producción Agropecuaria (2023). Gobierno de la República Dominicana. Retrieved October 9, 2024, from https://view.officeapps.live.com/op/view.aspx?src=https%3A%2F%2Fagricultura.gob.do%2Fwp-content%2Fuploads%2F2024%2F04%2F1.6-Valor-Bruto-de-la-Prod.-Agrop.-a-Prec.-Corrientes-2002-2023.xlsx&wdOrigin=BROWSELINK

Van Niekerk, T. (2023). Wondering How Many Cows Are in the World? Global Cattle Population Data Revealed! *WAF*. How Many Cows Are In The World? (Global Distribution Data) (worldanimalfoundation.org)

Vite-Cristóbal, C., López-Ordaz, R., García-Muñiz, J.G., Ramírez-Valverde, R., Ruiz-Flores, A. & López-Ordaz, R. (2007). Producción de leche y comportamiento reproductivo de vacas de doble propósito que consumen forrajes tropicales y concentrados. *Veterinaria México*, 38(1), 63-79.

Xe (n.d.). Currency converter: 1 USD to DOP. Xe. Retrieved September 24, 2024, from https://www.xe.com/currencyconverter/convert/?Amount=1&From=USD&To=DOP

Zárate-Martínez, J.P., Esqueda-Esquivel, V.A., Vinay-Vadillo, J.C. & Jácome-Maldonado, S.M. 2010. Evaluación económico-productiva de un sistema de producción de leche en el trópico. *Agronomía Mesoamericana*, 21(2), 255-265. https://www.scielo.sa.cr/scielo.php?script=sci_arttext&pid=S1659-13212010000200004

7. Annexes

Annex 1. Questionnaire for Financial and Productive Monthly Projections

ENCUESTA GANADERA PARA REALIZAR
PROYECCION FINANCIERA MENSUAL

Cuestionario para Análisis Ex ante del Impacto Financiero de las tecnologías promovidas por PROMEGA en la República Dominicana

Informar al productor el objetivo de la encuesta*: "Esta encuesta se está realizando en el marco del proyecto PROMEGAN, con apoyo del Centro Agronómico Tropical de Investigación y Enseñanza (CATIE y la Universidad de Texas A&M, con fin de recopilar las variables biofísicas y financieras para evaluar el desempeño financiero que podría tener las tecnologías promovidas por PROMEGAN, usando tres casos de estudio como base. La información será manejada de forma confidencial. Los resultados de este estudio lo haremos llegar vía correo electrónico al productor si así lo desea."*

- ¿Está de acuerdo con la entrevista? (Sí) ☐ (No) ☐
- Si desea los resultados del estudio, (Sí) ☐ (No) ☐
  - Teléfono: ____
  - Email: ____

1. Información general del rancho

Fecha: ________________Nombre Técnico: ______________________________________

Productor: ____________________________ Edad: _______ Género: (Hombre) ☐ (Mujer) ☐

Ubicaciones coordenadas (GMS) X: ____________Y: ____________ Altitud (msnm):________

Dirección del rancho: ____

Provincia: _____________ Municipio: _____________ Comunidad/paraje: _______________

Reside en el rancho (Sí) ☐ (No) ☐

¿Cuál es su nivel de educación?

- Ninguna ☐ Primaria ☐ Secundaria ☐ Técnico ☐ Universitaria ☐ Posgrado ☐

I. Información del Hato

Categoría de ganado	**Cantidad (cabezas**	**Peso vivo por cabeza/ (indicar unidad > Lbs/qq/kg)***	****GDP (g/día)**
Vacas en producción (lactancia)			
Vacas secas (jorras)			
Novillas > 2 años			
Novillas 1-2 años			
Becerras (en lactancia) < un año			
Toros			
Machos > 2 años			
Machos 1-2 años			
Becerros (en lactancia) < un año			
Total			

*Si el productor no sabe es información, preguntarle al técnico (el promedio en la región).
**GDP preguntarle al técnico – respecto al promedio en la región.

II. Reproducción animal

Tipo de reproducción	**Cual aplica, marque con x**	**Costo en RD$**
a) Monta natural		
b) Monta natural controlada		
c) Inseminación artificial (IA)		

Monta Natural: se deja al toro suelto para que el monte libremente a las vacas mientras cae en celo.
Monte natural controlada: Época de apareamiento en donde las vacas aptas para reproducción son expuestas al toro durante un periodo de tiempo determinado.

