**Journal of Social Responsibility, Tourism and Hospitality**
**ISSN: 2799-1016**
Vol : 02 , No. 03, April-May 2022
http://journal.hmjournals.com/index.php/JSRTH
**DOI:** https://doi.org/10.55529/jsrth.23.1.15

# Tourism and Recreational Carrying Capacity of Octopus Islet Adventure in Bacuag, Surigao Del Norte: An Essential Instrument for Sustainable Tourism

**Shekynah Marrie Y. Ando[1*], Grace Ann C. Benlot[2], Mary Grace A. Siva[3], Efamae C. Tresiana[4], Medielyn M. Odtojan[5]**

*[1*,2,3,4,5]Surigao State College of Technology, Narciso St., Surigao City, Caraga 8400, Philippines*

*Email: [1]sando@ssct.edu.ph, [2]gbenlot@ssct.edu.ph, [3]msiva@ssct.edu.ph, [4]etresiana@ssct.edu.ph, [5]modtojan@ssct.edu.ph*

**Received:** 28 January 2022 **Accepted:** 10 April 2022 **Published:** 19 May 2022

***Abstract:*** ***A sustainable tourism approach is a requisite for ecotourism sites to provide a quality tourism experience. Tourism Carrying Capacity and Recreational Carrying Capacity is an influential concept in ecotourism management as for the assessment of the maximum permissible number of users in a destination. Bacuag Octopus Islet Adventure, a tourist destination, is anticipated as an area susceptible to carrying capacity issue which has not been recognized and no thorough implementation guidelines provided. This study focused on the determination of the site's tourism and recreational carrying capacity. Questionnaires were administered to the participants of 385 tourists and 136 local residents. The tourism carrying capacity (TCC) was determined through the three levels of Boullon's Carrying Capacity Mathematical Model (BCCMM) while recreational carrying capacity was determined utilizing the social norm/impact acceptability curve and importance-performance matrix. As a result, the estimated TCC for the area of Bacuag Octopus Islet Adventure is 225 visitors per day. For the specific activities, the calculated carrying capacity for swimming, viewing, zipline, and skybike are 119, 10, 16, and 8, respectively. Using image capture technology, consecutively, the recreational carrying capacity by means of social indicators was 202 combining the tourists' and local resident's preferences. Thus, it is recommended to the management to implement the estimated carrying capacity on the visitors for the sustainability of the tourism area.***

***Keywords:*** ***Bacuag Octopus Islet Adventure, Recreational Carrying Capacity, Sustainable Tourism, Tourism Carrying Capacity***

## 1. INTRODUCTION

Sustainable tourism is concerned not only with environmental protection but also with the economic and social aspects preserved for future generations. Hence, to achieve sustainable

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tourism, several aspects need to be considered such as determining the carrying capacity of destinations as guide in land use allocation and management.

Carrying Capacity in tourism originates in the 1960s [1] which is defined as a tool to prevent and control the over-utilization of tourist sites through the identification of the ideal use level of visitors. According to Henry A. Adornado, Acting Director of Ecosystem Research and Development Bureau, in his foreword on the manual of Calanog [2] he stated that the Philippines has a booming tourism industry which makes carrying capacity an important planning tool for sustainable and lasting ecotourism sites.

Prominently, Bacuag is a coastal municipality located in the northeastern part of Surigao del Norte, Philippines. The hanging bridge is the latest tourist attraction in Bacuag that connects the mainland to the Octopus Islet. The ecotourism site was named "Octopus Islet", basically, due to its built-up cables extended to the shore which represents the arms of an octopus. It attracts many tourists because of its nature and its challenging hanging bridge, which is visited by many tourists. Recreational activities include swimming, viewing, zipline, and skybike which have been the main leisure for the tourists.

There are many aspects of carrying capacity depending on the focus. This study focuses on tourism carrying capacity and recreational carrying capacity. The purpose of this research is to understand the current conditions of ecotourism of Bacuag Octopus Islet Adventure, highlighting tourism and recreational carrying capacity to serve as an essential instrument for strengthening tourism and environmental sustainability of the area.

## 2. METHODOLOGY

### Study Area

This study focused on the assessment of tourism and recreational carrying capacity limited to the area of Octopus Islet Adventure in Bacuag. Bacuag is a coastal municipality located on Mindanao's north-eastern coast in the province of Surigao del Norte. The sampling was conducted at premises of Sitio Bitaog where Octopus Islet Adventure is located. It can be tracked 44 km northeast of Bacuag, Surigao del Norte, about 30 nautical miles (56.01 km) from Surigao City, with a land area of 2.76 hectares. Since the local government unit built a hanging bridge linking the mainland and the islet, it becomes the province's newest tourist attraction.

