Habitat Quality Assessment and Carrying Capacity Estimates of Dream Falls in Luisiana, Laguna, Philippines

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Abstract. Ecotourism promotes sustainable engagement with natural landscapes, particularly in rural and forested areas. Pilgrim's Dream Eco Farm & Resort in Luisiana, Laguna is an emerging ecotourism destination that integrates recreational activities with nature-based experiences. However, unmanaged visitation may pose threats to its freshwater features, particularly Dream Falls. This study assessed the water quality and physical habitat conditions of Dream Falls and estimated its recreational carrying capacity using Boullon's Carrying Capacity Mathematical Model. Field data revealed generally healthy water conditions based on pH, temperature, TDS, and Secchi depth values. Carrying capacity estimates indicate a high potential for visitor accommodation, but ecological integrity must still be considered in long-term site management. Findings aim to support future planning toward sustainable tourism development within the site.

1. Introduction

Pilgrim's Dream Eco Farm & Resort, a DOT-accredited (Depart of Tourism) nature destination located in Luisiana, Laguna, serves as an emerging model for sustainable recreational tourism in Southern Luzon. Known for its serene landscape and diverse eco- recreational offerings—including ziplining, trekking to Aliw Falls, and wall climbing—the resort draws both tourists and nature enthusiasts seeking rest and adventure in equal measure. Its family-friendly ambiance and immersion in natural beauty make it a unique platform for the integration of ecotourism and conservation efforts [1].

Sustainable tourism, as defined by the UN Environment Programme (UNEP) and UN World Tourism Organization (UNWTO), is a form of tourism that takes full account of its current and future economic, social, and environmental impacts while addressing the needs of visitors, host communities, and industry stakeholders [2].This holistic framework recognizes both the negative and positive contributions of tourism: it can generate employment, preserve natural and cultural heritage, and support local economies, but also risks environmental degradation, overcrowding, and resource depletion if left unmanaged.

Within the broader framework of sustainable tourism lies ecotourism, a niche sector that emphasizes responsible travel to natural areas with the goal of environmental conservation, cultural appreciation, and local empowerment. Ecotourism must be low-impact, non-consumptive, and ethically managed [3]. Sites like Pilgrim's Dream Eco Farm represent critical testing grounds for such initiatives, particularly in balancing visitor experiences with ecological preservation.

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Recognizing the environmental challenges posed by tourism activities, international policy instruments like Agenda 21, the Rio+20 outcome document, and the 2030 Agenda for Sustainable Development (particularly SDGs 8.9 and 12.b) emphasize the role of sustainable tourism in fostering inclusive economic growth while preserving natural resources and biodiversity. These global frameworks urge Member States to invest in ecotourism and local enterprises, establish appropriate guidelines, and develop tools for monitoring ecological impacts [4].

This study evaluated the water quality and physical habitat conditions at Dream Falls, a key natural attraction within the resort. Furthermore, it explored the carrying capacity of the site. The study does not include an analysis of the correlation between water quality and carrying capacity. Additionally, the water parameters examined are limited to basic physical characteristics and do not encompass comprehensive chemical or biological assessments.

The findings aim to support ecotourism planning and contribute to ongoing discussions on sustainable site management, particularly in freshwater-based recreational ecosystems.

2. Methodology

2.1 Habitat Quality Assessment

Luisiana municipality is located around 14° 11' North latitude and 121° 31' East longitude on Luzon Island and its elevation at these coordinates is approximately 388.9 meters, or 1,275.6 feet, above mean sea level [5].

The assessment of Dream Falls at Pilgrim's Dream Eco Farm & Resort involved an on-site field visit focusing on habitat quality evaluation and ecotourism carrying capacity estimation. Figure 1 shows the actual water testing site, located within the plunge pool area of the falls. This location was selected due to its constant use for recreation and its ecological importance in sustaining freshwater organisms and tourism appeal.