Parámetros de reproducción	**Indicar valor**
a) Intervalo entre partos (en meses	
b) Días abiertos	
c) Porcentaje de parición (%)	
d) Edad primer parto de vaquillas (meses)	
e) Edad de descarte (años)	

*Información es probable que el productor no la sepa, estimar/sugerir un promedio con ayuda el técnico.

Parámetros de mortalidad	**Porcentaje anual (Muertes/Total animales-categoría)**
a) Mortalidad adultos	
b) Mortalidad de vacas en producción	
c) Mortalidad terneros	

*Indicar que porcentaje de los animales se mueren en promedio por razones varias (enfermedades, sequías, accidentes, etc.). Sugerir con el técnico y el productor un promedio anual.

¿Cuántos terneros(as) nacieron el año pasado?

Categoría	**Cantidad**	**Peso promedio**	**Unidad (lb/qq/kg)**
Terneros			
Terneras			

III. Parámetros productivos

Categoría	**Actual-mente**	**Época Seca**	**Época lluviosa**	**Promedio anual**
Producción de leche total en el rancho/día (litros)				
Número de vacas ordeñadas en promedio				
Precio de la leche promedio (RD$/Litro)				

- Duración de lactancia/vaca, en promedio: __________meses
    - % de Grasa en Leche: ___________
    - % de proteína en leche: __________
- Tipo de ordeño:
    - (Manual) ☐ (Mecánico) ☐
- ¿Cuántas veces ordeña al día?
    - (Una vez al día) ☐ (Dos veces al día) ☐
- Tipo de apoyo ordeño:
    - (Con ternero) ☐ (Sin ternero) ☐ (Inyección) ☐
- ¿Dónde entrega la leche al comprador?
    - (En el mismo rancho) ☐ (En un centro de acopio) ☐
- ¿Enfría la leche?
    - (Sí) ☐ (No) ☐
- ¿Procesa la leche?
    - (Sí) ☐ (No) ☐
        - Si procesa la leche,

- ¿Qué producto produce? ___________
- Cantidad/mes __________
- Precio/unidad__________

IV. Ventas de animales en el año pasado, precio promedio, y peso vender al vender. Venta de animales esperadas en el futuro.

			Cantidades													
Categoría	**unidad**	**Precio / Unidad**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Ventas anuales futuras esperadas promedio/año**	**Peso vivo promedio en (qq)/animal**
Ventas de Vacas en producción	Cabezas															
Ventas de Vacas de descarte	Cabezas															
Ventas de Novillas>2años	Cabezas															
Ventas de Novillas, 1-2años	Cabezas															
Ventas de Becerras, lactantes	Cabezas															
Ventas de Becerros, lactantes	Cabezas															
Ventas de Toro	Cabezas															
Ventas de Novillos>2años	Cabezas															

Ventas de Novillos, 1-2años	Cabezas															

V. Compra de animales en el año pasado, precio promedio de compra, y peso al comprar. Compra de animales esperadas en el futuro.

			Cantidades													
Categoría	**unidad**	**Precio / Unidad**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Ventas anuales futuras esperadas promedio/año**	**Peso vivo promedio en (qq)/animal**
Ventas de Vacas en producción	Cabezas															
Ventas de Vacas de descarte	Cabezas															
Ventas de Novillas>2años	Cabezas															
Ventas de Novillas, 1-2años	Cabezas															
Ventas de Becerras, lact	Cabezas															
Ventas de Becerros, lact	Cabezas															
Ventas de Toro	Cabezas															
Ventas de Novillos>2años	Cabezas															

Ventas de Novillos, 1-2años	Cabezas														

VI. Uso del suelo

Favor, indicar cuál es el área total de la finca (Tareas): ________________________________

Favor, indicar cuanta área es para ganadería (Tareas): __________________________________

Indicar las áreas forrajeras:

Tipo de pasto	Nombre del forraje	Tareas	*Árboles de potreros (Si, o No);	Tipo pasto: (Natural, Mejorado)	Nivel de degradación de la pastura: (Ninguna - 1, Leve – 2, Severa - 3, Muy Severa - 4)
Pasto de piso					
Pasto de corte					
Bancos forrajeros					

*Dos árboles/tarea o más.