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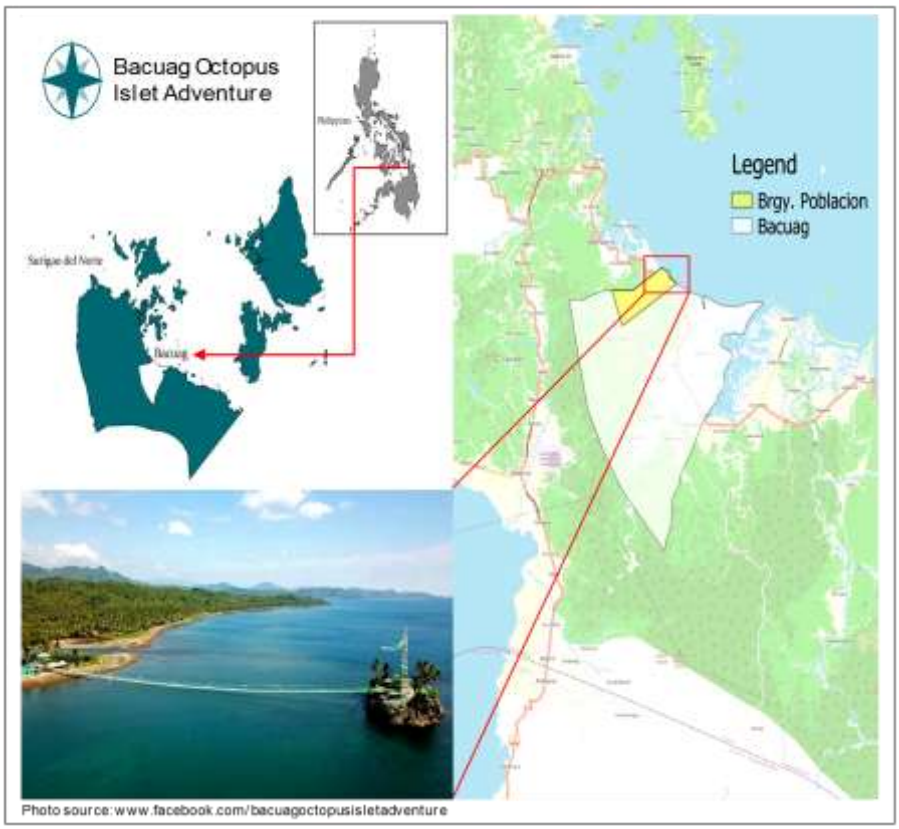


Fig. 1 Map of the Study Site.

**Data Gathering**

In selecting tourist respondents, opportunity sampling was used which means that the sample population is those available during the sampling time. Whereas, systematic sampling was utilized for the local residents. Since there is only small number of households, every 5$^{th}$ house was the sampling interval. Thus, the preceding and following 4 houses were the selected sample. Any family members aged 18 years old and above qualified for the household survey selecting only one (1) respondent per household.

The respondents of this study were the local residents that were surveyed in their houses and the tourists present at the site during the data collection. It is anticipated that the residents have been to the Octopus Islet Adventure, since Sitio Bitaog is a small area and the destination is just adjacent to their respective houses. The sample size for the local residents of Sitio Bitaog was generated by the RaosoftTM sample size online calculator. At a 95% confidence level, 5% margin of error, and 50% response distribution, 136 target local residents were interviewed based on a household population of 208.

Moreover, the management does not hold exact records on the average number of tourists visiting the area, therefore, the ideal sample size for the tourists was calculated utilizing Cochran Formula which is shown below. Cochran Formula provides an ideal sample size if there is no information available about the population size. It was calculated using a 95% confidence level, 5% margin error, and 50% response distribution. Based on the Z table a

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confidence level of 95% has a value of 1.96, hence, the total tourist participants were approximately 385.

$$n^o = \frac{Z^2pq}{e^2}$$

where:
e = margin of error
p = estimated response distribution
q = 1 – p

**Data Analysis**

The determination of the site's tourism carrying capacity values and the social indicator's recreational carrying values, took account of Boullon's [2] carrying capacity mathematical model for carrying capacity assessment protected areas. BCCMM is measured at three degrees: basic carrying capacity (BCC), potential carrying capacity (PCC), and real carrying capacity (RCC).

