MANUAL ON
CARRYING CAPACITY
DETERMINATION FOR SUSTAINABLE TOURISM DESTINATIONS

Dumaluan Beach,
Panglao, Bohol

Chamantad-Tinyan Viewpoint
Sabtang, Batanes

Chocolate Hills,
Carmen, Bohol

Department of Environment and Natural Resources
Ecosystems Research and Development Bureau

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Manual on Carrying Capacity Determination for Sustainable Tourism Destinations

Department of Environment and Natural Resources
Ecosystems Research and Development Bureau
College, Laguna

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MESSAGE

In recent years, there has been a 'boom' in the tourism industry worldwide. Despite its socio-cultural and economic benefits, tourism has also generated negative impacts, particularly on the environment. There have been several cases of over-development without considering the destination's carrying capacity and environmental implications (Wong, 1991). Typical examples are the Pattaya Beach in Thailand, Hikkaduwa in Sri Lanka, and recently, Boracay in the Philippines. The latter was closed down for tourist visitation for six months rehabilitation in 2018.

The Philippines, being an archipelago, boasts thousands of islands that qualify as tourism destinations. The increase in the number of tourists brings about multiplicity of problems that compromise the sustainability of the environment and these include overcrowding, pollution, and destruction of wildlife and their habitats. Whereas tourism was oftentimes treated as an industry, and thus, strongly linked with economics, other aspects such as the cultural or environmental impacts must also be given priority attention.

As far back as 2014, the Department of Environment and Natural Resources (DENR) and the Department of Tourism (DOT) have adopted the National Ecotourism Strategy (2013-2022). Its main goal is to develop responsible tourism that safeguards the integrity and diversity of its natural resources, provide education and enjoyment to visitors, and deliver larger and more widely distributed income and employment opportunities to the local communities and their constituents, especially the women, youth, indigenous peoples, and other vulnerable groups. There is now a marching order for the DENR Bureaus and regional offices to undertake carrying capacity assessment of popular and environmentally important tourist destinations to ensure sustainable tourism in both terrestrial and aquatic destinations. With the growing demand and increasing interest in nature-based and responsible tourism, researchers, planners, and decision makers are compelled to apply holistic and participative approaches for a sustainable tourism development.

This manual is a commendable effort of the Ecosystems Research and Development Bureau (ERDB) to provide guidance for the DENR and relevant government agencies and private sector for the promotion of sustainable tourism in the country.

ROY A. CIMATU
Secretary, DENR

PREFACE

The tourism industry is considered as one of the major drivers of a country's economy. According to the United Nations World Tourism Organization (UNWTO), there has been an increase in global tourists from 25 million in 1950 to about 1.1 billion in 2015, and is predicted to reach 1.8 billion in 2030. In the Philippines, tourist arrivals were pegged at 7.1 million in 2018, and are observed to be increasing every year. This growth has driven the industry to become increasingly complex, consequently producing negative impacts on the environment. Tourism without proper planning, management and monitoring can have destructive effects on the natural resources and the environment such as disturbance and pollution in air, water, and land. This has led to one of the emerging concepts which is sustainable tourism.

For ecotourism to be sustainable, there has to be a balance between economic, social and most importantly, environmental aspect, which is often than not, least prioritized. One approach to properly manage ecotourism is to determine the number of tourists that can be accommodated in an area without compromising environmental quality, a concept known as carrying capacity. However, the determination of carrying capacity requires an interdisciplinary approach from the various field of natural and social sciences which further requires, time, knowledge and financial resources. In addition, there are hundreds of tourism destinations throughout the Philippines which are labeled as ecotourism sites. Determination of carrying capacity in these destinations is a vital approach in the sustainable management of resources while developing ecotourism sites in the Philippines.

The learnings from the case of Boracay, which underwent a 6-month closure in 2018 to facilitate rehabilitation, underlie the importance of conducting carrying capacity assessments in major tourism destinations in the country. With the growing demand and increasing interest in nature-based tourism, researchers, planners, and decision makers are encouraged to apply holistic and participative planning approaches in pursuit of sustainable tourism development in the Philippines. This manual provides the concepts and methodologies in the conduct and operationalization of carrying capacity assessment to achieve this goal.

***HENRY A. ADORNADO**, Ph.D.*
Director, ERDB

LIST OF ACRONYMS AND ABBREVIATIONS

BCC	Basic Carrying Capacity
BMB	Biodiversity Management Bureau
BCCMM	Boullon's Carrying Capacity Mathematical Model
CarCap	Carrying Capacity
CRERDEC	Coastal Resources and Ecotourism Research, Development and Extension Center
CENRO	Community Environment and Natural Resources Office
CLUP	Comprehensive Land Use Plan
CSO	Civil Society Organization
DENR	Department of Environment and Natural Resources
DPWH	Department of Public Works and Highways
DOT	Department of Tourism
EMB	Environment Management Bureau
ERDB	Ecosystems Research and Development Bureau
FGD	Focus Group Discussion
FLUP	Forest Land Use Plan
GIS	Geographic Information System
GPS	Global Positioning System
KII	Key Informant Interview
LGU	Local Government Unit
NGA	National Government Agency
NGO	Non-government Organization
PENRO	Provincial Environment and Natural Resources Office
PCC	Potential Carrying Capacity
RCC	Real Carrying Capacity
RC	Rotation Coefficient
SAFE	Sustainable Accommodation through Feedback Evaluation
SPSS	Statistical Product and Service Solution
WTO	World Tourism Organization

RATIONALE

Sustainable tourism as defined by the United Nations Environmental Program (UNEP) and United Nations World Tourism Organization (UNWTO) is: *"Tourism that takes full account of its current and future economic, social and environmental impacts, addressing the needs of visitors, the industry, the environment and host communities".* Therefore, sustainable tourism equates to the development of tourism sites through responsible use of environment and natural resources, respecting innate socio-cultural traditions and fair distribution of economic benefits from tourism. The underlying concept of sustainable tourism is geared towards sustainable development and is anchored on its three pillars: environmental integrity, social acceptability and economic viability.

Following the principle of sustainable tourism, the development of tourism destinations must be undertaken responsibly, which entail employing strategies that will lead to the country's economic growth through the creation of employment opportunities, participation and empowerment of local people, and reduction of poverty incidence. Development of tourism destinations must always be guided by science-based information and technology to maintain the ecological balance of the ecosystems. As such, the arrival of tourists and tourism activities must be regulated in order to preserve and protect the environment without compromising the level of satisfaction of the visitors.

Pursuant to Executive Order No. 192, the Department of Environment and Natural Resources (DENR) is mandated as the primary government agency responsible for the sustainable development of the country's environment and natural resources. The Executive Order No. 111, series of 1999 (Establishing the Guidelines for Ecotourism Development in the Philippines) along with the provisions of Republic Act No. 9593, otherwise known as the Tourism Act of 2009, emphasize the need to ensure the sustainability of tourist destinations in the country. The case of Boracay which faced severe environmental degradation from unregulated tourism activities necessitated the need for a more wholistic approach in the assessment of carrying capacity not only from the tourist's viewpoint but also on the innate capacity of the area to support the tourism activities. Hence, this manual is prepared by the DENR for the guidance of all concerned. The Manual was initially prepared by the ERDB with inputs from other staff bureaus of the Department such as the Biodiversity Management Bureau (BMB), the Forest Management Bureau (FMB), and the Land Management Bureau (LMB).

PURPOSE OF THE MANUAL

The purpose of this manual is to guide policy makers, Local Government Units (LGUs), National Government Agencies (NGAs), academe, Civil Society Organizations (CSOs), researchers, field implementers, and other stakeholders to effectively conduct carrying capacity determination of ecotourism sites in the context of sustainable tourism. It underscores the need for an interdisciplinary approach in the conduct of the assessment and the importance of both primary and secondary data on the site, people (local and tourists), infrastructures and biodiversity and their interactions, as basis in the overall development of the site for sustainable tourism. This manual provides the general operational guidelines in conducting carrying capacity assessments including preparatory activities, field data collection, processing, and analysis of data. It also highlights the need for inter-agency coordination to efficiently conduct carrying capacity determination in ecotourism sites.

OBJECTIVES

The primary purpose of determining the carrying capacity of all tourism destinations is to determine the ability of a certain system to support an activity or features at a given level or magnitude. Specifically, the manual intends to:

1. Provide guidance in the computation of carrying capacity based on the limitations imposed by the biophysical, economic, and socio-cultural environment of the tourism destination without compromising the quality of visitor's satisfaction;
2. Facilitate a more consistent methodological and procedural understanding on the concept of conducting a carrying capacity study; and
3. Assist in sustainable tourism planning, management, and development.

Carrying Capacity Concepts

In simple terms, the carrying capacity of the ecosystem is defined as its ability to support healthy organisms while maintaining its productivity, adaptation, and capacity renewal (IUCN/UNEP/WWF, 1991). More specifically, carrying capacity refers to the number of individuals that can be supported in a given area within natural resource limits, and without degrading the natural, social, cultural, and economic environment for present and future generations (Chamberlain, 1997).

Applied to tourism activity, carrying capacity is viewed as the specific environmental carrying capacity of the biological and social environment with respect to tourist activity and development. Ceballos-Lascurain (1996) emphasized that the basic knowledge and understanding of the environmental impacts of tourism development are important pre-requisites if carrying capacity methodologies are applied rather than simply the understanding of visitor's satisfaction and expectations.

It depends on the following main factors: (1) the amount of resources available in the ecosystem; (2) the size of the population or the number of users; and (3) the amount of resources each individual consumes. It also considers other related factors such as social, psychological, economic, and environmental that may influence carrying capacity and normally limit the level of the same in a certain area (Calanog, 2016).

The UN-WTO (1993) defines carrying capacity as the "maximum number of people that may visit a tourist destination without causing destruction of the physical, economic and socio-cultural environment and an unacceptable decrease in the quality of visitors' satisfaction".

The Joint DENR-DOT Memorandum Circular No. 98-02, which describes the Guidelines for Ecotourism Development in the Philippines, defines carrying capacity as: "the extent of development and maximum number of individuals that can be accommodated in a given area without adversely affecting the state of the environment, the level of satisfaction of the visitors, and the sociocultural characteristics of the concerned community".

In the context of sustainable tourism development, carrying capacity is interpreted as the maximum number of individuals that can be accommodated in an area without adversely affecting the biological and physical condition of the environment, the level of satisfaction of the visitor, and the socio-cultural norms of the local or host community.