VII. Otros usos del suelo, indicar cual aplica:

Uso de Suelo	**Especies**	**Área (tareas)**	**Observaciones**
Cultivos Anuales			
Cultivos Permanentes			
Plantaciones Forestales			
Bosques ribereños			
Bosques secundarios			

VIII. Sistema de pastoreo en el rancho.

Sistema de pastoreo	**Marque con una X cuál usa por época**		**Periodo de ocupación, indique si aplica**	**Periodo de descanso, indique si aplica**
	Lluviosa	**Seca**		
Rotational **				
Alterno**				
Continuo*				
Agostadero				

*Aplica cuando se manejan todos los potreros abiertos, como sucede en la época seca para acceso al agua u otro motivo.
** Hay períodos de ocupación y período de descanso aplican para sistema rotacional y alterno.

IX. Arboles adentro del rancho

¿Tiene arboles dispersos en potreros?

- (Sí) □ (No) □, cuántos:_________/tareas

Si hay árboles, ¿Especies dominantes de árboles en potreros? ___________

X. División de potreros

- ¿Qué tipo de cercas utiliza en su rancho? (Muerta) ☐ (Vivas) ☐, (Cercas eléctrica) ☐,

Frecuencia de poda de las cercas vivas (marque con una X la que aplica)

	Anual	Bi-anual	Cada dos años	Cada 3 años	Otro
frecuencia					

XI. Salud animal

- Paga servicios a un veterinario (Sí) ☐ (No) ☐,
    - Si sí, Cuánto le paga por servicios (RD$): _________
        - Con qué frecuencia por año: _______________

- ¿Qué medicamentos / vitaminas / Minerales usa en su finca? Nombrar (buscar el costo con él técnico, en caso de que el productor no lo tenga)

Nombre del producto	**Unidad**	**Cantidad/año**	**Precio/unidad**

II. Gastos en la finca

COSTOS			**Cantidades**											
CATEGORIA	**unidad**	**Costo /unidad**	**Ene**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Suplementación														
Sal común														

Sales minerales														
Concentrado														
Silo de maíz														
Silo de sorgo granífero														
Silo de sorgo forrajero														
Afrecho de Arroz														
Afrecho de Trigo														
Silo Mombaza														
Melaza de caña														
Gallinaza														
Concentrado lechero														
Concentrado iniciador														
Heno – pacas														
Bloque nutricionales														
Mano de Obra														
Familiar														
Permanente														
Temporal														
Dueño														
Energía y combustible														
Energía eléctrica														
Gasolina														
Petróleo														
Diesel														
Sanidad y Reproducción														

Gastos en medicinas														
Gastos en reproducción														
Servicios veterinarios														
Mantenimientos de pasturas														
Fertilizantes														
Herbicidas														
Control Manual														
Otros														
Mantenimientos de Infraestructuras														
Materiales p/cercas														
Materiales p/corrales de manejo														
Materiales p/sala de ordeño														

Indicar otros gastos aquí:

____

De las tecnologías que promueve PROMEGA, cual le interesa más adoptar:

Indicar si se dedica a otras actividades productiva, laborales o servicio:

Preguntas para los técnicos: En qué consiste las tecnologías que promueve PROMEGA, aquellas que serán evaluadas:

Tecnología 1: ________________________

A) En qué consiste:

B) Listar los insumos, cantidades requeridas, y precios para una finca de 10 tarea

C) Listar los servicios, cantidades requeridas, y precios para una finca de 10 tarea

Tecnología 2: ________________________

A) En qué consiste:

B) Listar los insumos, cantidades requeridas, y precios para una finca de 10 tarea

C) Listar los servicios, cantidades requeridas, y precios para una finca de 10 tarea

Tecnología 3: ________________________

A) En qué consiste:

B) Listar los insumos, cantidades requeridas, y precios para una finca de 10 tarea

C) Listar los servicios, cantidades requeridas, y precios para una finca de 10 tarea

Tecnología 4: ________________________

A) En qué consiste:

B) Listar los insumos, cantidades requeridas, y precios para una finca de 10 tarea

C) Listar los servicios, cantidades requeridas, y precios para una finca de 10 tarea

Tecnología 5: ________________________

A) En qué consiste:

B) Listar los insumos, cantidades requeridas, y precios para una finca de 10 tarea