First level: Basic Carrying Capacity (BCC)
Formula for BCC:

$$BCC = \frac{\text{Area used by visitors (i.e., in sq.m.)}}{\text{Average visitors' standard (i.e., in sq.m.)}}$$

Second level: Potential Carrying Capacity (PCC)
Formula for PCC:
PCC = BCC x RC

$$RC\ (\text{Rotation Coefficient}) = \frac{\text{Total no. of hours a specific area is open for use}}{\text{Average no. of hours an area is used by visitors}}$$

Third level: Real Carrying Capacity (RCC)
Formula for RCC:

$$RCC = PCC \times \frac{100 - Lf_1}{100} x \frac{100 - Lf_2}{100} x \frac{100 - Lf_3}{100} x \frac{100 - Lf_n}{100}$$

$$\text{Limiting Factors } (Lf_{1,2,3..n}) = \frac{M_{(a,b,c..n)}}{MT} X\ 100$$

where:
$M_{(a, b, c.... n)}$ = limiting magnitude of the factor/variable
MT = total magnitude of the factor/variable

Whereas, in recreational carrying capacity to analyze the social and facility indicators of the study, descriptive analysis was utilized; namely, cross-tabulations, social norm/impact acceptability curve and importance-performance matrix for measuring satisfaction to understand relationships between importance and performance (i.e., satisfaction).

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## 3. RESULTS AND DISCUSSION

### A. Tourism Carrying Capacity

### Basic Carrying Capacity Calculation

The required data for BCC were assessed (e.g., area used by visitors and standard area requirement for tropics). The area used by visitors was determined via Google Earth measurement (see Fig. 2) since there is no given data from the management. Table 1 shows the summary of data for TCC calculation.

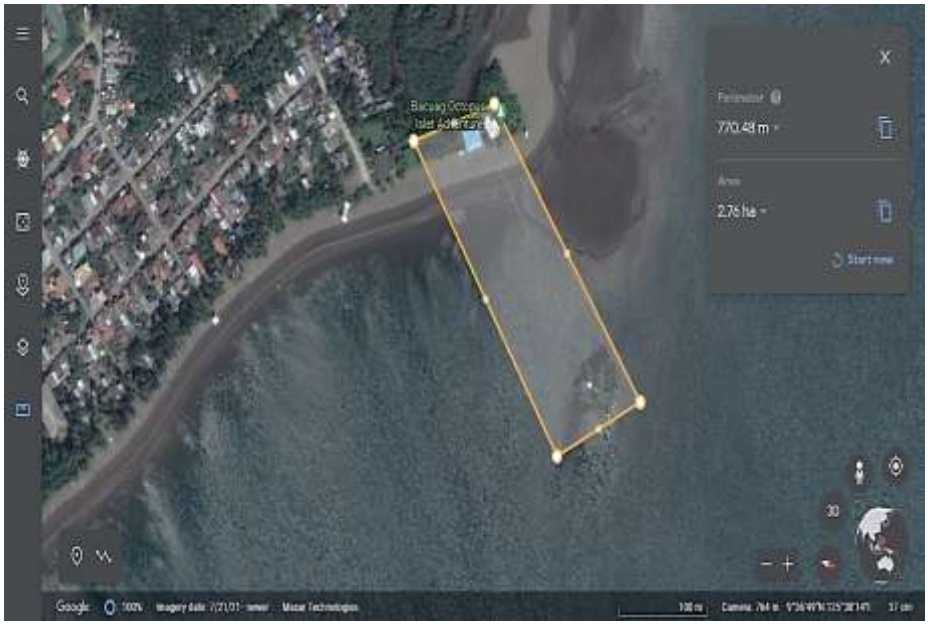


Fig. 2 Area of the Octopus Islet Adventure.

Table 1. Summary of Data for TCC Calculation of the Area

| **BCC Calculation** | **Quantity** |
|---|---|
| Average area used by visitors | 27600m$^2$ |
| Standard area requirement for the activity per person | 30m$^2$ |
| Basic Carrying Capacity | 920 visitors/day |
| **PCC Calculation** | **Quantity** |
| Basic Carrying Capacity | 920 visitors/day |
| Standard area requirement for the activity per person | 30.00m$^2$ (WTO) |
| Available time for activity per day | 8 hours |
| Average tourist time | 2.1 hours |
| Rotation Coefficient | 4 |
| Potential Carrying Capacity | 3680 visitors/day |
| **Limiting Factors** | **Quantity** |
| 1. Typhoon & rainfall in a year | 184 days |

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| | |
|---|---|
| 2. Intense sunlight in a day (hours)<br>3. Days closed due to pandemic | 4 hours<br>275 days |
| **RCC Calculation** | **Quantity** |
| Potential Carrying Capacity<br>Limiting Factor (1)<br>Limiting Factor (2)<br>Limiting Factor (3)<br>Real Carrying Capacity | 3680 visitors/day<br>50.41 days<br>50 hours<br>75.34 days<br>225 visitors/day |

**Potential Carrying Capacity**

With the calculated BCC, the Potential Carrying Capacity was determined. The rotation coefficient (RC) was calculated as the quotient of the time an area is open for use and the average response of the respondents' enjoyed time with the respective activities.