Definition of Terms

a) **Basic Carrying Capacity** – the number of visitors computed by dividing the total size of a particular area designated for use of the visitors with the average or standard size/space requirement of the visitors.

b) **Biodiversity** - is the variability among living organisms from all sources, including terrestrial, marine, and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species between species, and of ecosystems.

c) **Ecological Carrying Capacity** – measure of the population that an ecosystem can sustain, defined by the population density beyond which the mortality rate for the species becomes greater than the birth rate. In a recreational context, ecological carrying capacity can also be defined as the stress that an ecosystem can withstand in terms of changing number of visitors or activities before its ecological value is unacceptably affected.

d) **Ecotourism**– a "form of sustainable tourism within a natural and cultural heritage area where community participation, protection, and management of natural resources, culture and indigenous knowledge and practices, environmental education and ethics, as well as economic benefits are fostered and pursued for the enrichment of host communities and the satisfaction of visitors" (NES, 2002).

e) **Physical Carrying Capacity** – the spatial limitations of an area and is often expressed as the number of units that an area can physically accommodate; the threshold limit beyond which natural and cultural heritage of a destination are damaged by tourism.

f) **Population Carrying Capacity –** the maximum number of individuals that can be supported sustainably by a given environment; encompasses the range human activities and their associated environmental impacts such as solid and liquid waste generation, extent of land use and other physical development in the tourist destination.

g) **Potential Carrying Capacity** – the number of visitors computed by multiplying the BCC by the rotation coefficient.

h) **Real Carrying Capacity** – the maximum permissible number of tourists allowed to use an area once the limiting factors derived from the particular characteristics of the site (or standards/needs of the visitors) have been applied.

i) **Rotation Coefficient** – the value computed by dividing the number of hours the tourism site is opened for use by the standard time spent by a visitor for one visit.

j) **Social Carrying Capacity** – a measure of crowding tolerance. It is also defined as "the maximum visitor density at which recreationists still feel comfortable and

uncrowded”; the threshold beyond which social aspects of the host community are badly influenced and damaged by tourism activities and life’s quality of residents is not granted; this situation can also lead to conflicts between tourists and resident population, generating social tensions.

k) **Sustainable Tourism** – refers to the environmental, economic, and socio-cultural aspects of tourism development, in which a suitable balance must be established to guarantee long-term sustainability.

l) **Tourism** – the commercial organization and operation of vacations and visits to places of interest.

General and Methodological Framework

This manual is intended to be used as a standard procedure in the carrying capacity assessment of tourism destinations in both terrestrial and aquatic environments keeping in mind sustainability as the end goal in any tourism planning and development. Carrying capacity is temporal and it can either increase or decrease depending on the various environmental and socio-economic factors (Arrow et al., 1995; Kumar, 2017). Relative to this, careful and thorough determination of various limiting factors that may require the reduction in the number of tourists allowed at a given time in a particular site is very crucial and is of absolute importance to ensure the sustainable operation of any tourism activity. Furthermore, accurate determination of limiting factors may provide basis for the implementation of management strategies and site improvements that may bolster and enhance certain features of the site in order to improve visitor's satisfaction and experience and consequently increase the carrying capacity of the site.

The determination of carrying capacity shall be guided by a conceptual framework (Figure 1) based on the procedures applied in the Carrying Capacity Study of Boracay Island, Malay, Aklan (DENR-ERDB, 2018). The framework emphasizes the importance of the ecosystems approach in the conduct of carrying capacity assessment in pursuit of sustainable tourism. Tourism can have positive or negative effects due to population movement and dynamics and every form of human activity, whether of the local populace or the tourists, may cause changes in the environmental condition of the tourism site. Thus, the importance of looking at the physical, biological and social components, as basis in determining the carrying capacity of the tourism destination cannot be over-emphasized. The social component highlights the importance of monitoring the influx of visitors (tourist carrying capacity) vis à vis sociodemographic characteristics of the locality (population carrying capacity). The physical component (physical carrying capacity) looks into the physical environment such as water supply, waste management, traffic and infrastructure that may affect the quality of life of the local populace including visitor's satisfaction. The biological component looks into interaction of the site's unique flora and fauna and their status in response to the tourism activity in the site. Regardless of the tourism activity's location, the interaction among these components, whether direct or indirect, should be used as basis in identifying management strategies to ensure the ecological health and sustainability of the tourist destination.

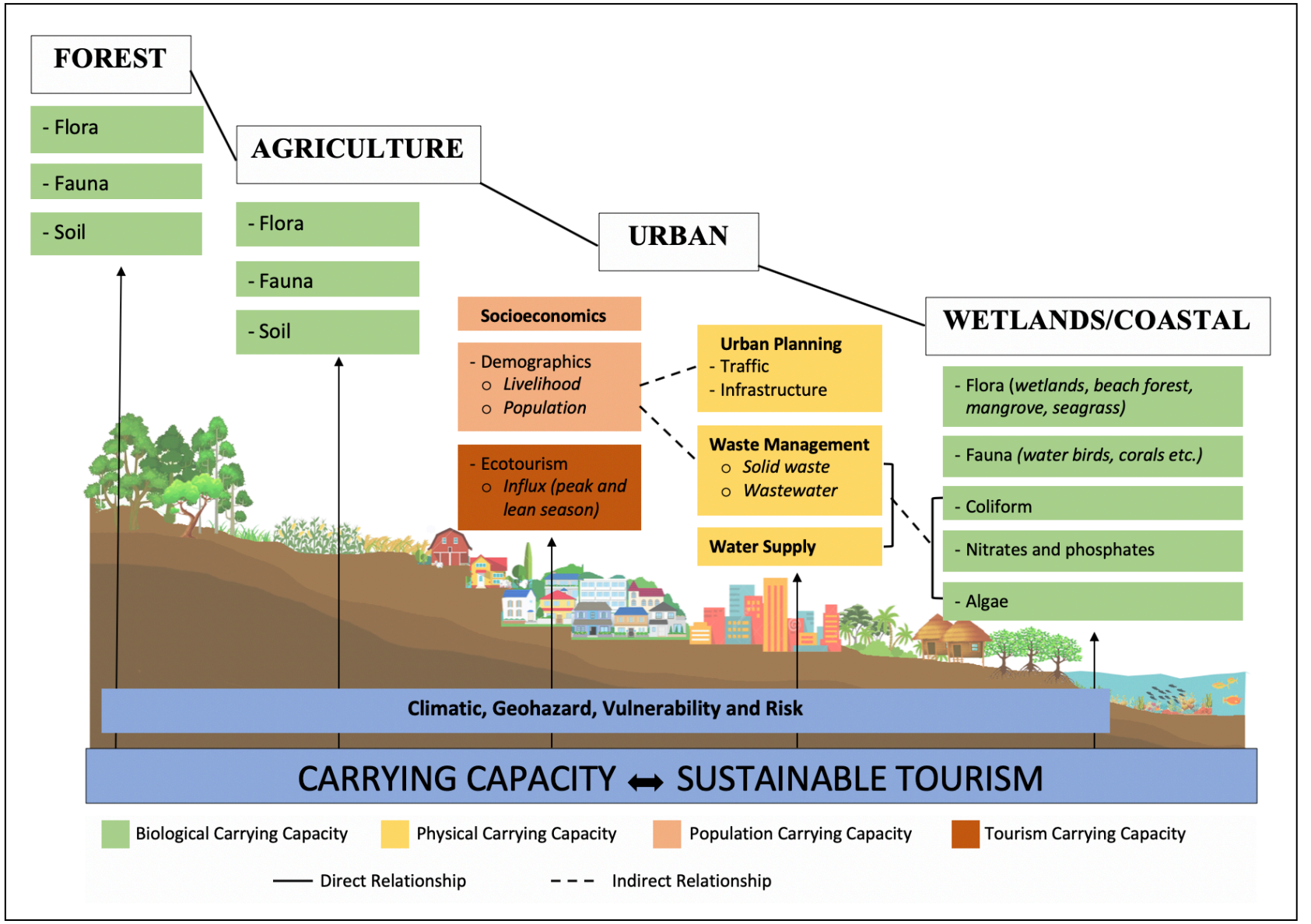


Figure 1. Carrying Capacity Conceptual Framework

Among the important steps in the process, as shown in Figure 2, include:

PHASE 1 a) Gathering of relevant secondary data including maps
b) Coordination with relevant agencies, groups and People's Organization with stake to the site

PHASE 2 a) Field work and collection of relevant primary data and information;

PHASE 3 a) Data processing and analysis
b) Report writing and Identification of recommendations for sustainable tourism implementation
c) Presentation of results to stakeholders and validation of results

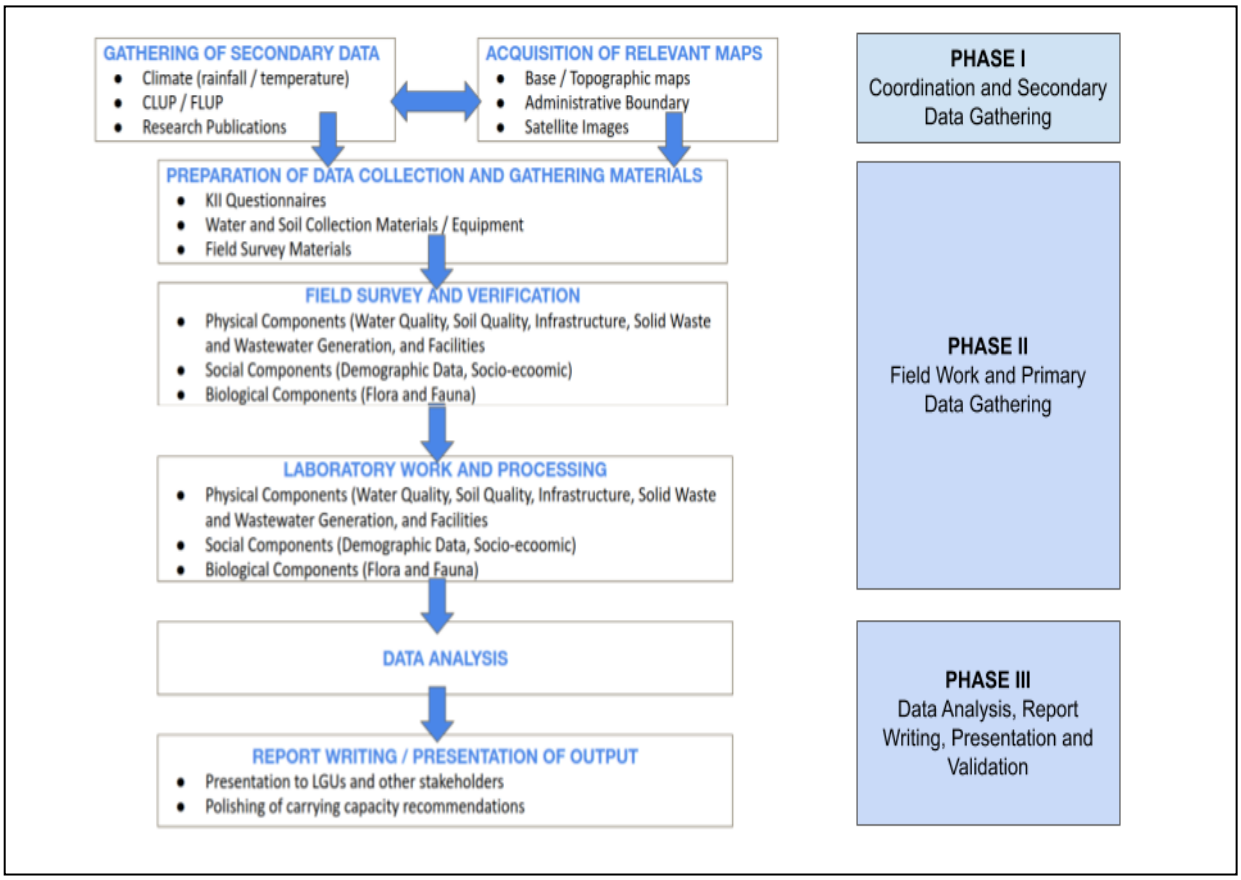


Figure 2. *Process flow in the conduct of carrying capacity assessment for sustainable tourism*

How to Assess Carrying Capacity

1. Preparatory Carrying Capacity Activities

1.1 Creation of interdisciplinary team and mobilization for scoping of target tourism destination

The conduct of carrying capacity assessment is an interdisciplinary approach. Team membership must include, but not limited to, those with expertise in natural sciences (biology, forestry, marine biology, wildlife sciences, and other related fields) statistics, GIS, social sciences, economics, sociology, development communication, and geology among others.