Fig. 1. Water sampling location within the plunge pool area of Dream Falls, Pilgrim's Dream Eco Farm, Luisiana, Laguna

Water quality parameters were measured using the RCYAGO pH Meter 3-in-1 Water Tester, a handheld digital instrument capable of assessing pH, temperature, and total dissolved solids (TDS) simultaneously. Prior to use, the device was calibrated according to the manufacturer's guidelines to ensure accurate field readings. Water transparency was measured using a Secchi disk.

2.2 Carrying Capacity Estimates

Data gathering was conducted with the use of questionnaire-based survey to gather information from 10 tourists in the month of June 2025. The interview comprised three parts: management, environmental degradation and carrying capacity, and ecotourism needs. Key informant interviews were conducted to collect insights on the challenges and issues facing Dream Falls. Additionally, the visitor logbook, which records the monthly number of tourists entering the site, was reviewed and summarized (Table 1). This data was used to determine the monthly visitor numbers for the site.

The preferred distance between visitors and the average preferred length of stay were used to simulate visitor flow and spacing needs for safe and sustainable use of the falls. Boullon's Carrying Capacity Mathematical Model (BCCMM) model was utilized in the study following the framework of Sarmiento in her carrying capacity study within the Mount Banahaw-San Cristobal Protected Landscape [6]. The 300 square meters pool area of Dream Falls was used to compute the carrying capacity estimates. Basic Carrying Capacity (BCC) was calculated based on area-per-person estimates, followed by the derivation of Potential Carrying Capacity (PCC), which adjusted BCC based on average visitor stay and usable time per day.

The formulas below are based on the equation developed by Cifuentes (1992) and referenced by Sayan and Atik (2011) [7]

$$\text{BCC} = \frac{\text{Available area for use by visitor (sq. m.)}}{\text{Average visitor's standard space requirement (sq. m.)}} \quad (1)$$

RC, or rotation coefficient, is a measure that relates the total hours an attraction is available to visitors with the average duration visitors spend using the attraction. It is calculated as:

$$\text{RC} = \frac{\text{Total no. of hours an attraction is open for use}}{\text{Numebr of hours an area is used by visitors}} \quad (2)$$

The PCC indicates the maximum number of visits possible in a single day, determined by the ratio of the attraction's operating hours to the duration of each visit. It is calculated as:

$$\text{PCC} = \text{BC x RC} \quad (3)$$

The daily visits to Dream Falls are influenced by several limiting factors, which are considered when calculating its Real Carrying Capacity (RCC). The RCC reflects the maximum number of visitors the site can support while maintaining its sustainability and quality of experience. This limit is established by taking into account the site's specific characteristics and visitor needs. The identified limiting factors— determined through interviews and site observations are incorporated into the RCC calculation to promote responsible and balanced management of the area. It is calculated as:

$$\text{RCC} = \text{PCC x } (100 - \text{Lf1}) / 100 \text{ x } (100 - \text{Lf2}) / \text{PCC x } (100 - \text{Lf3}) / 100 \text{ x } (100 - \text{Lf4}) \quad (4)$$

Table 1. Number of Tourists per month (2024)

Month	Number of Tourists
January	6,000
February	8,000
March	8,000
April	8,000
May	6,000
June	6,000
July	6,000
August	4,000
September	4,000
October	5,000
November	6,000
December	7,000

3. Results and Discussion

Water samples collected from Dream Falls within Pilgrim's Dream Eco Farm & Resort revealed values indicative of relatively stable freshwater conditions. The measured pH was 8.0, which falls within the acceptable freshwater range of 6.0 to 9.0 [8] indicating an environment not under acidification stress. Water temperature at the site was recorded at 26°C, which is slightly higher than the expected surface temperature for tropical freshwater biomes, generally reaching up to 75°F or approximately 24°C [9]. While the reading is slightly elevated, it is still within tolerable limits for freshwater systems in tropical climates, likely influenced by direct sunlight exposure or the depth and flow characteristics of the plunge pool. No thermal stratification was observed, and the temperature remains conducive to most native aquatic species and ecological functions.