**Real Carrying Capacity**

To determine the RCC, several limiting factors were considered; specifically, bad weather conditions (typhoon and rainfall), intense sunlight, and COVID-19 pandemic. The data for the bad weather condition (rainfall) were gathered from PAG-ASA. Then, typhoons and intense sunlight were adapted as standard from the CARCAP Manual of Calanog [2]. Lastly, the data for the days closed due to the COVID-19 pandemic was obtained from the management itself. There was a significant number of rainfall and typhoon in 2019 which have affected the RCC. The bad weather condition has a substantial influence on the visits of tourists to the destination. Thus, weather plays a crucial role in quality tourism experiences. Table 1 shows the summary of data for RCC which is 225 visitors per day, a number that reflects the use level of visitors that can be accommodated by the Bacuag Octopus Islet Adventure.

Furthermore, there are several approaches to impose limitations for tourism carrying capacity and these are determined through the standards, impacts, and the individual's perceptions of the natural resources and offered services. The TCC varies among all beaches [3] because of the limiting factors. Three (3) limiting factors were considered in the carrying capacity estimation for it to be localized [6] and three (3) levels for TCC estimation. Based on the results of the tourism carrying capacity of the area, the actual amount of visitors/day in the area usually reach to 150 visitors/day which did not exceed with its Real Carrying Capacity of 225 visitors/day. Nevertheless, Real Carrying Capacity could still be changed and improved along with the users' impacts and the management of the tourist destination.

B. **Recreational Carrying Capacity**

**Swimming**

To determine the tourism carrying capacity of swimming activity, the three levels were measured; BCC, PCC, and RCC. For BCC, the area used by visitors was measured using Google Earth (see which has an area of 16295.57m$^2$. Hence, Table 2 shows the TCC of swimming

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Fig.3 Permissible Swimming Area in Octopus Islet Adventure.

Table 2. Summary of Data for the Tourism Carrying Capacity of Swimming

| **Type of Activity** | **Swimming** |
|---|---|
| Area used by visitors | 16295.57$m^2$ |
| Standard area requirement for the activity per person | 30.00$m^2$(WTO) |
| Available time for activity per day | 8 hours |
| Average tourist time | 1.30 hours |
| Limiting Factor (1) | 50.41 days |
| Limiting Factor (2) | 50 hours |
| Limiting Factor (3) | 75.34 days |
| Rotation Coefficient | 6 |
| Basic Carrying Capacity | 543 swimmers/day |
| Potential Carrying Capacity | 3258 swimmers/day |
| Real Carrying Capacity | 199 swimmers/day |

Based on the table above, the following is the tourism carrying capacity of the swimming activity: With a swimming area of 16,295.42 $m^2$, the BCC is 543 swimmers/day, the PCC is 3,258 swimmers/day, and the RCC is 199 swimmers/day.

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**Viewing**

For the BCC of viewing activity, the area used by visitors was gathered from the management. The same limiting factors were implied. For BCC, the area used by visitors was measured using Google Earth (see Fig. 4). Thus, table 3 shows the tourism carrying capacity of viewing.