1.2 Leveling-off with counterparts

The study team shall coordinate and establish linkage with the Local Government Units (LGUs), National Government Agencies (NGAs), academe, Civil Society Organizations (CSOs), and other stakeholders operating in the tourism site to be assessed.

1.3 *Gathering of secondary data*

Secondary information on the biophysical component, socio-economic, and cultural components shall be secured from DENR Regional Office, concerned PENRO or CENRO, other NGAs, NGOs, LGUs, and published and other reliable sources. For reference, the following should be secured:

- List of existing tourism activities within the tourism destination
- Location and area allotted for each activity within the tourism site
- Profile of visitors (low and peak levels of visitors) for the last 3 to 5 years
- Relevant Maps from NAMRIA
    - Base/topographic maps
    - Land Use map
    - Administrative boundary
    - Satellite Images
- Comprehensive Land Use Plan (CLUP)/Forest Land Use Plan (FLUP)
- Other management plans, if available, such as:
    - Ancestral Domain Sustainable Development and Protection Plan areas covered by ancestral domain claims or titles
    - Protected Area Management Plan
    - Management plans for special use zones such as civil or military reservations, economic zones, mineral reservation, major watershed areas under NIA, etc.
    - Tourism Development Plan

- Municipal/Barangay profile(s) of tourism destination;
    - Population
    - Number of households
    - List and location of existing establishments and infrastructures such as tourism facilities (hotels and other lodging areas), hospitals/clinics, drug stores, food service providers, transport providers, among others.
    - Road and traffic network
- Climatic data from nearest weather station;
- Soil, air and water quality data;
- Geological data (topographic/geographic features);
- Local environmental ordinances and policies related to tourism activities;
- Results of researches conducted particularly on biodiversity status, if any, in the tourism area done in the last 5 years;
- Other government projects operating in the area, if any.

Information may be obtained from secondary sources (tourism offices, Local Government Units, academe, published literatures etc.). In the absence thereof, primary data or actual site validation should be done for the profiling of the tourism site. Secondary data shall be supported by primary data generated through actual field survey using interview schedule (one-on-one interviews, KII, and FGD) and ground truthing, field measurements, and mapping of resources using GPS handset and GIS software.

2. Primary/Field Data Gathering Activities

2.1 Reconnaissance Survey and Validation of the Tourism Activities with Key Informants/Tourism Regulators

Reconnaissance survey shall be done to validate the location of the tourism destinations including tourism facilities. Initial activities shall include meetings and focus group discussions with tourism managers, operators, workers and local officials to obtain general overview of the tourism sites and activities.

2.2 Biophysical characterization and biodiversity assessment

2.2.1 Biological Characterization

Biodiversity assessment shall include floral and faunal survey in specific ecosystems (e.g. forests, wetlands, coastal, marine, caves, urban parks etc.) covered by tourism activity using standard methods and tools per DENR policies/manual as shown in Annex A. Secondary data may be used given that the assessment period was done within the last 5 years prior to the conduct of carrying capacity assessment.

For both floral and faunal assessment, species that are likely to be affected by tourism activity or vice versa must be be listed and categorized in a

matrix as shown in Tables 1 and 2, respectively. Ethnobiological accounts may be included to determine the uses of each species. Invasive Alien Species which pose threat to the existence of other flora and wildlife species shall likewise be noted.

It is also important to delineate the area and distribution of species with ecological importance using GPS. In addition, the species must be classified according to conservation status (i.e., critically endangered, endangered, near-threatened, vulnerable or least concern as described by DENR Administrative Order 2019-09, 2017-11, IUCN Red List Categories, and CITES appendices (i.e. endemic, migrant, or resident). Endemic species that have a limited distribution or keystone species in which other species rely on for survival such as seed dispersers (fruit bats and fruit doves) and top predators (e.g. raptors birds, and snakes) must also be categorized accordingly.

Table 1. *List of observed flora species*

Family	Scientific Name	Common Name	Uses	Biogeographic Distribution*	Conservation Status**

**Endemic, exotic or invasive;*
*** Critically endangered, endangered, near-threatened, vulnerable or Least Concern (DENR Administrative Order No. 2017-11)*

Table 2. *List of observed faunal species.*

Family	Scientific Name	Common Name	Count	Feeding Guild	Biogeographic Distribution*	Conservation Status**

* *Endemic, migrant or resident;*
** *Critically endangered, endangered, near-threatened, vulnerable or Least Concern (DENR Administrative Order No. 2019-09, IUCN Red List Categories); Appendix I, II or III (CITES Appendices)*

***Table 3**. List of DENR Policies/Manual in assessing biodiversity status.*

Ecosystem/Biological Community	DENR POLICIES/MANUAL
TERRESTRIAL FLORA AND FAUNA	BMB Technical Bulletin No. 2016-05 "Guidelines on Biodiversity Assessment and Monitoring System for Terrestrial Ecosystems" Biodiversity Assessment and Monitoring System for Terrestrial Ecosystems Manual (BAMS) BMB Technical Bulletin 2018-02 "Procedures in the Conduct of Assessment of Urban Biodiversity"
INLAND WETLANDS AND CAVES	BMB Technical Bulletin No. 2019-06 "Inland Wetlands and Terrestrial Caves: Technical Guide on Biodiversity Assessment and Monitoring Systems (BAMS)" BMB Technical Bulletin No. 2017-01 "Guidelines in safeguarding caves utilized for ecotourism" DENR Memorandum Circular 2007-04 "Procedure in Cave Classification
AQUATIC MARINE AND COASTAL	BMB Technical Bulletin 2017-05 "Guidelines on the Assessment of Coastal and Marine Ecosystems"

2.2.2 Physical Characterization

With reference to the land-use classification system as indicated in the CLUP, physical characterization covers water and air quality and soil physico-chemical properties to determine the condition of the habitat and its ability to support biodiversity. If available, historical data on these parameters within the tourism site should be collected and compared with current readings to analyze the trends (Annex B).

Water quality provides basic scientific information about chemical and physical, vis à vis biological contents of water as well as the parameters and ecologically relevant toxicological threshold values to protect specific water uses (Lawson, 2011). Important chemical and physical factors affecting the aquatic environment are temperature, pH, dissolved oxygen (DO), total dissolved solids (TDS), oxidation-reduction potential (ORP), salinity, and presence of heavy metals. Primary data from important water sources such as deep wells, springs, streams, rivers, and water districts should be collected and analyzed.

Air quality, parameters that should be considered include particulates, sulfides, carbon monoxides, and hydrofluorocarbon (HFCs), to be obtained from Environment Management Bureau (EMB) or its regional offices.

For soil sampling, samples should be collected from the established plots and should be composited per zonation using a soil corer. Parameters that should be measured are moisture content, pH, organic matter content, NPK (nitrogen, phosphorus, and potassium), and soil texture using standard methods. Soil samples should be properly prepared (e.g., air-drying) prior to laboratory analysis.

For waste management in the tourism area (barangay or municipality level), data on solid and waste water generated may be obtained from the LGUs and analyzed according to sources and treatment procedures as practiced in the community. The Materials Recovery Facility (MRF) shall be located with reference to the tourism area. Consequently, local policies pertinent to solid and wastewater management must be secured.

Although activities in tourism is generally less dangerous for the environment compared to the majority of other activities like industry, in particular, it does contribute directly or indirectly, to the increased pollution of air, water and land, and burdens the infrastructure systems due to its seasonal character.

2.3 Vulnerability/Geohazard Assessment

For areas with history of severe erosion, landslides, storm surge, coastal flooding and other similar geohazard events, the conduct of vulnerability assessment (VA) should be done.

The VA is anchored in the climate change framework as a function of exposure, sensitivity, and adaptive capacity. Exposure refers to the physical environment conditions influencing the changes in the present state of the system. Sensitivity represents the condition of the system and adaptive capacity measures the ability of the system to cope with climate change (MERF, 2013).

Both terrestrial and coastal vulnerability should be assessed in each tourism site, as applicable. Terrestrial vulnerability takes into account flooding and soil erosion, while coastal vulnerability covers coastal erosion and storm surge (Joint Technical Bulletin 16-A (ERDB-FMB-EMB and BMB), July 12, 2019). The data requirement for both assessments are shown in Annex C.

2.4 Social survey

Key players in any tourism destination include tourists, community or local populace, LGUs, and service providers (food, accommodation, health and transport). The social survey should be directed to these key players through KII, FGD, household surveys and tourist/visitor interviews preferably done during peak and off-peak period. For the household, tourist/visitor and workers/service providers interview and determination of appropriate sample size should be done using the Cochran formula (Israel, 1992). The target respondents and interview schedule to be used for the social survey are as follows:

2.4.1 Community/Local Population. The context of sustainable tourism development is anchored on the determination of the maximum number of tourists that maybe accommodated in a tourism site without affecting the state of the environment, the level of satisfaction of the visitors and the sociocultural norms of

the local community. Thus, survey of the community is deemed as the starting point of carrying capacity determination which includes socio-demographic profile and their involvement in and benefits from tourism-related activities; insights and perception of the tourism activity including factors that limit the attainment of the tourism potential of the site and their waste generation disposal practices/systems. The interview schedule is attached in Annex D.

2.4.2 Tourist/Visitors. Tourists appreciate a particular tourism destination differently, depending on their age, financial capability and social orientation. Sustainable tourism development presupposes the attainment of maximum visitor satisfaction of the amenities provided by the tourism area. The interview schedule for the tourist, preferably administered during the peak and off-peak period of visitor's arrival is attached in Annex E.

2.4.3 Service Providers. Regardless of the distance that tourists have to travel, tourists are attracted by the unique natural features and resources of any tourism site and the pleasurable experiences that they bring. What makes a tourism area even more enjoyable are the services that are made available to the tourist. The interview schedule for the different service providers such restaurants, hotel and resort owners, transport operators, and health care providers is attached in Annex F.

2.4.4 Key Informant. The respondents for Key Informant Interviews (KII) shall include local officials, health workers and other NGOs/interest groups, among others. Focus Group Discussion (FGD) may be undertaken with key informants including senior citizens, women's group, Persons with Disability (PWD) on specific problems and issues pertaining to the operation of tourism activities in the area. The Interview schedule for key informants is attached as Annex G.

3. Sample Size Determination, Data Tabulation and Analysis

In order to facilitate the interview schedule, an appropriate sample size should be determined using Cochran's formula, given as follows

$$n_0 = \frac{Z^2 pq}{e^2}$$

where

n_0 is the calculated or the desired sample size

Z is the value from the standard normal distribution for the desired level of confidence (the z-value is obtained from the Z-table)

p is the estimated proportion of an attribute present in the population

q is $1 - p$

e is the desired level of precision (i.e. the margin of error)

The Cochran's formula is considered appropriate in situations with large populations. For the purpose of this manual, a 5% margin of error (level of precision), a 95% level of confidence, and 0.5 estimated proportion shall be used to determine the sample size. Using the Cochran's formula, and by way of substitution,

$$n_0 = \frac{(1.96)^2(0.5)(0.5)}{(0.05)^2}$$

$$n_0 = \frac{(3.8416)(0.25)}{0.0025} = \frac{0.9604}{0.0025}$$

$$n_0 = 384.16 \cong 385.$$

Hence, the desired sample size for the large population is 385.