C) Listar los servicios, cantidades requeridas, y precios para una finca de 10 tarea

Annex 2. Cost of technologies per region

1. Bonao

a. Inseminación Artificial (10 tareas 1 year)

Insumos	**Cantidades**	**Precios**
Pajilla	25	500$-$2,000 X pajilla
Tanque (nevera)	20 litros	$50,000
Nitrógeno	1 litro	$300(se rellena cada 2 meses)
Catete	50	$500
Guates	1 caja de 100 pares	$800
Overall	1 (desechable)	$350
Mascarilla	50	$2,250
Botas de Ule	1	$600
Servicio	**Cantidad**	**Precio**
Servicio	1 inseminación	$2,000
Inseminación	1 Inseminador	$1,000 (con materiales)
TOTAL		**$84,300 (RD)**

b. Banco Energético (10 tareas 1 year)

Insumos	**Cantidades**	**Precios X Unidad**
Herbicida 24D	1 gal	$865
Mancozone	4.5 kg	$380 (1,710)

Cypermectina	1.5 lit	$535 (802.5
Foliar	12 lbs	$85 (1,020)
Semilla	20 lbs	$350 (7,000)
Adherente	1 litro	$300
Fertilizante Basal	6 quintales	$20 la libra
Servicios	**Cantidad**	**Precio X Unidad**
Preparación del terreno	1	$1,500
Control Manual	1	$600
Análisis de suelo	1	$7,200
Siembra	1	$600
TOTAl		**$20,995.5(RD)**

c. Pasturas Mejoradas (10 tareas 1 year)

Insumos	**Cantidades**	**Precios X Unidad**
Herbicida 24D	1 gal	$865
Mancozone	4.5 kg	$380 (1,710)
Cypermectina	1.5 lit	$535 (802.5
Foliar	12 lbs	$85 (1,020)
Semilla	20 lbs	$350 (7,000)
Adherente	1 litro	$300
Fertilizante Basal	6 quintales	$20 (120)
Servicios	**Cantidad**	**Precio X Unidad**
Preparación del terreno	1	$1,500
Control Manual	1	$600
Análisis de suelo	1	$7,200
Siembra	1	$600
TOTAl		**$20,995.5(RD)**

d. Pastoreo Rotacional (10 tareas 1 year)

Insumo	**Cantidad**	**Precio**
Alambre de púa	13.2 rollos	$2,250 X rollo (29,700)
grapas	11 libras	$70 X libra (770)
Postes	320	$30 X poste (9,600)
Alambre galvanizado 12	Medio quintal	$4,908 quintal (2,454)
Varilla de tierra 6pies 5/8	5	$900X varilla (4,500)
Madrina	10	$50 X madrina (500)
Arboles de sombra	52	$10 X árbol (520)
Fertilizante	6 quintales	$20 X libra (12,000)

Servicio	Cantidad	Precio
Cavar, abonar, sembrar	52	$10 X hoyo (520)
Transporte de postes	1	$640 el viaje
Transporte de árbol	1	$520 el viaje
Fijar el poste	330	$5 X poste (1650)
Atensar y agrapar	1	$3,000 trabajo completo
TOTAL		**$66,374**
Mas Cotizacion		**$168,609.39**

INVESAGRO
Soluciones Agropecuarias

Carretera las Palomas, calle Francsico Tita # 75,
Santiago de los Caballeros, R.D.
Tel. 809-570-6889 - 809-430-4429
www.invesagro.com
RNC-130413614

Cotización

FECHA DE DOCUMENTO:	22/04/2024	Nº de documento:	2043
NOMBRE O RAZON SOCIAL:	JAEL ANTONIO ESTEVEZ VALERIO/RNC: 35000023651	Vendedor:	JAEL ESTEVEZ
		Referencia:	
TELEFONO:	829-497-5590		
CONTACTO:			
Dirrección:	SANTIAGO		

