



Map-based Information system of ecotourism Sites in Laiban, Tanay, Rizal, Philippines

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Abstract

Eco-tourism is a well-known concept of tourism industry in the Philippines, considering that the country is rich in different natural resources. The province of Rizal is one of the famous provinces in the Philippines because of its upland ecosystems that can be utilized for tourism activities. Some tourists' destinations that showed attractions of the natural environment are already offered for the tourists in Barangay Laiban, Tanay, Rizal. However, there are still potential areas that need to be studied for better management in terms of tourism services. Thus, this study intended to provide a systematic approach in managing the newly discovered tourist spots in Barangay Laiban. The study identified three potential ecosystems that can be offered as tourist destinations - Laiban Falls, Puting Bato River and Mount Matang Ulang. The study used Carrying Capacity through Map-based Information System to acquire baseline data as basis in the management of the tourism operations. The method identified the number of tourist that can be accommodated in the identified tourist spots. Based on the result, the Carrying Capacity is an efficient approach to be used for the decision-making procedure of the possible number of individuals allowable in the identified eco-tourism locations.

Keywords: Carrying Capacity, Map-based Information System, Eco-tourism, Tourists

Introduction

Ecosystem is the association of living and non-living organisms in various area of the environment. The Philippines has rich biodiversity and endemism, natural resources that provides economic gain for the local communities. As a matter of fact, the agricultural sector and industry of the country are dependent on the resources of the forest, upland, marine environment and urban ecosystem. These living and non-living components are linked together through ecological relationship, recycling and energy flows (Smith, 2017) ^[2].

Among the world countries, the Philippine archipelago have a very high degree of land with diverse ecosystems, species and genetic resources. The Philippine islands host more than 52,177 described species of which is prevalent only in the country. The DENR-BMB (2016) ^[3] discussed that on a per unit area basis, the country harbors more diversity of life than any other areas on the planet.

Despite the ecosystem richness, the Philippines is one of the most severely deforested countries in the tropics in the last 40 years (Walpole, 2011) ^[6]. The Philippine Forestry Statistics of the Forest Management Bureau (FMB) provides analysis of 2003 satellite imageries showing national forest cover of 7.168 million hectares or 23.89 percent of the total land area of the country; which is 30 million hectares. This result regarding the status of forest cover is way below the year 1934 data of 17.8 million

hectares. (Carandang *et al.*, 2012) ^[1]. This is because the Philippines continues to experience an alarming rate of destruction of these important resources brought about by overexploitation, deforestation, and land degradation. Based on the presented data, better management of the forest, upland and aquatic ecosystem must be observed to prevent the abuse of natural resources. These ecosystems have encountered tremendous loss due to unregulated anthropogenic activities from harvesting, mining, logging, and recreation. And one of the sectors that benefits on the ecosystem services is tourism. The concept of eco-tourism is widespread across countries. By utilizing the natural attractiveness of the ecosystems available from ridge to reef, the social and economic aspects of a particular country gains and improved; due to increase in income and employment. However, this sector has drawbacks when poorly managed. In recent years, Barangay Laiban in the Municipality of Tanay, Province of Rizal, Philippines has become a famous destination for trekkers and field trips. Decision-making and planning in the tourism sites become complicated because of the interrelationship between local people, tourists, other stakeholders and the natural environment. Evidence-based planning in eco-tourism sites is a challenge to achieve sustainable development in the area. There should be a computation or estimates of Carrying Capacity for the tourists in trekking sites, including the river and waterfall found in the community. The abovementioned approach determines the maximum number of people that may visit a tourist spot. Furthermore, helps to avoid overcrowding that may cause physical, economic, and socio-cultural environment of a particular ecosystem. This is necessary to ensure effective political decisions in protecting the natural resources of Laiban.