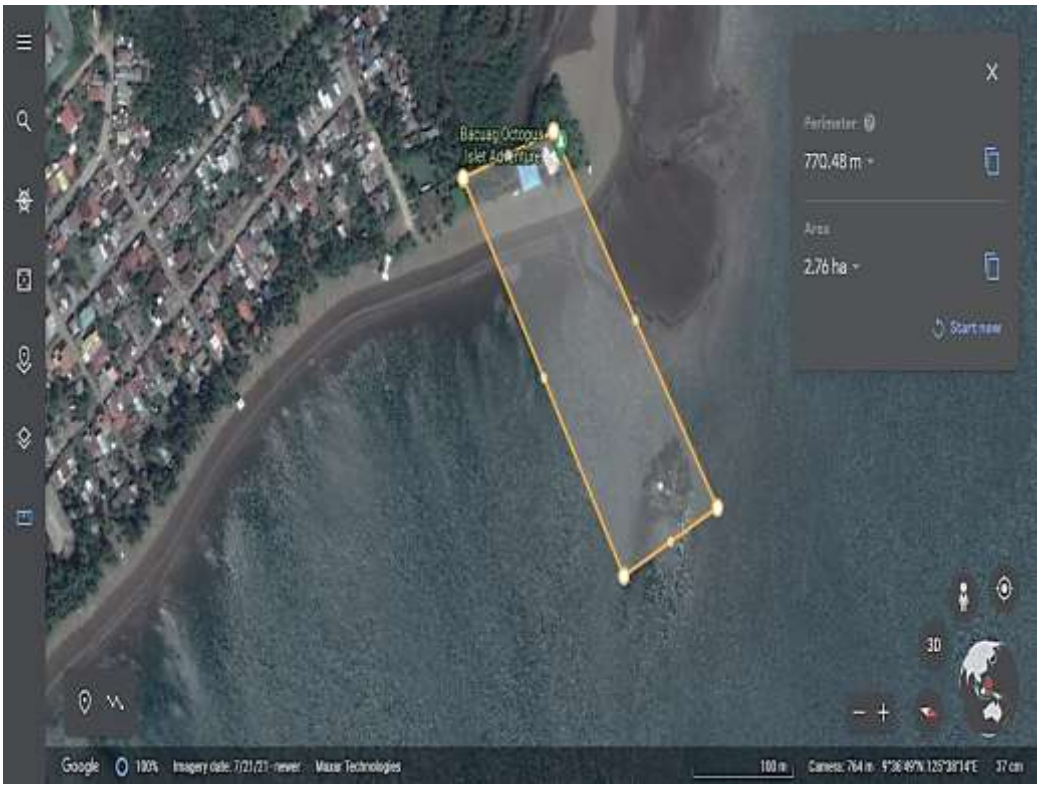


Fig. 4 Viewing Area in Octopus Islet Adventure.

Table 3. Summary of Data for the Tourism Carrying Capacity of Viewing

| Type of Activity | Viewing |
|---|---|
| Average area used by visitors | 27,600 $m^2$ |
| Average area requirement as determined by respondents' responses | 807.9 $m^2$ |
| Available time for activity per day | 8 hours |
| Average tourist time | 1.67 hours |
| Limiting Factor (1) | 50.41 days |
| Limiting Factor (2) | 50 hours |
| Limiting Factor (3) | 75.34 days |
| Rotation Coefficient | 5 |
| Basic Carrying Capacity | 34 viewers/day |
| Potential Carrying Capacity | 170 viewers/day |

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| | |
|---|---|
| Real Carrying Capacity | 10 viewers/day |

Based on the table above, the following is the tourism carrying capacity of the viewing activity: With a viewing area of 27,600 $m^2$, the BCC is 34 viewers/day, the PCC is 170 viewers/day, and the RCC is 10 viewers/day.

**Zipline**

In the tourism carrying capacity of zipline activity, only two (2) levels were measured, namely, Basic Carrying Capacity (BCC) and Real Carrying Capacity (RCC). Potential Carrying Capacity was not calculated since the carrying capacity was based on rides/day, instead of weight capacity. Table 4 shows the tourism carrying capacity of the zipline.

Table 4. Summary of Data for the Tourism Carrying Capacity of Zipline

| **Type of Activity** | **Zipline** |
|---|---|
| No. of tourist per ride | 1 person/ride |
| Estimated time use | 3.31 mins. |
| Allowed time | 480 mins. |
| Basic Carrying Capacity | 145 riders/day |
| Limiting Factor (1) | 8.22 days |
| Limiting Factor (2) | 50 hours |
| Limiting Factor (3) | 75.34 days |
| Real Carrying Capacity | 16 riders/day |

The tourism carrying capacity of the zipline activity with an allowed zipline riding time of 480 minutes, per zipline cable BCC is 145 riders/day and RCC is 16 riders/day.

**Skybike**

For the TCC of the skybike activity, only two levels were measured; BCC and RCC, PCC was not also calculated.

Table 5. Summary of Data for the Tourism Carrying Capacity of Skybike

| **Type of Activity** | **Zipline** |
|---|---|
| No. of tourist per ride | 1 person/ride |
| Estimated time use | 6.82 mins. |
| Allowed time | 480 mins. |
| Basic Carrying Capacity | 70 riders/day |
| Limiting Factor (1) | 8.22 days |
| Limiting Factor (2) | 50 hours |
| Limiting Factor (3)<br>Real Carrying Capacity | 75.34 days<br>8 riders/day |

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Based on Table 5, the following is the tourism carrying capacity of the skybike activity: With an allowed skybike riding time of 480 minutes, per skybike cable the BCC is 70 riders/day and the RCC is 8 riders/day.
Among the four (4) activities offered by the Octopus Islet Adventure, visitors preferred viewing and then swimming. Viewing is becoming a more popular and common activity among visitors since it is a relaxing activity in which people can quietly appreciate and enjoy the landscape of the site without exerting much effort. Zipline and skybike are the third and fourth most popular activities among tourists and locals, respectively.

Table 6. Activities in Octopus Islet Adventure Ranked According to the Visitor's Preference

| **Activity** | **1st** | **2nd** | **3rd** | **4th** |
|---|---|---|---|---|
| Swimming | 188 | 220 | 39 | 74 |
| Viewing | 274 | 180 | 45 | 22 |
| Zipline | 32 | 88 | 375 | 25 |
| Skybike | 22 | 32 | 63 | 404 |

The results revealed the respondents' preferred activities in a day which could be a guideline for the permissible users of the activities. Furthermore, environmental issues and overcrowding frequently originate from the beach recreational activities [3], which explains that beach activities should set a recreational carrying capacity for the management of the site.