Codigo	Descripción	Cantidad	Unidad	Precio	ITBIS	Tota
AR-0578	AISLADOR PIVOTE AMARILLO	200		6.19	222.84	1,238.00
AR-0180	AISLADOR OVALADO NEGRO	25	UND	25.00	112.50	625.00
AR-0222	TENSOR GALVANIZADO EN CALIENTE PARA 500 METROS	20	UND	150.00	540.00	3,000.00
AR-0216	MANIGUETA PORTILLO AMARILLA CON RESORTE	5	UND	160.00	144.00	800.00
AR-0219	RECIBIDOR DE MANIGUETA AMARILLO	25	UND	45.34	204.03	1,133.50
AR-0189	CABLE AISLADO * 50 MT	1	UND	1,389.66	250.14	1,389.66
AR-0363	GENERADOR PARA 15 KM A 110 V	10	UND	7,525.00	13,545.00	75,250.00
AR-0194	CUCHILLA DOBLE TIRO ALTO VOLTAJE	1	UND	665.00	119.70	665.00
AR-0195	DESVIADOR DE RAYOS	1	UND	1,066.00	191.88	1,066.00
AR-0213	LLAVE PARA TENSOR	1	UND	143.00	25.74	143.00
AR-0226	VOLTIMETRO DE LUCES	1	UND	1,330.00	239.40	1,330.00

Subtotal RD$	86,640.16
ITBIS 18%	15,595.23
Total RD$	**102,235.39**

e.

Sistemas silvopastoriles (10 tareas 1 year)

Insumo	Cantidad	Precio
Alambre de púa	13.2 rollos	$2,250 X rollo (31,500
grapas	11 libras	$70 X libra (770

Postes	320	$30 X poste (9,600
Madrina	10	$50 X madrina (500
Arboles de sombra	52	$10 X árbol (520
Fertilizante	6 quintales	$2,000 X quintal (12,000
Servicio	**Cantidad**	**Precio**
Cavar, abonar, sembrar	52	$10 X hoyo (520
Transporte de postes	1	$640 el viaje
Transporte de árbol	1	$520 el viaje
Fijar el poste	330	$5 X poste (1650
Atensar y agrapar	1	$3,000 trabajo completo
Total		**$61,220**

2. Santiago Rodríguez

a. Sistemas silvopastoriles (10 tareas 1 year)

Insumo	**Cantidad**	**Precio**
Alambre de púa	13.2 rollos	$2,600 X rollo (36,400
grapas	11 libras	$70 X libra (770
Postes	320	$80 X poste (25,600
Madrina	10	$50 X madrina (500
Arboles de sombra	52	$10 X árbol (520
Fertilizante	6 quintales	$2,000 x quintal (12,000
Servicio	**Cantidad**	**Precio**
Cavar, abonar, sembrar	52	$10 X hoyo (520
Transporte de postes	1	$640 el viaje
Transporte de árbol	1	$520 el viaje
Fijar el poste	330	$5 X poste (1650
Atensar y agrapar	1	$3,000 trabajo completo
TOTAL		**$82,120**

b. Bancos energéticos

Insumos	**Cantidad**	**Precio**
Semillas (Zuri)	1.6 lb X tarea	$9,248 (578 x libra)
Fertilizante (15-15-15)	62.5 libras X 10 tareas	100 libras X ($2,400)

Servicio	**Cantidad**	**Precio**
preparación de Terreno	10 tareas	$12,000 X 10 tareas
Mano de obra	1 tarea	$600
TOTAL		**$24,248**

c. Pasturas Mejoradas

Insumos	**Cantidad**	**Precio**
Semillas (Zuri)	1.6 lb X tarea	$9,248 (578 x libra)
Fertilizante (15-15-15)	62.5 libras X 10 tareas	100 libras X ($2,400)
Servicio	**Cantidad**	**Precio**
preparación de Terreno	10 tareas	$12,000 X 10 tareas
Mano de obra	1 tarea	$600
TOTAL		**$24,248**

d. Inseminación Artificial

Insumo	**Cantidad**	**Precio**
Pajilla	25	$500-$2,000 X 1
Nitrógeno	1 litro	$300 (se rellena cada 2 meses)
Tanque	20 litros	$50,000
Catete	50	$500
Pistola de Inseminacion	1	$3,500
Guante	1 caja de 100 pares	$800
Regla para medir nitrógeno	1	$400
Pinza	1	$3,800
Termómetro	1	$3,900
Servicio	**Cantidad**	**Precio**
Inseminador	(del estado) si no 1	$500
TOTAl		**$89,600**