If the population under study is small, the Cochran's correction formula should be used instead, given as follows:

$$n = \frac{n_0}{1 + \left(\frac{n_0 - 1}{N}\right)}$$

where

n is the calculated or the desired sample size

n_0 is the value obtained using the Cochran's formula for large population (for this manual, $n_0 = 385$)

N is the population size

Example:

Suppose you are to conduct a research study wherein you need to survey tourists of a certain nature-based tourism site. Based on the data available from the tourists' logbook, shows that the latest tourist arrivals totals to 1,500. Determine the sample size of tourist respondent for the survey using 5% margin of error and 95% level of confidence.

Solution: Using the Cochran's correction formula,

$$n = \frac{385}{1 + (\frac{385-1}{1500})} = \frac{385}{1 + (\frac{384}{1500})} = \frac{385}{1 + (0.256)} = \frac{385}{1.256}$$

$$n = \frac{385}{1 + (\frac{385-1}{1500})} = \frac{385}{1 + (\frac{384}{1500})} = \frac{385}{1 + (0.256)} = \frac{385}{1.256}$$

$$n = 306.53 \cong 307$$

Data gathered from social survey and interviews shall be encoded in excel format for easy coding and application of appropriate statistical tools. The data shall be imported, and variables shall be coded per data in IBM SPSS® Statistics, a powerful statistical software platform, for processing and analysis.

Descriptive statistics shall be used to describe the community, the tourists, and the tourists' activity preferences and standard requirements. Regression and correlation analysis shall be used to determine the limiting factors that significantly affect the tourists' preferred activities in the area. Also, pivot tables, cross tabulations, and graphs shall be prepared for better presentation of results.

4. Determination of limiting factors.

The concept of tourism carrying capacity is based on a general statement that any form of development within the carrying capacity of ecosystem means sustainable development. The identification of limiting factors is a crucial step in any carrying capacity assessment which may be obtained from interviews of the different stakeholders operating in the area. For the tourists alone, the limitations imposed by environmental disturbances due to storms, monsoons, heavy rainfall must always be considered as a hedge to tourists' safety and enjoyment. The provision of mobility support to the tourists, availability of accommodation facilities, guides and food sources/providers assure tourists of a pleasurable stay in the tourist destination. Other support systems such as peace and order situation, security maintenance and presence of hospitals and clinics, including drugstores are key elements to ensure the safety of the tourists. On top of these, solid waste management and waste water disposal are primary considerations in the carrying capacity assessment of any tourism destination. Careful administration of the questionnaires should reflect these limitations to be able to clearly describe the tourism activity in any particular site.

<table>
<tr><th rowspan="2">Type of Tourism</th><th rowspan="2">Range of Activities</th><th colspan="3">Possible Limiting Factors</th></tr>
<tr><th>Ecological</th><th>Services</th><th>Facilities</th></tr>
<tr><td>Beach/water-based tourism</td><td>Swimming, scuba diving, snorkeling, boating/kayaking, island hopping, camping, bird watching, fishing</td><td rowspan="2">physical and biological factors such as rainy days, stormy days, period of algal bloom, intense sunlight, forests, mangroves, corals, seagrass, wildlife (nesting grounds, breeding season, mating season), historical features, among others</td><td rowspan="2">Tour guides/ briefing services, Life guards, Food services. Emergency health services , water source, Transport services</td><td rowspan="2">Hotel accommodation, lodging areas, restaurants, stores, picnic tables, cooking area, health clinics, drugstores, garbage area/bins, walking trails, supporting sports equipment</td></tr>
<tr><td>Land-based tourism</td><td>trekking, camping, bird watching, picnicking, camping, sight-seeing, cave exploration</td></tr>
</table>

Computation of Carrying Capacity

1. Tourism Carrying Capacity

There are several models in computing carrying capacity but for the purposes of the manual, tourism carrying capacity shall be computed using Boullon's Carrying Capacity Mathematical Model (BCCMM) as adopted by Calanog (2016). The model hinges on the careful determination of visitor standards for different tourism activities such as swimming, bathing, boating, snorkeling, trekking and the like. The required standard per visitor, which may come in the form of time, space, material, psychological, ecological and other needs of the visitor (e.g. how much area is needed for swimming, snorkeling, diving, etc.) expressed in square meters should be derived from the results of the interview schedule of the tourists.

This model has three (3) level computations, as follows

- First Level: Basic Carrying Capacity (BCC)

The BCC is calculated by dividing the total size of a particular area designated for use of the visitors with the average or standard size/space requirement of the visitors.

$$\mathbf{BCC} = \frac{Area\ used\ by\ visitors\ (in\ m^2)}{Average\ visitors'standard\ (in\ m^2)}$$

- Second Level: Potential Carrying Capacity (PCC)

The PCC is the product of the BCC multiplied by the Rotation Coefficient (RC) of a specific tourism activity which is computed as follows:

$$\mathbf{PCC} = BCC\ x\ RC$$

where:

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

- Third Level: Real Carrying Capacity (RCC)

The RCC is the maximum permissible number of use of an area once the limiting (i.e. corrective) factors (Lf_1, Lf_2 , … Lf_n) derived from the particular characteristics of the site (or standards/needs of the visitors) have been applied. RCC is computed by incorporating the limiting factors based on interviews of the different sets of respondents and from direct observations of the flow of tourism in the area attributable to climatic disturbances.

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

Where: $\mathrm{Lf}\ (1,2,3\cdots n) = \text{Limiting factors with significant regression coefficients}$

$$\mathrm{Lf}\ (1,2,3\ldots n) = \frac{\mathrm{M}\ (a, b, c \ldots n)}{\mathrm{MT}}\ \mathrm{X}\ 100$$

$M_{(a, b,c,\ldots n)}$ = limiting magnitude of the factor or variable
MT = total magnitude of the factor or variable

For reference, the World Tourism Organization (WTO) for instance, prescribed the standard space requirements for beach areas as follows: Medium standard - 15 m^2; Comfort standard - 20 m^2 and De Luxe standard - 30 m^2 (Huttche et al., 2002) While these standards may be used in the computation of carrying capacity, the values provided by the tourist, community and key informants themselves are the preferred standards and must be used in the computation of carrying capacity to ensure maximum enjoyment of the tourism activities and accuracy of the site-specific assessment of carrying capacity. The use of international standards only serves as basis in validating the values obtained through survey and maybe used only in situations where interview of tourist is not possible.

Sample Computation 1. Tourism Carrying Capacity of Boracay Island (DENR-ERDB, 2018)

Based on site assessment, social survey and key informant interviews, the following are the most popular swimming areas in Boracay:

Swimming Areas	***Location***	***Area (m^2)***
Puka	*Brgy. Yapak*	*10,300*
Ilig-iligan	*Brgy. Yapak*	*26,500*
White Beach	*Brgy. Balabag to Brgy Manoc-Manoc*	*400,000*
Bolabog	*Brgy. Balabag*	*159,000*
TOTAL		***595,800***

Average standard area for swimming area is 30 m^2 based on WTO recommendation. Basic Carrying Capacity is computed as follows:

$$\mathbf{BCC} = \frac{Area\ used\ by\ visitors\ (in\ m^2)}{Average\ visitors'standard\ (in\ m^2)}$$

BCC = 595,800/30
BCC = 19, 860 tourists/day

Although Boracay is open for 24 hours, the effective swimming hours is only for 6 hours. Given that tourists, based on interview, spend an average of 4 hours swimming within the 6 hours effective swimming period, ***Rotation coefficient (RC) is computed as follows:***

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

RC = 6/4

RC = 1.5

The Potential Carrying Capacity is therefore computed as follows:

$$\mathbf{PCC} = BCC\ x\ RC$$

PCC = 19,860 X 1.5

PCC = 29,790

Sample Computation 1 continued…

For the computation of Real Carrying Capacity (RCC), limiting factors were identified based on the results of interview, as follows:

Limiting Factors (Lf)	Number	Magnitude of Lf	Limiting factor (Lf)
Lf 1 = Tropical Cyclones (days)	6	365	1.64384
Lf2 = Heavy Rainfall (days)	60	365	16.43836
Lf3= Flooding (days)	30	365	8.21918
Lf4 = Docking area for boats (area in m^2)	10,000	595,800	1.67842
Lf5 = Presence of Algae (days)	60	365	16.43836
Lf6= Restricted Swimming Areas /water depth beyond 6 feet (area in m^2)	144,000	595,800	24.16918
Lf7 = Sea Grass Beds (area in m^2)	128,000	595,800	21.48372

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

$$\mathbf{RCC} = PCC\ x\ \frac{100 - 1.643}{100}\ x\ \frac{100 - 16.438}{100}\ x\ \frac{100 - 8.219}{100}\ x\ \frac{100 - Lf_{n\ldots}}{100}$$

RCC = 10,992 persons/day

Note: *Ideally, the standard area requirement for various activities must be obtained from interviews of tourist/visitors cross-checked with the responses of the community and key informants. However, when the magnitude of responses vary widely due to basic differences in age, origin, financial status, purpose of visitation, among others, the WTO standards ranging from 15 to 30 square meters /person may also be used depending on the level of desired comfort for the tourist. Note also that different activities will have a different estimate of tourist carrying capacity which will also follow the same procedure as above. The overall tourism carrying capacity is the total number of tourists per activity on the premise that there is no overlap in the area used per activity. Since visitors usually stay for longer periods in the tourist destination (usually 3 days), daily allowable tourist is computed at one-third of the tourism carrying capacity and subsequently compared with the recorded/ actual daily tourist arrival.*

2. Physical Carrying Capacity

Physical Carrying Capacity (PCARCAP) is the maximum number of structures and used units that can be built and raised in an available area that will not affect the existing environment in its natural processes considering all possible limiting factors (Calanog, 2008). Physical carrying capacity is the threshold limit beyond which natural and cultural heritage of a destination are damaged by tourism; physical carrying capacity of a destination is thence determined through the analysis of its environmental components (for example, water resources quantity and availability, limits for air pollutants concentrations) and through the analysis of the facilities required by both tourists and residents: saturation limits for existing facilities (for example, sewage treatment plants, waste treatment plants) and limits for new facilities construction.

For the determination of physical carrying capacity, land-use maps are most useful to ascertain the existing land-uses viz-a-viz management plans for the site. On this aspect, Comprehensive Land-use Plans, which illustrate the zoning of existing alienable and disposable lands for different purposes such as residential, commercial and tourism area is most indispensable. Once identified, the application of Boullon's model maybe applied to determine the physical carrying capacity of a tourism destination.

The Potential Carrying Capacity (PCC) is an estimated number of structures that can be built in a particular area divided by the standard area requirement.

$$\mathbf{PCC} = \frac{Total\ area\ available\ for\ development}{Average\ standard\ size\ requirement\ (ASSR)}$$

The Real Carrying Capacity (RCC) is the maximum permissible number of use of an area (number of structures) once the limiting (i.e., corrective) factors (Lf_1, Lf_2, . . . Lf_n) derived from the particular characteristics of the site (or standards/ needs of the visitors) have been applied and is computed by incorporating the limiting factors identified during the interviews and observations in the sites (Calanog, 2015).