Total Dissolved Solids (TDS) were measured at 34 ppm, well below the 300 mg/L benchmark for high-quality freshwater [10], indicating low mineral content and minimal anthropogenic input. In terms of salinity, the water registered a reading of 34 mg/L, far below the freshwater threshold of 1,000 mg/L [11]. This confirms that Dream Falls remains within freshwater classification and that no significant saltwater intrusion or mineral contamination is evident at the site. The murky greenish-brown color observed is likely a result of natural sediment resuspension and organic runoff, common in high-flow zones, rather than indicative of pollution or algal blooms. This interpretation is further supported by substrate composition data, which revealed a rocky and sharp bottom profile along with visibly smoothed and weathered boulders. Such features suggest long-term physical erosion consistent with the geomorphological activity of waterfalls.

Two Secchi disk readings were obtained at 220 cm and 340 cm, respectively. Averaging these values yields a Secchi depth of 280 cm or 2.8 meters. Freshwater bodies exhibiting Secchi depths between 2 to 10 meters generally reflect moderate to good transparency [12]. This level of clarity indicates that Dream Falls still supports sufficient light penetration for basic aquatic

photosynthesis. The substrate was rocky and sharply contoured, with an estimated water depth of 33 feet. Signs of physical erosion were evident through the smoothing, fracturing, and cracking of surrounding boulders, indicating continuous weathering due to the persistent flow and pressure of water over time. Furthermore, there are no immediate signs of eutrophication, which often correlates with diminished water clarity, algal proliferation, and nutrient saturation. Thus, the water quality parameters collectively support the notion that Dream Falls remains in a relatively healthy ecological state, with physical and chemical factors still within favorable bounds for freshwater recreation and biodiversity conservation.

3.1 Basic Carrying Capacity

The portion of the site designated for tourist use measures 300 square meters. Tourists were surveyed regarding their preferred recreational space, which is referred to as the "area of tolerance." According to the survey results, this area amounts to 3 square meters per person. The Basic Carrying Capacity (BCC) of Dream Falls was calculated to be 100 visitors per day. Additionally, the tourist logbook indicates that the peak visitor period each year occurs from February to April.

3.2 Rotation Coefficient (RC) and Potential Carrying Capacity

Although the site is open for 9 hours each day, the survey revealed that visitors typically prefer to stay for an average of 3 hours. Using the specified methodology, the resulting RC was calculated as 3. Subsequently, the Peak Carrying Capacity (PCC) was determined to identify the maximum number of tourists the site can accommodate each month without harming the environment. The calculation showed that the PCC is 300 visitors per day, amounting to approximately 9,300 visitors per month.

This generated a Potential Carrying Capacity (PCC) of 9,300 per month and it indicates that Dream Falls offers larger recreational capacity.

3.3 Real Carrying Capacity (RCC)

The daily visitation numbers, whether by individuals or groups, are heavily influenced by various factors that depend on the current state of the site [13]. The survey identified ecological and site-specific aspects that affect visitation to ecotourism attractions, and these have been integrated into the calculations. It is important to understand that these factors are expressed as magnitude limits: when the calculated value approaches zero, they become restrictive; conversely, values of one or higher indicate minimal restriction. These factors will be used to compute the Real Carrying Capacity (RCC) of the attractions, which will be explained in the succeeding sections. The limiting factors are closely linked to the characteristics of the site, which in turn influence visitor volume and standards. The factors considered in this study include: typhoon-related closures, accessibility, availability of ecotour guides, and crowding.

3.3.1 Typhoon-caused closure

Laguna is among the top ten provinces in the country most vulnerable to climate-related hazards, such as droughts, typhoons, shifts in rainfall patterns, and temperature variations [14]. Data indicates that Region IV-A, which includes Laguna, receives an average annual rainfall ranging from 1,550 to 3,500 mm and experiences approximately 1.5 typhoons each year [15].