Materials and Method

Research Setting

The study was conducted in Barangay Laiban, Municipality of Tanay, Province of Rizal Philippines. There were three ecotourism sites selected for the conduct of Carrying Capacity; Laiban Water Falls (Rapid 1 and Rapid 2), Puting Bato River and Mount Matang Ulang. Geographically, the site is within the Sierra Madre Mountain Range, and surrounded by a watershed (namely Kaliwa), and major river system (Lanatin River).

Research Design

The study used cartography and basic statistic to materialize the research concept, and carry out effective data gathering procedures and analysis. The abovementioned design is a combination of visuals through computer generated maps and mathematical estimates of a certain space through the provided values of software for cartography

Data Gathering Procedures

In order to provide the output regarding the Carrying Capacity for the tourist destinations in Laiban, a map-based

data collection was utilized through the Global Positioning Satellite (GPS) handset. This was used to log significant coordinates of the tourist spots, and way point to track the trail of each destination. The recorded data in the GPS were transferred in to the computer to be processed in Quantum Global Information System (QGIS). The software generates database of geographical information, digital map and files for mobile mapping, and modelling. Moreover, the values provided for each land area or bodies of water were acquired through the use of QGIS. These figures were essential in estimating the Carrying Capacity of each tourist sites while sketching the tourism map for Laiban.

Computation of Carrying Capacity

Carrying capacity refers to the maximum number of people that can physically into a define area over a particular time upholding safety and without damaging the area's physical, economic, and socio-cultural environment. Thus, Boullon's formula (Buan *et al.*, 2016) ^[4] utilized:

- Carrying Capacity = area used by tourists/average individual standard
- Rotation Coefficient = no. of daily hours area is open to tourist/average time of visit
- Total Daily Visit = carrying capacity x rotation coefficient

In order to compute the tourists' carrying capacity of the view decks of the study site, a space of three-square meters per person must be considered to move freely (Manalo *et al.*, 2016) ^[7].

Results and Discussion

Laiban, Tanay, Rizal have three identified serviceable areas for eco-tourism activities. For better management of these tourist spots, a Carrying Capacity was done to estimate the maximum or minimum users of the space, physically, in a specific area. Discussion of the Carrying Capacity of each tourism sites is the following:

Laiban Waterfall

The Laiban waterfall is one of the major attractions for tourists in Laiban, Rizal. The waterfall has a total area of 7,472 sqm space identified for tourism activities. There are two areas of the waterfall selected for Carrying Capacity; Laiban Falls Level 1(2, 200 sqm), and Level 2 (5, 272 sqm), as named for the serviceable area for tourists.

Using Boullon's formula in computing the Carrying Capacity, the area limit was set to 4.65 sqm as for the lower limit and 18.58 sqm for the higher limit. Using the lower limit, the computed Carrying Capacity of the Laiban Waterfall Level 1 was 473 individuals in a 4.65 sqm limit based on the equation standard. Moreover, the upper limit value of 118 individuals has a standard space of 18.58 sqm (refer Table 1).



Fig 1: The map of Laiban Waterfall (Level 1 and Level 2), Tanay, Rizal

Table 1: Computed Daily Carrying Capacity of Laiban Falls (Level 1 and Level 2)

Area Requirement Limit	Average Individual Standards (Sqm)	Area Used by Tourist (Laiban Falls Level 1) (sqm)	Tourist Carrying Capacity	Area Used by Tourist (Laiban Falls Level 2) (sqm)	Tourist Carrying Capacity
Lower Limit	4.65	2200	473	5272	1134
Upper Limit	18.58	2200	118	5272	284

Putting Bato River

The Putting Bato River serviceable area was 9, 429 sqm. The site is located downstream of Laiban Waterfall. Moreover,

the water rushing through the channel of Putting Bato was also contributed by the Lanatin River.