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

$$\text{Where: Lf}\ (1,2,3\ldots\text{n}) = \text{Limiting factors with significant regression coefficients}$$

$$\text{Lf}\ (1,2,3\ldots\text{n}) = \frac{\text{M(a, b,c...n)}}{} \text{ X } 100$$

$M_{(a,\ b,c,\ldots n)}$ = limiting magnitude of the factor or variable
MT = total magnitude of the factor or variable

Identification of corrective or limiting factors for the physical carrying capacity should consider the current topographic/geographic features, geohazards and other vulnerable areas including forest lands that not alienable and disposable as mandated by law and are therefore not allowed for infrastructure development and the like.

Sample Computation 2. Physical Carrying Capacity of Boracay Island (DENR-ERDB, 2018)

A starting point in the analysis of physical carrying capacity is the CLUP which contains the maps describe the intended land-uses of the municipality where the tourism destination is located. Other land-use maps (Proclamation No. 1064) also be used the Boracay CarCap study to enhance the accuracy of data, but for purposes of illustration, only the land use described in the CLUP of Malay, Aklan shall be used.

Land use based on digitized CLUP map of Malay, Aklan (2013-2022)

Land Use	Percent Distribution (%)	Area. (hectares)
Residential	26	156.51
Hotels and Beach Resorts	66.55	398.25
Other Establishments	7.09	42.44
Wetland	0.2	1.22
TOTAL	**100**	**598.42**

The average standard size requirements (ASSR) that were obtained from social survey were as follows: residential areas =233.35 m^2; commercial structures = 193.07 m^2; and for hotels and resorts = 6,328 m^2.

$$\textbf{PCC} = \frac{Total\ area\ available\ for\ development}{Average\ standard\ size\ requirement\ (ASSR)}$$

PCC (Residential areas) =156.51ha/.0233 ha = **6717 units**

PCC (Hotels/ beach resorts) = 398.25 ha/ .6328 ha = **629 units**

PCC (Other establishments) = 42.44 ha/.0193 ha = **2198 units**

Limitations on the use of the different land use categories based on CLUP.

Limiting Factors	Total Area (hectares)	Area Occupied in Residential areas (hectares)	Area Occupied in Other Establishments (hectares)	Area Occupied Hotel/beach resorts (hectares)
Lf1 Sinkholes	98.82	23.42	3.53	14.35
Lf2 Roads (12 m wide)	42.39	3.40	4.23	6.67
Lf3 Wetlands	38.28	6.81	0.81	7.14
Total	**179.49**	**33.64**	**8.57**	**28.15**

Sample Computation 2 continued…

Using Boullon's formula with Lf1 = area of sinkhole

Lf2 = area allotted to road

Lf3 = area of wetlands

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

Computation for RCC for different land uses are as follows:

Residential Areas:

$$\mathbf{RCC} = 6717\ x\ \frac{100 - \left(\frac{23.42}{156.51}\right)100}{100}\ x\ \frac{100 - \left(\frac{3.4}{156.51}\right)100}{100}\ x\ \frac{100 - \left(\frac{6.81}{156.51}\right)100}{100}$$

RCC. = 5345 Residential Units

Hotels and Beach Resorts:

$$\mathbf{RCC} = 629\ x\ \frac{100 - \left(\frac{14.85}{398.25}\right)100}{100}\ x\ \frac{100 - \left(\frac{6.67}{398.25}\right)100}{100}\ x\ \frac{100 - \left(\frac{7.14}{398.25}\right)100}{100}$$

RCC = 585 units of Hotels and Beach Resorts

For Other Establishments:

$$\mathbf{RCC} = 2198\ x\ \frac{100 - \left(\frac{3.53}{42.54}\right)100}{100}\ x\ \frac{100 - \left(\frac{4.23}{42.54}\right)100}{100}\ x\ \frac{100 - \left(\frac{0.81}{42.54}\right)100}{100}$$

RCC = 1781 Units of Other Establishments

***Note**: The RCC values represent the recommended number of structures based on the average standard size requirement for residential units, hotels/beach resorts and other establishments and land uses as indicated in the CLUP. Other limiting factors such as requirement for open spaces as dictated by the local ordinances particularly for residential areas and hotels and beach resorts of Malay, Aklan must also be factored in. Likewise, PCC and RCC were derived based on the assumption of homogeneity, i.e., to mean that all structural units require the same size. In reality, this is not the case. Hence the values are not necessarily prescriptive but they are still useful in pointing out problem such as overcrowding or illegal settling. Any exceedance in terms of the actual or existing number of structures per land use maybe interpreted as a condition that overshoots carrying capacity which must be addressed accordingly alongside waste management practices, water availability and traffic condition, among others.*

3. Population Carrying Capacity

Under normal circumstances, the local population competes with tourists on the use of the tourism destination and its resources which may result in the alteration of the physical environment. Sustainable tourism advocates that neither the needs of the tourist nor the local population must be compromised. The Indian Institute of Technology (IIT) Guwahati (2012) proposed the Sustainable Accommodation through Feedback Evaluation (SAFE) in the determination of population carrying capacity. It was first developed for computing carrying capacity of hilly urban area in order to insure hazard free sustainable urban development. However, the concept can be applied to any urban area. The SAFE method is represented by the equation.

$$CC = [A_u - (A_{ND} + A_{IF})]\, x \left(\frac{FAR}{S}\right)$$

Where:

A_U = Total delineated area

A_{ND} = Net non-developable area

A_{IF} = Area for infrastructure development

FAR (Floor Area Ratio) = $A_{F\ (Total\ Floor\ Area)}/A_P$ (Area of the Plot)

S = Floor area requirement per Head

Sample Computation 3. Population Carrying Capacity of Boracay Island (DENR-ERDB, 2018).

The values used in the computation of population carrying capacity based on CLUP using the SAFE Model is as follows:

Variables	Area Coverage	CLUP values (ha)
A_U - total urban area	Total urban area of Boracay	771.42
A_{ND} - net non-developable area	Sum of forest, wetland and beach	164.08
A_{IF}- area for infrastructure development	Sum of commercial tourism and utiility facilities, parks, MRF, roads, and the like	440.68
FAR - floor area ratio	Total floor area/total lot area	0.39
S - floor area requirement per head	UN Population Division Standard	0.002

Sample Computation 3 continued…

Data on Floor area was obtained from results of interviews with household, businesses with lodging and businesses with other services, as shown below.

Unit Category	Total Existing Structures (No.)	Total Actual Area measurement (m^2)	Average Area per unit (m^2)	Total Computed Area (ha)
Residential	10,250	55,204	178	182
Hotels/ Resorts	430	158,546	2007	86
Other Commercial Establishments	2779	22,606	117	32
Total				301
TOTAL FLOOR AREA= Residential Area + Hotels/Resorts Area + Other Commercial Establishment Areas = 301 ha				

Using the safe model, the population carrying capacity may be computed, as follows

$$CC = [A_u - (A_{ND} + A_{IF})]\, x \left(\frac{FAR}{S}\right)$$

Population CC = $[771.42 - (164.08 + 440.68)]\, x(0.39/.002)$

= 32,498

The actual population of Boracay Island per day without tourists based on the number of residents, resident and migrant workers in Boracay Island and daily tourist arrivals is as follows:

Resident Workers	22,395
Residents	16,526
Migrant Workers	13,605
Tourist/day	18,255
Total	70,781

Sample Computation 3 continued…

The total Population Carrying Capacity is therefore computed as follows:

Method	Carrying Capacity (no. of person/day)	Existing Population	Exceedance (no. of person/day)
Population CC (SAFE)	32499	52526	20027
Tourist CC (Boullon's)	10992	18255*	7263
Total	**43491**	**70781**	**27290**

*A total of 6,085 tourists arrive in Boracay per day in 2017 based on DOT data. On the assumption that the 6,085 tourists stay in the island for 3 days and 2 nights, there is a total 18, 255 tourists/day.

The case presentation of Population CC showed and exceedance in number not only of the local populace but also in the number of tourists that visit the area on a daily basis. This has created an increasing demand for public services such as water, electricity, solid and liquid waste management, sewerage and transportation especially during the peak season.

Integration of the Findings & Interpretation of the Results

There is no simple measure of carrying capacity that can be evenly and equally applied to all destinations and attractions because they are not homogeneous in their morphology and structure. In fact, it is most commonly split into at least four elements, and sometimes more, encompassing at least four dimensions namely: physical, socio-economic, perceptual (tourist's perception), and ecological. The physical carrying capacity of a tourist resource is the maximum use of the resource by the tourist, before the resource begins to be environmentally degraded and includes other land/water usage and conflicts over land rights. The social carrying capacity of a tourist resource is the maximum use of the resource by tourists in consonance with the use and level of control of the local populace without compromising the integrity and environmental stability of the tourist resource, in the long run. Tourist or perceptual carrying capacity is a measurement of tourist's perceived level of appreciation of the tourist resource, beyond which tourists perceive the resource as over - crowded. The ecological carrying capacity of a tourist resource is the maximum use level that can take place without causing unacceptable damage to the natural environment and biodiversity of the tourist resource. The carrying capacity approach, in all these cases, attempts to quantify these concepts in terms of numbers of tourists. This is to emphasize that the figure obtained from computations of tourism carrying capacity is not an absolute figure . This is possible only if the limitations at the level of the physical, population and ecological components are suitably met. Results of the carrying capacity assessment should thus be used as a planning tool to ensure sustainable tourism and should also include recommendations that will ensure the long-term productivity, socio-economic acceptability and viability of the tourism area and ultimately the achievement of the tourists' enjoyment and appreciation of the tourist area.

Tourism activities can generate both positive and negative impacts on the conditions of the areas. Since, every form of human use of natural environment causes changes to the environment conditions, evaluation of carrying capacity of a tourist destination has the purpose the measuring the threshold over which alteration due to human activities becomes unacceptable. This way, the carrying capacity concept is linked with resilience and rises from the necessity of estimating the maximum acceptable level of impact for the environment or for one of its components and the capability of recovering to its prior healthy condition. Because every situation has specific unique characteristics, measuring impact of tourism activities on biodiversity requires specific study on the areas under investigation. The assessment of loss of biodiversity due to tourism activities requires planners/operators to identify a representative species for each kind of impact, considering a multiple stress condition. A detailed monitoring of the flora and fauna of tourism areas should be promoted.

REFERENCES

Arrow K, Bolin B, Costanza R, Dasgupta P, Folke C, Holling CS, Jansson BO, Levin S, Mäler KG, Perrings C & Pimental D. 1995. Economic growth, carrying capacity and the environment Science 268:1-2.

Boullon, RC. 1985. Planificacion del espacio touristico. Ed. Trillas, Mexico, DE.

Calanog LA. 2016. A Manual on Computing Carrying Capacity of Ecotourism Sites in Protected Areas. Ecosystems Research and Development Bureau, Department of Environment and Natural Resources, College, Laguna, Philippines.

Calanog, L. A. (2015). A manual on computing carrying capacity of ecotourism sites in protected areas. Ecosystems Research and Development Bureau-Department of Environment and Natural Resources.

Calanog LA. 2007. Developing Carrying Capacity Protocol for Sustainable Ecosystems Management. Presented during the National Training – Workshop on CARCAP Data Computation, Analysis, and Model Formulation held at ERDB Auditorium, ERDB, College, Laguna, 9-12 October 2007.

Calanog, LA. 2008. Tourism carrying capacity of Boracay island. Ecosystems Research and Development Bureau-Department of Environment and Natural Resources.

Catton W. 1986.Carrying capacity and the limits to freedom. Paper prepared for Social Ecology Session 1, Xl World Congress of Sociology. New Delhi, India. August 18, 1986.