On average, about 20 tropical cyclones (TCs) enter the Philippines' area of responsibility annually, with roughly 8 to 9 making landfall [14]. It would be advantageous to conduct studies that determine the average recovery time of a site following a TC, as this would enable a more precise assessment of how typhoons influence visitation to ecotourism destinations. However, this study uses the number of TCs crossing the country as a proxy for typhoon days. The number of TCs crossing the country, which serves as an indicator of typhoon days, is represented by:

$$Lf1 = (9 \text{ typhoon days} / 365 \text{ days}) \times 100 = 2.47 \quad (5)$$

3.3.2 Accessibility

Dream Falls is accessible daily from 8:00 AM to 5:00 PM. Visitors are permitted to enter only until 5:00 PM, with the remaining hour allocated for returning to the visitor center or entrance. Therefore, the accessibility limiting factor is determined as:

$$Lf2 = (8 \text{ recreation hours} / 9 \text{ hours the attractions are open}) \times 100 = 88.88\% \quad (6)$$

3.3.3 Ecotourist guide availability

Dream Falls does not have any registered ecotourist guides on staff; however, there is one lifeguard and one assistant available. Therefore, the limiting factor related to ecotourist guides is calculated as:

$$Lf3 = (0/0 \text{ registered tourist guide}) \times 100 = \text{undefined} \quad (7)$$

3.3.4 Crowding

The capacity of an ecotourism site to accommodate visitors simultaneously is a key factor in estimating visitation levels. Recent surveys suggest that the site should not be empty, and the optimal maximum occupancy is around 300 people at once. To provide a comfortable and enjoyable experience, however, the ideal number of visitors is approximately 30, which helps prevent overcrowding while maintaining a pleasant recreational environment.

Thus, the crowding limiting factor is calculated as:

$$Lf4 = (30 \text{ individuals} / 300 \text{ as maximum number}) \times 100 = 10\% \quad (8)$$

Finally, the RCC for Dream Falls is determined to be 29 visitors per day, based on the four limiting factors converted into coefficients, as expressed:

$$RCC = PCC \times (100 - Lf1) / 100 \times (100 - Lf2) / 100 \times (100 - Lf3) / 100 \times (100 - Lf4) / 100$$

$$RCC = 300 \times (100 - 2.47) / 100 \times (100 - 88.88) / 100 \times (100\text{-}10) / 100 = 29.27 \text{ or } 29 \quad (9)$$

Since the expression is undefined due to division by zero, Lf3 was excluded from the calculation. The number of tourists from February to April (8,000) does not exceed the computed Potential Carrying Capacity (PCC) of 9,000. The increase in the number of tourists during these months can be attributed to the Holy Week or Lenten season, when many people travel or take vacations, resulting in higher visitor numbers during these times. During peak periods, overcrowding and congestion are common. If visitor limits are not properly set, the surge in tourists can place considerable strain on natural resources and disturb the ecological balance, potentially degrading the quality of the area.

As seen in Sarmiento's assessment of Taytay Falls, adjustments must be applied to ensure that ecosystem services are not overwhelmed. While Dream Falls demonstrates high potential to accommodate visitors based on spatial metrics, its long-term sustainability hinges on ecological monitoring and the strategic integration of sustainable tourism practices. The findings align with

the sustainable tourism framework of UNEP and UNWTO (2005), which emphasizes balancing visitor experiences with the ecological and socio-cultural integrity of host environments. Therefore, although current environmental data show that Dream Falls remains within healthy thresholds, proactive measures are needed to prevent the degradation observed in many other ecotourism sites across the country.

4. Conclusion

The findings of this field investigation within Pilgrim's Dream Eco Farm & Resort affirm that the site currently maintains an ecologically stable freshwater environment, marked by acceptable levels of pH, temperature, turbidity, and total dissolved solids. These water quality indicators fall within recommended environmental thresholds for recreation and aquatic life [8; 12]. The physical characteristics of the falls—namely its rocky, weathered substrate and moderate Secchi depth averaging 2.8 meters—support its classification as a naturally eroding yet functioning freshwater system, conducive to both recreational and ecological functions.

Furthermore, the site's estimated Potential Carrying Capacity of 9,300 visitors per month, computed using Boullon's Carrying Capacity Mathematical Model highlights its considerable spatial capacity for tourism. However, sustainability does not solely hinge on spatial metrics [2]. Without the incorporation of ecological safeguards and community-driven conservation mechanisms, these numbers remain theoretical and potentially hazardous if mismanaged.