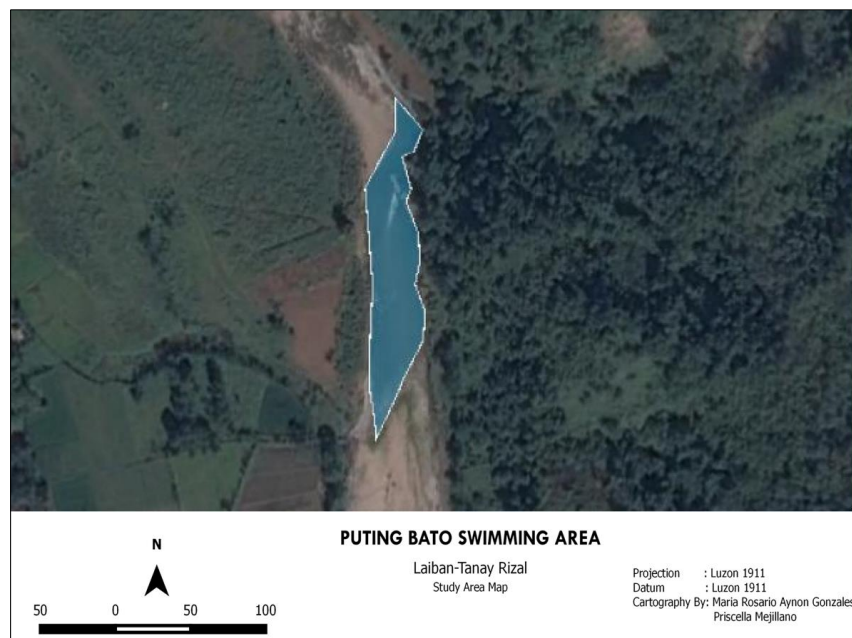


Fig 2: The map of Putting Bato River, Tanay, Rizal

Using the same lower and upper limits of Boullon, the average individual area requirement, of Putting Bato River were; 2,028 individuals can be considered occupying the area based on the upper limit of the site, and for the lower limit,

the carrying capacity can be utilized by 507 tourists. The seasonal temperature such as low tide and depth of water was indirectly considered into the computation for upper limit.

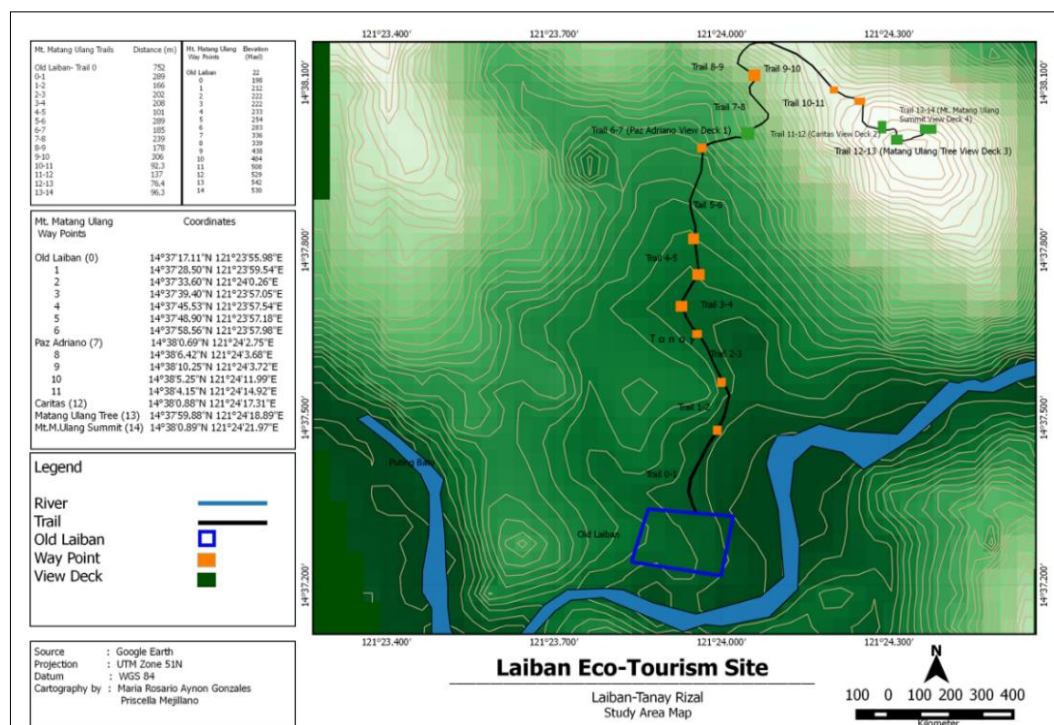
Table 2: Computed Daily Carrying Capacity Laiban Puting Bato River