Ceballos-Lascurain, H. 1996.Tourism, ecotourism and protected areas. The State of Nature-Based Tourism around the World and Guidelines for Its Development.Gland, Switzerland: IUCN.

Chamberlain K. 1997. Carrying capacity. Tourism Focus, No. 8, 1997.

Chatterjee A and Chatterjee S. 2016. Sustainable metropolitan development using carrying capacity as tool: a case of Mumbai Metropolitan Region, India. International Advanced Research Journal in Science, Engineering and Technology, 2(4): 32-35

DENR-ERDB. 2018. Carrying Capacity of Boracay Island, Malay, Aklan. Terminal Report. Pp. 1-159.

Guwahati, IIT., 2012. Urban carrying capacity, GUWAHATI: ILPWRM.

Israel, G. D. 1992. *Determining Sample Size*. University of Florida IFAS Extension.

Kumar N. 2017. Urban Carcap Assessment for Metropolitan Area: Case Study of Patna City, Bihar, India, IRJET.

Lawson, O & Lawson, Emmanuel. (2011). Physico-Chemical Parameters and Heavy Metal Contents of Water from the Mangrove Swamps of Lagos Lagoon, Lagos, Nigeria. Advances in Biological Research. 5. 8-21.

Luzar EJ, Diagne A, Gan C & Henning BR. 1995. Evaluating nature-based tourism using the new environmental paradigm. Journal of Agricultural and Applied Economics 27:1-8.

MERF. 2013. Vulnerability Assessment Tools for Coastal Ecosystems: A Guidebook. Marine Environment and Resources Foundation, Inc.: Quezon City, Philippine

Huttche, C.M., A.T. White & M.M.M. Flores, 2002. Sustainable Coastal Tourism Handbook for the Philippines. Coastal Resource Management Project, DENR-DOT, Cebu City, Philippines. 144pp.

Rees WE. 1992. Ecological footprint and appropriated carrying capacity: What urban economics leaves out. Environmental Urbanization 4:121-130.

Wong, P.P. 1991. Coastal Tourism in Southeast Asia. International Center for Living Aquatic Resources Management, Manila. 40 p.

World Tourism Organization. 1993. Sustainable tourism development: Guide for local planners. WTO - World Tourism Organization, Madrid, Spain.166 pp.

ANNEXES

Annex A. *Methods, Materials and Indices relevant in assessing biodiversity status*

Biodiversity Composition	Methods	Materials/ Equipment Needed	Biodiversity indices
TERRESTRIAL			
Forest vegetation	Quadrat sampling	GPS, Transect tape, Diameter Tape, Meter Stick	Shannon Index/Simpson Index
Weeds	Line intercept	GPS, Transect tape, Diameter Tape, Meter Stick	Shannon Index/Simpson Index
Avifauna	Visual, sound observation, mist netting	Mist Net, Meter Tape, Binoculars	
Mammals	Mist netting (volant mammals) and trapping for (non-volant such as rats and murids)	Mist Net, Traps and bait,	Species Richness/count
Arthropods	Sweep net, light trapping		Shannon Index/Simpson Index
AQUATIC			
Mangroves	Quadrat sampling	GPS, Diameter Tape, Meter Tape, 1x1 Quadrant (PVC material)	Shannon Index/Simpson Index
Seagrasses/ seaweeds	Quadrat sampling	Mask and Snorkel	Shannon Index/Simpson Index
Fish	Fish visual census	Mask and Snorkel, meter tape, Slateboard, underwater camera	Shannon Index/Simpson Index
Plankton (phytoplankton and zooplankton)		Plankton net	
Macrobenthos (Arthropods, Annelids, Molluscs)	Pitfall trapping	Kick-net, Surber sampler and Grab sampler, glass traps and killing agents	Shannon Index/Simpson Index
Corals	Line intercept	Transect Tape, Photo Quadrat, Tetrapod	

Annex B. *Methods, Materials and Indices relevant in assessing physical characteristics*

Physical Characteristics	Data Requirements	Procedures	Indices/Standards
A. WATER QUALITY			
pH BOD DO Turbidity TSS E. Coli (Total and Fecal coliform) Salinity Phosphates Nitrates Heavy Metals (as needed)	Primary and/or secondary data	**Water Samples / in-situ analysis and Laboratory analysis, as applicable**	**DENR standards for specific uses**
AIR QUALITY			
Particulates Sulfides Carbon Monoxides HFC	Secondary data from EMB (only if the tourism site is highly urbanized)		**DENR standards for specific uses**
SOIL			
pH NPK OM Heavy metals (as needed)	Primary and/or secondary data	**Laboratory Analysis of soil samples**	

Annex C. *Data requirements for the conduct of terrestrial and coastal Vulnerability Assessment.*

Hazard	Exposure	Sensitivity	Adaptive Capacity
Terrestrial Vulnerability Assessment			
Erosion	Slope Soil type Land use Management practices Watershed boundary Topography River network	Monthly rainfall Typhoon frequency Projected rainfall	Soil & Water Conservation Mgt. Technology Funding support Capacity building programs Reforestation and Rehabilitation Initiatives within the watershed Institutional (existence of FLUPS, CLUPS, etc.) and (local legislations)
Flood	Watershed boundary Topography Slope Soil type	Rainfall (100-year) Projected rainfall	Availability of structures Availability and use of facilities and equipment Functional communication/availability of technology Indigenous adaptive mechanisms applied Institutional support (status of local DRRMC; capacity building programs) Institutional (local legislations) and (existence of FLUPs, CLUPs, etc.) Number of solid wastes management
Coastal Vulnerability Assessment			
Storm Surge and Coastal Erosion	Rates of relative sea level change (mm year^{-1}) Sea level rise exposure by 2050 (cm) Tidal range (m) Erosion/accretion rate (m yr^{-1}) Storm surge exposure at 1-m wave height (%)*	Storm/typhoon frequency (no.) Rainfall amount (mm) Beach width (m) Coastal geomorphology Coastal slope (%) Proximity to river mouth (m) Width of the reef flat (m) Lateral extent of the reel flat (% length of the shoreline) Beach forest and vegetation Coastal habitats Structures on the foreshore** Man-made buffers*	number of ordinances on beach/sand mining, proximity of settlement to coastline, coastal protection structures, land use pattern/ coastal development, implementation of coastal zoning plan in the CLUP, awareness of community on the guidelines of setback zone, presence of coastal resources management program (CRMP), community participation to CRMP, presence of environmental laws, knowledge of the community on the presence of environmental laws, enforcement of environmental laws, dissemination of information and education campaign materials, early warning device PA system, communication technology, evacuation center, resettlement areas, LGU knowledge and application of geohazard map, community knowledge on geohazard map and alternative or supplemental livelihood

**For storm surge only.*
***For coastal erosion only*

Annex D. *Survey Instrument for the Community/Local Populace.*

Interviewer: _____
Date of Interview: _____

Name of Respondent: _____
Address: _____

A. Respondent's Profile

1. Age (yrs): _____
2. Sex: [ ] Male [ ] Female
3. Educational Attainment: _____
4. Civil Status: [ ] Single [ ] Married [ ] Separated [ ] Widow/Widower
5.Household Type:[ ] Nuclear [ ] Extended
6.Household Size
7. Tourism-related Skills/Talents:

Member	Skill/Talent	In school or not	
Respondent			
Father			
Mother			
Son 1			
Son 2			
Daughter 1			
Daughter 2			
Other members, specify			
Other members, specify			
TOTAL Other members, specify			
TOTAL			

7. Religion: _____
8. Years of residence in the barangay: _____
9.Years of residence in the area: _____
10.Involvement in tourism-related activities and size of area used for each activity and family members' involvement:

Activities	Size of Area Used	Time/Period	Family Members Involved*

*Father - F; Mother - M; Son - S; Daughter - D; Other members - OM; All Members - AM

11. Is the size of your area presently occupied enough to meet your basic needs to live a decent life?

Yes: ___ Why? _____
No: ___ Why? _____
If not, how much area is needed (has) _____

12. What other activities do you want to do in the area aside from what you are doing now? Why?
_____

B. Respondents insights and perception of the Tourism Activity:

1. Name of Tourism Destination _____
2. Total area of the Tourism Destination (ha): _____
3. What are the tourist attractions/activities and describe each in terms of area/size covered (has), available facilities and number, payment for the use of facilities and other related fees, and limitations required on their use?

Attraction/Activities (i.e. camping, swimming, picnicking, etc.)	No. of hours open for tourists	No. of hours spent per tourist	Fees and related costs	Ideal area required/tourist (square meters)
Swimming				
Picnicking				
Trekking				
Camping				
Sight seeing				
Others (please specify)				

Attraction/Activities (i.e. camping, swimming, picnicking, etc.)	No. of hours open for tourists	No. of hours spent per tourist	Fees and related costs	Ideal area required/tourist (square meters)
Swimming				
Picnicking				
Trekking				
Camping				
Sight seeing				
Others (please specify)				

4. Among the different tourist attractions/activities in the PA, what are the three most popular? And why?

Attraction/Activity	Reasons
No. 1	
No. 2	
No. 3	

5. How much area (ha) in each tourism attraction/activity is necessary to make the visit of a tourist or a group of tourists satisfactory and enjoyable? How many per group of tourists? How many hours in a day these facilities are open for use by the tourists?

Attraction/Activity (e.g., camping swimming, trekking, etc.)	Area necessary (ha)/Standards		
	Per tourist/visitor	Per group of tourists and visitors	How many per group?

C. Respondent's insights on factors that limit enjoyment of tourism in the area (Limiting Factors)

1. Enumerate all possible significant factors that may affect tourism/visitor's activities in the area and explain how they pose limitation:

Existing Facilities	No.	Required Facilities	No.	Existing Services	No.	Required Services	No.	Limiting Factor in the Use of Facility/Service
Cottages				Tour Guides				Crowded, etc.
Parking Area				Life Guards				Limited, etc.
Access Road								Low maintenance, etc.
Canteen								Crowded, etc.
Tents								Limited, etc.
								Scarce, expensive fare, etc.