Ecotourism, in its most authentic form, aims not only to promote responsible travel to natural environments but also to support conservation efforts, enhance community welfare, and foster education. This study reaffirms that Dream Falls embodies these ideals through its serene natural setting, potential for economic stimulation, and capacity for environmental education. Ecotourism demands a low environmental footprint, encourages meaningful exchanges between hosts and visitors, and provides economic advantages that directly contribute to conservation initiatives. Sites like Pilgrim's Dream Eco Farm offer a rare opportunity to apply these principles in real-world contexts.

It is imperative, however, that the resort continues to adhere to the globally accepted ecotourism guidelines such as those proposed by The International Ecotourism Society, which emphasize low-impact infrastructure, Indigenous rights recognition, and long-term ecological stewardship. The resort must also draw insights from early ecotourism advocates such as Hector Ceballos-Lascurain from the International Tourism Society who warned against tourism that merely commodifies nature rather than safeguards it. Sustainable tourism must transcend economic gain—it should be viewed as an active commitment to ecological harmony, cultural respect, and intergenerational equity.

The study recommends the inclusion of the chemical characteristics of water, regular monitoring of water quality, and improving the visitor management program to mitigate degradation, reinforce carrying capacity thresholds, and ensure that Dream Falls can continue serving as a model for ecotourism that genuinely unites conservation, communities, and sustainability.

References

1. Luisiana Tourism Office, Pilgrim's Dream Ecofarm & Resort Description, Luisiana, Laguna Tourism Department (2024).
2. UNEP, UNWTO, Making Tourism More Sustainable – A Guide for Policy Makers, 11–12 (2005).
3. Fennell, D.A. Ecotourism: An Introduction, Routledge, London (1999).
4. UN Department of Economic and Social Affairs (UN DESA), Sustainable tourism (2017).https://sdgs.un.org/topics/sustainable-tourism

5. Phil-Atlas, Luisiana, Province of Laguna (2025). https://www.philatlas.com/luzon/r04a/laguna/luisiana.html
6. Sarmiento B.G., Determination of carrying capacity estimates for an ecotourism site within the Mount Banahaw-San Cristobal Protected Landscape (MBSCPL), Philippines, E3S Web Conf 262, 02001 (2025). https://doi.org/10.1051/e3sconf/202562402001
7. Sayan, M.S., M. Atik, Recreation carrying capacity estimates for protected areas: a study of Termessos National Park, Ekoloji 20(78), 66–74 (2011).
8. Pennsylvania State University, Interpreting water tests for ponds and lakes (2022). https://extension.psu.edu/interpreting-water-tests-for-ponds-and-lakes
9. Santhosh, L., Climate in a freshwater biome (2018). https://www.sciencing.com/climate-freshwater-biome-23959/
10. Ojo, O. TDS level of drinking water for consumer ratings [Data table] (2015). https://www.researchgate.net/profile/Olukayode-Ojo/publication/279416545/figure/tbl4/AS:670538078900225@1536880144216/TDS-level-of-drinking-water-for-consumer-ratings.png
11. California Water Boards, Salinity in drinking water (2017). https://www.waterboards.ca.gov/gama/docs/coc_salinity.pdf
12. University of Rhode Island, Water quality analysis: Secchi depth measurements, URI Watershed Watch Program (1996).
13. Eduarte G.T., R.T. Andrada, M.A. Galang, P.L. Malabrigo, C.L. Tiburan Jr, J.J.V. Dida, Determination of carrying capacity estimates of ecotourism attractions in the Quezon Protected Landscape, the Philippines, Philipp J Sci 150(3), 635–644 (2020).
14. Center for Environmental Geomatics-Manila Observatory, CW maps (2005). https://vm.observatory.ph/cwmaps.html
15. Concepcion, R.N. Gateway to the land and water information: Philippine national report (2004). http://www.apipnm.org/swlwpnr/reports/y_ta/z_ph/ph.htm