Area Requirement Limit	Average Individual Standards (sqm)	Area Used by Tourist (Putting Bato River) (sqm)	Tourist Carrying Capacity
Lower Limit	4.65	9429	507
Upper Limit	18.58	9429	2028

Mount Matang Ulang

Mount Matang Ulang has an elevation of 530 meters above sea level. The vegetation types of the tourist site are secondary forests that are scattered in patches along the

slopes, grassland, some plantation forest, and bamboo that seems to be the dominant vegetation (Villegas, 2008).

**Fig 3:** View decks and Trails in the Proposed Ecotourism Site, Mt. Matang Ulang

Based on the collected data, ten tourists can occupy a total trail length of 28 meters going to the View Decks (VD). Moreover, a 150-meter trail between groups was suggested in order avoid disturbance among others as well the biodiversity in the area. The total distance of Old Laiban (starting point) to the summit of Mount Matang-Ulang is 3,315 meters or 3.315 kilometers with an average trekking

time of 2 and half-hour. The maximum tourist Carrying Capacity at the summit was computed 8 persons at a time. The maximum daily visit to the summit is 32 individuals in four groups with eight members per group. Furthermore, Carrying Capacity at View Deck 1 was estimated at 56 individuals, View Deck 2 was 8 individuals, and View Deck 3 was individuals.

Table 3: Computed Daily Carrying Capacity of Mt. Matang-Ulang View Decks

Mt. Matang Ulang View Deck (VD) Stations	Average Individual Standards (m ²)	Area Used by Tourist (m ²)	Carrying Capacity
VD 1- Paz Adriano	3	168	56
VD 2- Caritas	3	25	8
VD 3- Mt. Matang Ulang Camp Site	3	142	47
VD 4- Mt. Matang Ulang Summit	3	25	8

Conclusion and Recommendation

Carrying Capacity is an effective tool to be used in estimating the minimum or maximum number of individual that a certain area in an ecosystem can accommodate, especially, if this will be utilized for eco-tourism activities. The maintenance of aesthetic beauty of water tourism and trekking will be obtained if the carrying capacity implementation are practiced. In this study, results indicate that the value of tourist destination with excellent satisfaction of the visitors were obtained using the upper limit requirements.

Sustainable ecotourism will often require that limits to be imposed on the physical components of natural resource because the natural, unbuilt environment is finite. A community-based ecotourism like in the case of Laiban is often challenge in terms of capacity to absorb the impacts of tourism. Thus, limits to natural used need to be imposed, such as the carrying capacity. The absence of ecotourism sites of Laiban in the Comprehensive land Use Plan (CLUP, 2014-2023) of Tanay, Rizal is also a major issue that needs to be addressed at the municipal and barangay levels. The tourist's

areas and destinations in Laiban are not mentioned in the CLUP. Vertical integration of barangay plan to municipal plan is very important. The initiative to compute and impose the carrying capacity in the three ecotourism areas in Laiban as proposed in this paper is a good start to sustain the environment.

Carrying Capacity must be considered in developing ecotourism concept for better management of ecosystem utilized for recreation and attraction for tourism activities. Estimate of the accommodation for different activities in eco-tourism can help lessen the stress and disturbance in the environment.

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