e. **Pastoreo Rotacional**

Insumo	**Cantidad**	**Precio**
Alambre de púa	13.2 rollos	$2,250 X rollo (29,700)
grapas	11 libras	$70 X libra (770)
Postes	320	$80 X poste $(25,600
Alambre galvanizado 12	Medio quintal	$4,908 quintal (2,454)
Varilla de tierra 6pies 5/8	5	$900X varilla (4,500)
Madrina	10	$50 X madrina (500)
Arboles de sombra	52	$10 X árbol (520)
Fertilizante	6 quintales	$2,000 X quintal (12,000
Servicio	**Cantidad**	**Precio**
Cavar, abonar, sembrar	52	$10 X hoyo (520)
Transporte de postes	1	$640 el viaje
Transporte de árbol	1	$520 el viaje
Fijar el poste	330	$5 X poste (1650)
Atensar y agrapar	1	$3,000 trabajo completo
TOTAL		**$82,374**
Mas Cotizacion		**$184,609.39**

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CONTACTO:
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AR-0213	LLAVE PARA TENSOR	1	UND	143.00	25.74	143.00
AR-0226	VOLTIMETRO DE LUCES	1	UND	1,330.00	239.40	1,330.00

Subtotal RD$	**86,640.16**
ITBIS 18%	**15,595.23**
Total RD$	**102,235.39**

3. Puerto Plata

a. Inseminación artificial (10 tareas 1 year)

Insumos	Cantidad	Precio
Pajilla	6	$1,200 (7,200)
Catete	6	$5,000
Guantes	1	$800
Tanque	1	$50,000
Nitrógeno	1 litro	$300
Varilla Inseminación	1	$3,500
Pinza	1	$3,500

Termómetro	1	$3,900
Tijera	1	$1,000
Estradiol	3 ml X 4	$1,200 (100 ml)
Prostaglandinas	2 ml X 4	$1,590 (20 cc) (6360)
Gestar	5 ml X 4	$385 (10 cc) (7700
Dispositivo intrauterino	4	
Jeringuillas	6	$10 X 1 (60
Servicio	**Cantidad**	**Precio**
Inseminador	1	$300 x inseminación (1,800)
Sincronizar una vaca	1	($900-$1,300) con DISP INTRAUTERINO (1,000)
Total		**$97,420**

b. Pastos Mejorados

Insumo	Cantidad	Precio
Semillas (Mavuno)	1.7 lb X Tarea	$585 X libra ($9,945)
Fertilizantes 5-6 kilos X Tarea	480 lbs	$10,080
Servicio	**Cantidad**	**Precio**
Preparación de Terreno	1 vez	$5,000
Mano de obra	1 vez	$1,300
Mano de obra	2	$3,500
Control de Malezas	10 tareas	$1,500
TOTAL		**$31,325**

c. Rotación de Pasturas

Insumos	Cantidad	Precio
Alambre de púa	13.2 rollos	$3,000/$2,535/$2,275/$1850
Grapas	11 libras	770$
Transporte de postes	330	$5,000
Postes	320	$150 X poste (48,000
Madrina	10	$100
Alambre galvanizado 12 gauge	Medio quintal	$4,908 X quintal
Varilla de tierra 6’ 5/8	5	$900 X varilla
Servicio	**Cantidad**	**Precio**
Mano de obra	330 hoyos	$20 X hoyo
Tensay y agrapar		$3,000

Total		**$113,324**

d. **Sistemas Silvopastoriles (10 tarea 1 year)**

Insumos	**Cantidades**	**Precios**
Arboles (pinion)	35	$15 (525
Leucaena	2-3 lb	$500 (1,500)
Saman	4	$10 (40
Servicio	**Cantidad**	**Precio**
Cavar y sembrar	35	$10 (350
Fertilizar 15-15-15	7.7 lb	$25 X lb (800)
Transporte	35	$10 x árbol (350
Total		**$3,565**

e. **Bancos Energéticos**

Insumos	**Cantidad**	**Precio**
Fertilizantes	3 quintales	$6,600
Semilla caña	7,500 esquejes	$10 X esqueje (75,000
Servicio	**Cantidad**	**Precio**
Mano de obra	3 aplicaciones	$2,800
Manejo de Malezas	2 veces	$3,500
Sembrar semillas	1 vez	$5,000
Preparación de Terreno	1 vez	$5,000
Remoción de troncos/piedras	1 vez	$2,000
TOTAL		**$99,900**