2. Is the activity/attraction gender suitable and satisfying? Encircle Yes or No and state the reason of your choice.

Gender Suitability				Satisfying		Reason/s if satisfied or not
Male	Female	Youth	Seniors			
				Yes		
					No	

3. Limiting factors of tourist activity/attraction

Activity/Attraction	Limiting Factors per Activity/Attraction	Hours/day	Days/month
Swimming	Typhoon		
	Heavy rains		
	Intense sunlight		
Picnicking	Closed facility/area for maintenance		
	Spawning/breeding season		
	Etc.		
Trekking			

4. What are the problems encountered by tourists and what solutions could be recommended to address them?

Problems Encountered	Recommended Solutions

5. What can you contribute to improve tourism in the area?

_____
_____
_____

6. In general, what suggestion or recommendation can you give to improve the carrying capacity of the area?

_____
_____

D. Solid Waste Generation and Disposal

1. What type of waste are you generating?
2. How many kilograms of waste do you usually generate per week?
3. What are your means of disposal? Plastics - recycling, re-using, burning, throw anywhere
   Papers - recycling, burning, throw anywhere
   Food waste – feed in animals, composting, throw away
   Yard waste – composting, burning
   Hazardous/special waste – stored/kept, buried in soil, throw away

TYPE	AMOUNT	MEANS OF DISPOSAL
( ) Plastics		
( ) Papers		
( ) Food waste		
( ) Yard waste		
( ) Hazardous/Special waste		

7. Knowledge regarding Solid Waste Management

   a. Do you practice waste reduction at source?
      ( ) Yes ( ) No
      If yes, how? _____

   b. Do you practice waste segregation at source?
      ( ) Yes ( ) No
      If yes, how? _____

   c. What type of storage facility do you used?
      ( ) Open pit
      ( ) Garbage bag
      ( ) Sack
      ( ) Garbage bin w/ label (bio/non-bio, & residuals)
      ( ) None

   d. Have you heard of R.A. 9003 or Ecological Solid Waste Management Act of 2000?
      ( ) Yes ( ) No
      If yes, where and how? _____

   e. Does your community have Materials Recovery Facilities (MRFs)?
      ( ) Yes ( ) No
      If yes, where? _____

   f. Does improper solid waste removal and disposal affects the environment?
      ( ) Yes ( ) No

   g. Does production of more wastes harm the environment?
      ( ) Yes ( ) No

   h. Does your community have a common disposal site?
      ( ) Yes ( ) No
      If yes, do you bring your solid waste to this common disposal site?
      ( ) Yes ( ) No
      If no, why? _____

   i. Who is in charge of solid waste disposal?
      ( ) Men ( ) Women

8. Attitudes regarding Disposal of Solid Waste

Question	YES	NO
1. Do you feel that street should be clean and clear of litters?		
2. Are you concerned about disposal of household solid waste? If yes, why?		
3. Are you and your household members willing to carry waste to collecting point?		
4. Do you think you play an important role in solid waste disposal? If yes, why?		
5. Does the community play an important role in solid waste disposal?		
6. Should solid waste disposal be taught in school as part of environmental education?		
7. Should correct waste disposal methods be taught to the community?		
8. Do you want to use less of disposable item and more of reusable items to reduce waste generation?		
9. Do you feel that less waste should be generated by household to preserve the environment?		
10. Do you think that proper solid waste removal and disposal is important? If yes, why?		

9. What would you recommend improving the solid waste management in (tourism destination)?

Annex E. *Survey instrument for Carrying Capacity Determination for Tourist Visitors.*

Interviewer: _____ Date of Interview: _____
Name of the Respondent: _____
E-mail address: _____
Address: _____

I. Visitors Profile

Socio-demographic characteristics

Age: _____ Gender: _____ Civil Status: _____
Household Size (including the respondent): _____ Educational Attainment: _____
Nationality: _____ (If Filipino, specify ethnic group): _____
Main Occupation / Profession: _____ Total Monthly Income (P): _____
Occupational Affiliation: _____
Amount allotted for vacation and similar activities per year per individual (P): _____

II. Tourism Preferences, Practices, and Standard Requirements

1. Manner of visit: [ ] Individual/single [ ] Group (please specify number: _____)
2. What are the activities preferred by the visitors in going to the area and how much is the area required to make the activity satisfying?

Activity	Rank (1,2,3)	Reason Preferred	How long do you spend doing each activity in a day (hour)	Standard Size Requirement (square meter)
Swimming				
Camping				
Trekking				
Picnicking				
Sight seeing				
Falls				
Cave				
Others, specify				

3. Will you come back here to the area?
   Yes, when? _____
   No, why? _____

4. Are you willing to pay certain amount to make your visit more satisfying?
   Yes, How much? _____
   No, Why? _____

5. How do you assess the facilities, equipment and services in (name of tourism destination) (please check)? Any other facilities needed/preferred (please enumerate).

Facilities/equipment/services	Excellent	Adequate	Poor	Needs Improvement	Remarks
Cottages					
Communication					
Comfort Rooms					

Facilities/equipment/services	Excellent	Adequate	Poor	Needs Improvement	Remarks
Tour Guides					
Life Guards					
Parking Area					
Access Road					
Others (please specify)					
Cottages					
Others, specify					

Limiting Factors

1. How do the following and other factors affect or limit your use of the preferred activity?

Existing Facilities	No.	Required Facilities	No.	Existing Services	No.	Required Services	No.	Limiting Factor in the Use of Facility/Service
Cottages				Tour Guides				Crowded, etc.
Parking Area				Life Guards				Limited, etc.
Access Road								Low maintenance, etc.
Canteen								Crowded, etc.
Tents								Limited, etc.
								Scarce, expensive fare, etc.

2. Is the activity/attraction gender suitable and satisfying? Encircle Yes or No and state the reason of your choice.

Gender Suitability				Satisfying		Reason/s if satisfied or not
Male	Female	Youth	Seniors			
				Yes		
					No	

3. Limiting factors of tourist activity/attraction

Activity/Attraction	Limiting Factors per Activity/Attraction	Hours/day	Days/month
Swimming	Typhoon		
	Heavy rains		
	Intense sunlight		
Picnicking	Closed facility/area for maintenance		
	Spawning/breeding season		
	Etc.		
Trekking			

4. How do you find your visit to the area? [ ] Highly satisfying [ ] Moderately satisfying

[ ] Poor [ ] Frustrating

5. What can you recommend to make your visit enjoyable and satisfying in terms of the available facilities, services inside the area, tour guide, security, etc. In the area?

_____

_____

6. How do you find the fees collected? [ ] Expensive [ ] Fair and compensating [ ] Cheap

Note: If expensive or cheap, how much do you think is the reasonable entrance fee? _____

7. How many times have you visited (name of tourism destination)? _____

8. Will you recommend this place to your friends? [ ] Yes [ ] No

III. Others

1. What are the problems that you encountered in the area and what solutions can you recommend to address them?

Problems	Proposed Solutions

Annex F. Survey Instrument for Carrying Capacity Determination of Beach Resorts/Hotels and Solid Disposal and Ecological Waste Management Practices.

I. Demographic information

Name of owner _____Sex _____ Age_____Religion _____
Educational attainment_____Civil status_____
Household size (including the respondent) _____
Settlement and Migration history
Nature of settlement [ ] Born-resident [ ] Migrant
Place of origin _____ Place of birth_____
Ethnic group _____ Length of stay in the area_____
Access to the area
[ ] Place of birth [ ] Seek employment
[ ] Parental migration [ ] Access to land
[ ] Invitation from relatives friends [ ] Association through marriage
[ ] Others, specify_____
Settlement plan
[ ] Permanent stay
[ ] Place of birth [ ] Employment
[ ] Conducive environment [ ] Acquisition of property
[ ] No place to go [ ] Place attachment
[ ] Access to land [ ] Others, specify_____
[ ] Transfer of residence, explain_____

Name of resort _____ Date established _____ Floor area _____

Beach Resort Facilities
1. Number of bedrooms
a. Fan _____
Room rate _____,Capacity_____
b. Air conditioned _____
Room rate _____,Capacity_____
2. Number of comfort rooms _____
3. Number of function halls _____ Capacity _____
4. Number of cottages _____ Capacity _____
5. Room rates for cottages_____
6. Number of staff assigned _____
7. Number of cooks assigned _____
8. Building materials [ ] Nipa/Cogon [ ] Wood/Bamboo with GI roof
[ ] Concrete [ ] Combination of concrete and wood with GI roof
[ ] Others, specify_____

II. Solid Waste Generation and Disposal

1. What type of waste are you generating?
2. How many kilograms of waste do you usually generate per week?
3. What are your means of disposal? Plastics - recycling, re-using, burning, throw anywhere
Papers - recycling, burning, throw anywhere
Food waste – feed in animals, composting, throw away
Yard waste – composting, burning
Hazardous/special waste – stored/kept, buried in soil, throw away

TYPE	AMOUNT	MEANS OF DISPOSAL
( ) Plastics		
( ) Papers		
( ) Food waste		
( ) Yard waste		
( ) Hazardous/Special waste		

III. Knowledge regarding Solid Waste Management

1. Do you practice waste reduction at source?
( ) Yes ( ) No
If yes, how? _____

2. Do you practice waste segregation at source?
( ) Yes ( ) No
If yes, how? _____

3. What type of storage facility do you used?
( ) Open pit. ( ) Garbage bin w/ label (bio/non-bio, & residuals)
( ) Garbage bag. ( ) Sack
( ) None

4. Have you heard of R.A. 9003 or Ecological Solid Waste Management Act of 2000?
( ) Yes ( ) No
If yes, where and how? _____

5. Does your community have Materials Recovery Facilities (MRFs)?
( ) Yes ( ) No
If yes, where? _____

6. Does improper solid waste removal and disposal affects the environment?
( ) Yes ( ) No

7. Does production of more wastes harm the environment?
( ) Yes ( ) No

8. Does your community have a common disposal site?
( ) Yes ( ) No
If yes, do you bring your solid waste to this common disposal site?
( ) Yes ( ) No
If no, why? _____

9. Who is in-charge of solid waste disposal?
( ) Men ( ) Women

IV. Attitudes regarding Disposal of Solid Waste

Question	YES	NO
1. Do you feel that street should be clean and clear of litters?		
2. Are you concerned about disposal of household solid waste? If yes, why?		
3. Are you and your staff members willing to carry waste to collecting point?		
4. Do you think you play an important role in solid waste disposal? If yes, why?		
5. Does the community play an important role in solid waste disposal?		
6. Should solid waste disposal be taught in school as part of environmental education?		
7. Should correct waste disposal methods be taught to the community?		
8. Do you want to use less of disposable item and more of reusable items to reduce waste generation?		
9. Do you feel that less waste should be generated by household to preserve the environment?		
10. Do you think that proper solid waste removal and disposal is important? If yes, why?		

V. Awareness on Wastewater

1. Which kind of wastewater system do you have?
   ( ) Cesspool. ( ) Community system
   ( ) Septic tank. ( ) Central sewer system
   ( ) Do not know/not sure

2. Do you know where is your wastewater system located?
   ( ) Yes ( ) No
   If yes, where? _____

3. How often do you need to have your cesspool or septic tank pumped out?
   ( ) Less than 3 years. ( ) 6-10 years
   ( ) 4-5 years. ( ) Greater than 10 years
   ( ) Do not know/not sure

4. What is the primary source of your water?
   ( ) Stream/Spring ( ) Local water utility (LOWA)
   ( ) Water pump ( ) Deep well
   ( ) Open tank (Sahodulan) ( ) Others, specify _____

5. Where do you dispose your kitchen and laundry waste water?
   ( ) River/sea
   ( ) Land
6. What is your average daily water usage?
   _____ gal/day sewer

7. Do you have rain water catchment basin?
   ( ) Yes ( ) No

8. Do you practice waste water recycling?
   ( ) Yes ( ) No

9. Are you aware of R.A 9275 or the Philippine Clean Water Act of 2004?
   ( ) Yes ( ) No
10. Do you have on ECC ? Yes ___ No ___ , Violations? ____

Annex G. *Survey Instrument for Carrying Capacity Determination for Key Informants.*

Interview: _____ Date of Interview: _____
Name of the Respondent: _____ Address: _____
E-mail Address: _____

Respondent's Profile

1. Age (yrs) : _____
2. Educational Attainment: _____
3. Household Type: [ ] Nuclear [ ] Extended
4. Sex: _____
5. Civil Status: _____

General Information

1. Name of Tourism destination
   _____
2. Total Area of the Tourism destination (ha)
   _____
3. What are the tourist attractions/activities and describe each in terms of area/size covered (ha), available facilities and number, payment for the use of facilities, number of hours spent, other related fees, and limitations required on their use.