**Social Indicators**
Social Norms can be used to estimate standards for social indicators and examine the extent to which these standards are being met or exceeded at a particular location [8]. Figure 5 shows the images used in perceiving crowds for the preferred number of visitors of the respondents.

**A**

0 people/500x200 yards

**B**

50 people/500x200 yards

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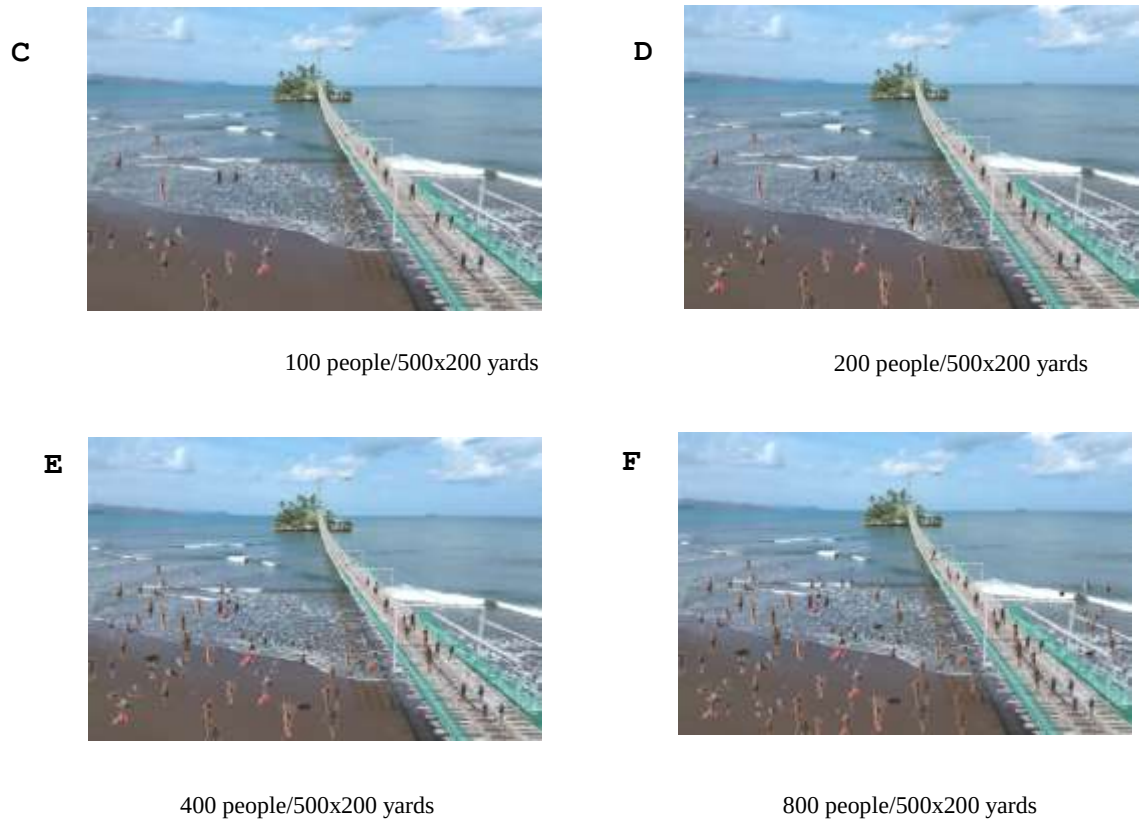


Fig. 5 Photographs Use for Measuring Use Level Norms Adapted from Manning et al. (2002) and Needham et al. (2008).

Measuring norms involved respondents rating their acceptance to visitors' density of six photographs in Figure 5 and was coded in a 5-point scale of -2 as very unacceptable to 2 as very acceptable, if it was to occur at Octopus Islet Adventure. The average acceptability ratings of tourists and local residents were plotted on social norm curves. As described in Figure 6, the impact acceptability curve shows that local residents rated acceptable photographs A and B containing 0 and 50 people per 500x200 yards while tourists rated acceptable photographs A, B and C.

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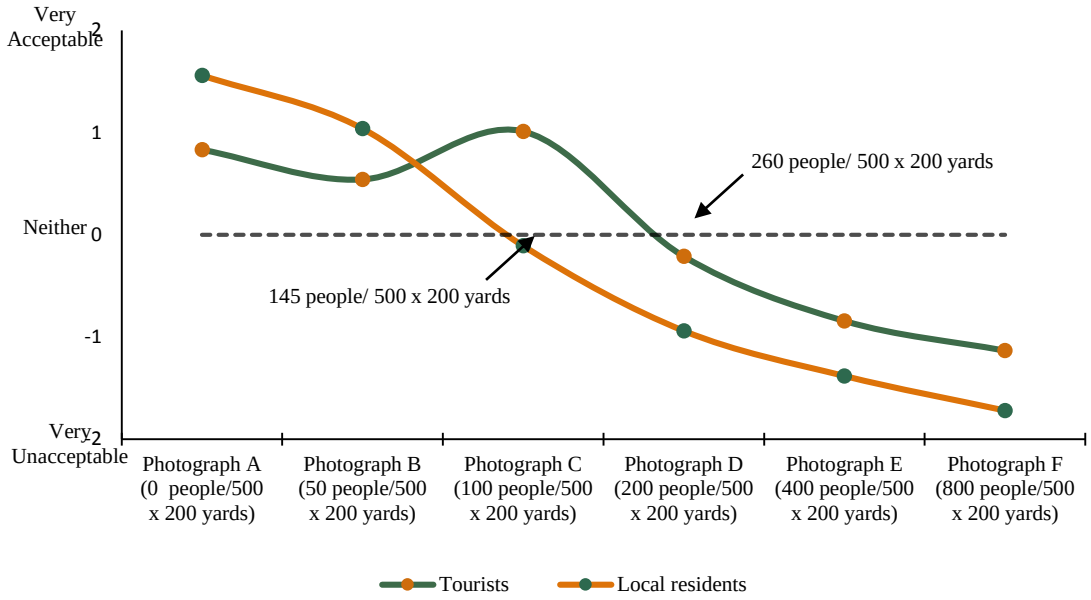


Fig.6 Social Norm/Impact Acceptability Curve of the Tourists and Local Residents.

Moreover, it also revealed that local residents considered photograph C, D, E and F containing 100, 200, 400 and 800 people per 500 x 200 yards to be unacceptable at Octopus Islet Adventure. It can be observed from the graph, for tourists (photograph C) would be good for their enjoyment and experience, but for local residents (photograph F) an overcrowded area would have an opposite effect to them. The minimum acceptable condition for the tourist respondents was established as 260 people per 500 x 200 yards and for the local respondents was 145 people per 500 x 200 yards; as to where the curve intersects neutral line. This point can be used to represent the standard of quality for this site before conditions deteriorate [9]. Table 7 shows that there was amount of crystallization on acceptable conditions at Octopus Islet Adventure. This is the average standard deviation of the norm curve; a low value implies higher degree of crystallization in which the data shows that tourists have high degree of crystallization whereas local residents have a moderate agreement with their responses.

Table 7. Social Norm/Impact Acceptability Curve Characteristics at Octopus Islet Adventure

| **Norm Characteristics** | **Norm Curve Characteristics** | |
|---|---|---|
| | Tourists Respondents | Local Respondents |
| Minimum acceptable condition | 260 people/500x200 yards | 145 people/500x200 yards |
| Norm Crystallization (range = 0 to 2) | 0.81 | 1.30 |

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**Facility Indicators**

It is important to know the relationship between both the importance and satisfaction of the respondents for each characteristic [11], since some of the respondents may feel satisfied with the particular characteristics present in the area and there is still possibility that they feel that these characteristics are not important to be actually provided at Octopus Islet Adventure. As shown in Figure 7, most of the tourists and residents were satisfied with many aspects at the site, however, there were still tourists' respondents that are less satisfied with the presence of lifeguards and information signs; sadly, lifeguards and information signs were lacking at Octopus Islet Adventure. With these findings, it is recommended that these concerns should be monitored and improved to ensure that satisfaction does not decline in the future [9].

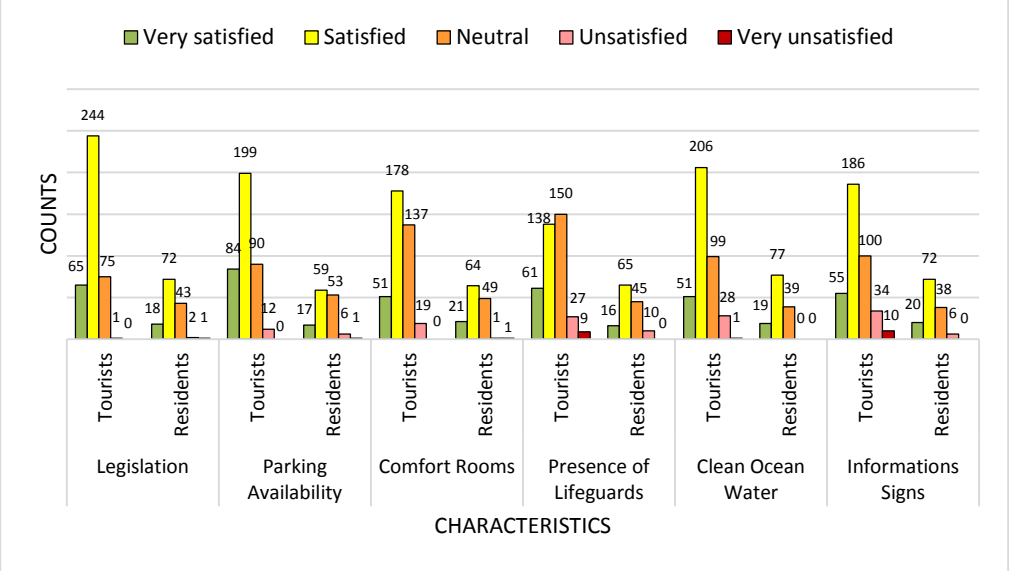


Fig. 7 Level of Satisfaction on the Characteristics found in Octopus Islet Adventur