Attraction/Activities (i.e. camping, swimming, picnicking, etc.)	No. of hours open for tourists	No. of hours spent per tourist	Fees and related costs	Ideal area required/tourist (m^2)	Total area for each activity/attraction (m^2)
Swimming					
Picnicking					
Trekking					
Camping					
Others (please specify)					

4. Among the different tourist attractions/activities, what are the three (3) most popular? And why?

Attraction/Activity (e.g. camping, boating, swimming, trekking, etc.)	Reason/s
1.	
2.	
3.	
4.	
5.	

5. How much area (ha) in each tourism attraction/activity is necessary to make the visit of a tourist or a group of tourists satisfactory and enjoyable? How many per group of tourists? How many hours in a ay these facilities are open for use by the tourists?

Attraction/Activity (e.g. camping, swimming, trekking, etc.)	Area Necessary (ha)/Standards		
	Per tourist/visitor	Per group of tourists/visitors	How many per group?

Limiting Factors

1. Enumerate all possible significant factors that may affect tourist/visitor's activities in the area and explain how they pose limitation.

Existing Facilities	No.	Required Facilities	No.	Existing Services	No.	Required Services	No.	Limiting Factor in the Use of Facility/Service
Cottages				Tour Guides				Crowded, etc.
Parking Area				Life Guards				Limited, etc.
Access Road								Low maintenance, etc.
Canteen								Crowded, etc.
Tents								Limited, etc.
Transportation								Scarce, expensive fare, etc.

2. Is the activity/attraction gender suitable and satisfying? Encircle Yes or No and state the reason of your choice.

Gender Suitability				Satisfying		Reason/s if satisfied or not
Male	Female	Youth	Seniors			
				Yes		
					No	

3. Limiting factors of tourist activity/attraction

Activity/Attraction	Limiting Factors per Activity/Attraction	Hours/day	Days/month
Swimming	Typhoon		
	Heavy rains		
	Intense sunlight		
Picnicking	Closed facility/area for maintenance		
	Spawning/breeding season		
	Etc.		
Trekking			

4. What problems are encountered in the tourism destination and what solutions could be recommended to address them?

Problems Encountered	Recommended Solutions

5. What can you contribute to improve the PA and the ecotourism in the area?

_____
_____

6. In general, what suggestion or recommendation can you give to improve the carrying capacity of the area?

_____
_____

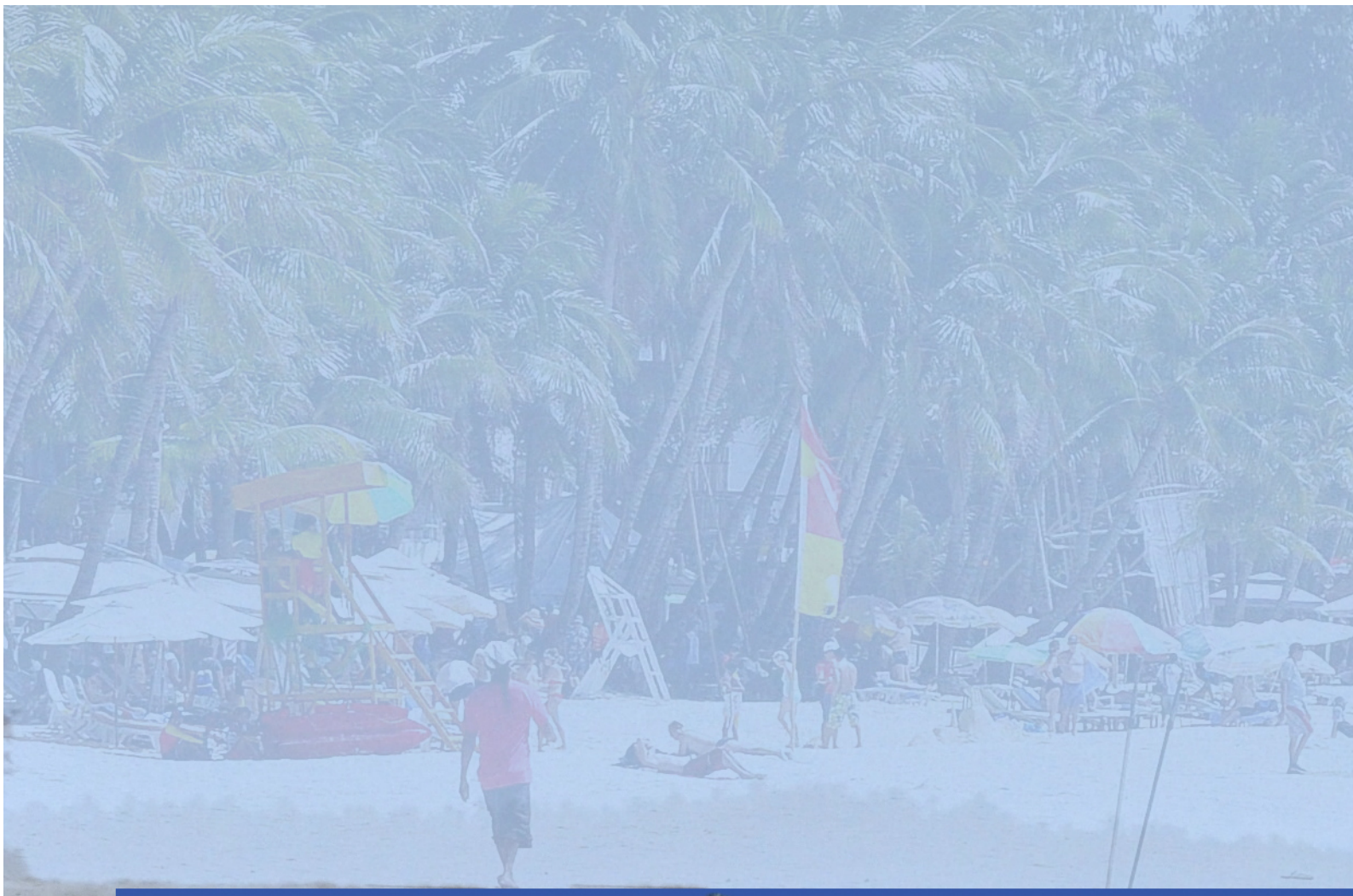
Annex H. *Summary of Carrying Capacity Assessment activities and unit of work measure and targets.*

Activity	Unit of Work measure	Target
A. Preparatory CARCAP Activities		
1. Team Mobilization (coordination and consultation	number meetings with stakeholders	1 per stakeholder
2. Initial Site Inspection/ identification of tourism activities/secondary data collection	number of site visits	at least 2 visits
3. Capability Building	number of meetings	1
B. CARCAP Field Activities		
1. Survey and mapping	number of hectares	all sites covered by tourism activity including impact areas
2. Engagement of professional services	per component of the carcap activity	
3. Biodiversity Assessment	per site	
-Flora and fauna		
-Cave assessment (if present)		
-Wetlands assessment (if present)		
-Coastal/marine assessment		
4. Population/Social Carrying Capacity		
- household survey/interview	number of respondents	relative to existing population
- Key informant interview	number of respondents	relative to number key informants
- Focused Group Discussion	municipal/barangay meeting	at least 2 meetings
5. Tourist Carrying Capacity		
- Tourists/visitors interview	number of respondents	relative to the number of tourists in the last 2 to year years or using 385 respondents if population is not known
6. Physical Carrying Capacity		
- tourist accommodation and other auxiliary facilities	number of hotels and auxiliary facilities	primary data and actual assessment
-transport facilities and traffic condition	number of vehicles servicing the area	primary data and actual assessment
-Vulnerability Assessment /geohazard assessment	as needed	secondary data if available; otherwise primary data
- soil characteristics, air and water quality condition	analysis per site	secondary data if available; confirmatory test of soil analysis once and water quality, twice during the assessment period
C. Staff engagement	per component of the carcap activity; number of enumerators to facilitate surveys; data analysis and interpretation	Job orders for the duration of the carcap assessment as needed

Annex I. *Cost estimates in the conduct of Carrying Capacity determination (per site).*

Activity	Unit Cost (Php)	Unit of Work Measure	Target	Total cost
A. Preparatory CARCAP Activities				
1. Team Mobilization for scoping, coordination and consultation and initial site inspection (Multidisciplinary team of 6 to 7 experts)	100,000.00	no of consultations/ meetings per site	3	300,000.00
2. Capability Building/ levelling off with local counterparts/stakeholders	250,000.00	per site	1	250,000.00
Sub-total				**550,000.00**
B. CARCAP Field Activities				
1. Survey and mapping (by land use and by ecotourism activity - ecotourism sites and impact areas)	1000	per hectare	100	100,000.00
2. survey /validation of existing infrastructure and facilities (lodging areas, hotels and other places relevant to ecotourism in the area where people conglomerate)	30,000.00	per site	1	30,000.00
3. Bio-physical Characterization/ Biodiversity Assessment (includes water quality, soil physico-chemical properties, agricultural practices, if any.				
a. Flora and fauna	1,000.00	per hectare	100	100,000.00
b. Other features of geologic interest such as caves, cliffs and other land forms used for tourism activity	1,000.00	per hectare	50	50,000.00
c. Wetlands assessment	1,000.00	per hectare	50	50,000.00
d. Coastal/marine assessment	2,000.00	per hectare	40	80,000.00
4. Socio-economic Survey				
a. household survey/interview	200	per respondent	100	20,000.00
b. Key informant interview	200	per respondent	10	2,000.00
c. Focused Group Discussion	20,000.00	barangay meeting	2	40,000.00
d. Tourists/visitors interview (peak and off-peak period	200	per respondent	1000	200,000.00
5. Vulnerability/Geohazard Assessment				
- Conduct of Vulnerability Assessment	350,000.00	per project site	1	350,000.00
6. Professional Supervision by experts	50,000.00	per professional	7	350,000.00

7. Laboratory services (soil and water analysis)	80,000.00	per site	1	80,000.00
8. Professional/Laboratory Services for taxonomic ID of specimens;	1000	per specimen	50	50,000.00
Sub-total of CARCAP activities				**1,502,000.00**
C. Equipment/supplies (mist nets, animal traps, laboratory chemicals, water quality calibrating solutions, diving gears, oxygen tanks, etc.)				
a. Flora and fauna	40,000.00	per set	3	120,000.00
b. Cave assessment (geologic)	40,000.00	per set	4	160,000.00
c. Wetlands assessment	30,000.00	per set	3	90,000.00
d. Coastal/marine assessment	60,000.00	per set	2	120,000.00
Sub-total of Procurement of Equipment				**490,000.00**
D. Other Activities				
1. Data processing and analysis	100,000.00	per site	1	100,000.00
2. Report Writing	100,000.00	per site	1	100,000.00
3. Preparation of IEC Materials	1,000.00	no of copies	200	200,000.00
4. Consultation of the carrying capacity model obtained from the study (NGOs and tourism operators, NGAs and Community	150,000.00	no of consultations	4	600,000.00
Sub-total				1,000,000.00
E. Over-all cost of activities				3,542,000.00
F. Over-all Project Management and Supervision (10% of over-all cost of activities)				354,200.00
G. Contingency (10% of over-all cost of activities)				353,700.00
TOTAL COST PER SITE (J +K+L)				**4,249,900.00**



Hinagdanan Cave,
Dauis, Bohol

Enchanted River,
Hinatuan, Surigao del Sur