However, some visitors may be satisfied with the characteristics of the area, there is still a possibility that they may consider that these characteristics are not important enough to be presented at Octopus Islet Adventure. To understand the relationships between importance and satisfaction, the importance-performance matrix was used (see Fig. 8). It provides the management with greater insight into any of the amenities are most and least important and that may or may not need to be addressed [1].

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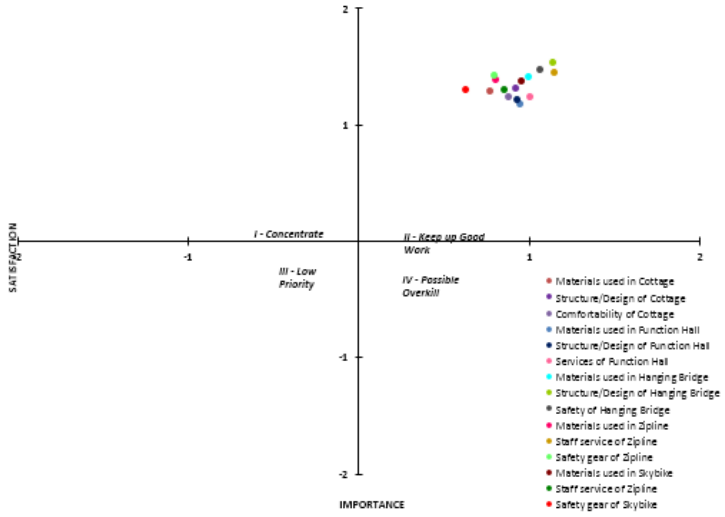
Fig. 8 Importance-performance Matrix Analysis in Octopus Islet Adventure.




As suggested by Chu and Choi and Needham [4], [9] the application of the -point Likert-scaled and respective values plotted with importance in the y-axis and satisfaction in the x-axis should be represented in 4 quadrants. As shown in Fig. 8, that a significantly high number of both residents and tourists, consider Octopus Islet Adventure's facilities to be crucially important. Respondents were also satisfied with all the above-mentioned facilities. To conclude, the findings suggests that the management of Octopus Islet Adventure should "Keep up the good work" (Quadrant II) in making a positive impression on visitors.
This means that the materials used, design/structure, comfortability, services, staff, and safety of the respective facilities provided by the site are sufficient and adequate. Facilities that are convenient satisfied the respondents' expectations and are fundamental recreational and tourism quality experience [3]. Perceiving the preferences, expectations, and experiences of the users can yield an immediate process of effective sustainable tourism [10]. Thus, the results inferred that facility indicators were rated acceptable for users' accommodation.

## 4. CONCLUSIONS

Tourists and residents have different perspectives and preferences with regards to usage and experience of Bacuag Octopus Islet Adventure. Thus, the study considered the relevance of the host community for the determination of carrying capacity. Since both influences' management plan, it would advantage the management to provide effective sustainable tourism of the site. The tourism carrying capacity of the area and the activities were based on the covered area, rotation coefficient, and three limiting factors. One of the limiting factors is the 'new normal' which is pandemic. Hence, any value of the carrying capacity of the permissible number of users were minimized accordingly. Recreational carrying capacity included social and facility indicators for recreational carrying capacity determination. Using image capture technology, consecutively, tourists prefer higher number of visitors than local residents. The majority of respondents, furthermore, rated all characteristics as important and were satisfied with most

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aspects of their visit. Nevertheless, the availability of lifeguards and signages was evaluated as negative aspect for some of the respondents. It is recommended for the management to have a good knowledge and application of carrying capacity towards sustainable tourism of Bacuag Octopus Islet Adventure.

**ACKNOWLEDGMENT**
The researchers would like to take this opportunity to express immeasurable gratitude to several individuals whose great support and help of this paper was the motivation and inspiration. A sincerest thanks to Mr. Felicisimo C. Cebedo the mayor at the Municipality of Bacuag, for approving the study to be conducted in their locale. Also, their deepest gratitude to Mr. Herman S. Saumbon for giving permission to conduct a study at Bacuag Octopus Islet Adventure.

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