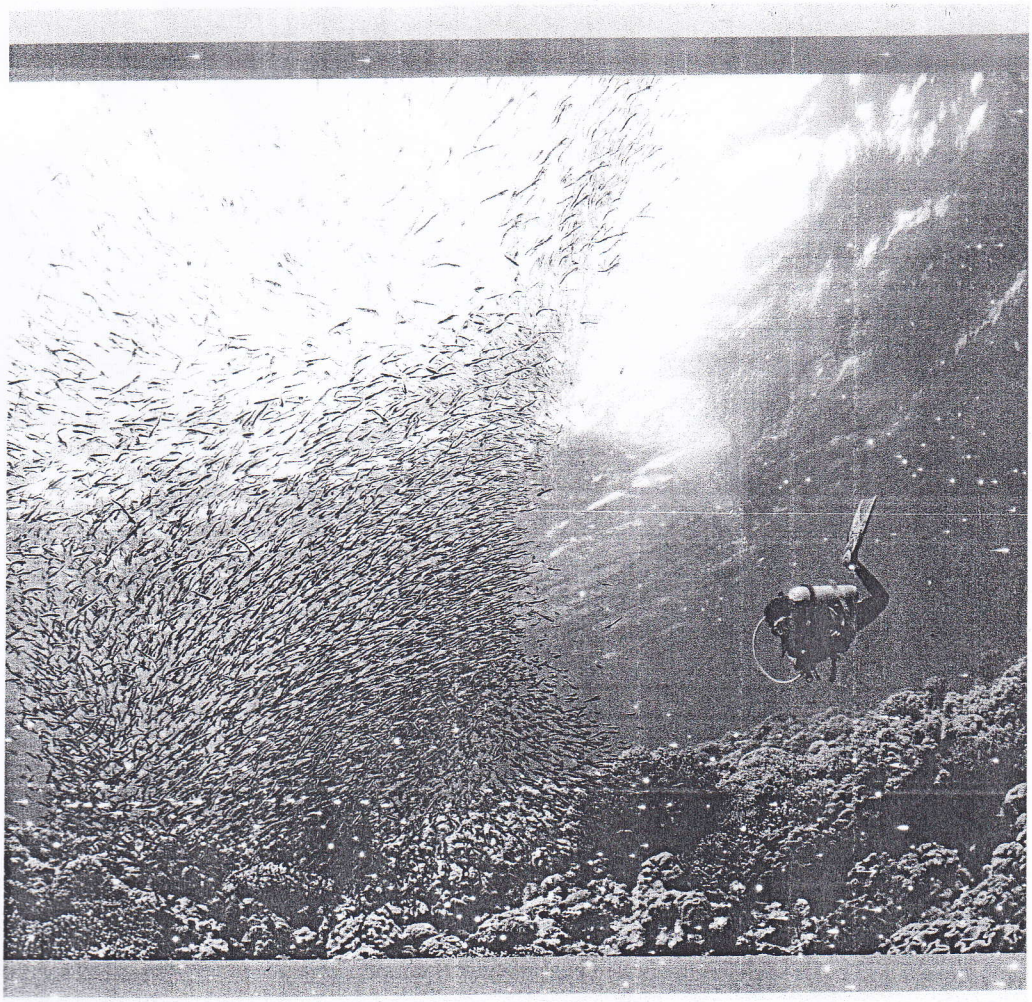

ECOTOURISM
and
SUSTAINABLE TOURISM DEVELOPMENT IN INDONESIA
Potentials, Lessons and Best Practices

ECOLOGICAL AND PSYCHOLOGICAL CARRYING CAPACITY OF ECOTOURISM ACTIVITIES

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INTRODUCTION

Ecotourism Carrying Capacity. In the year 2007, ecotourism contributed 7% from the total of international tourism expenses (Stanford University 2013: 1; The International Ecotourism Society/IES 2000: 1). United Nation Environment Program (UNEP 2011: 420) predicted that the economy contribution from ecotourism to the total global tourism expenses will increase approximately 20% each year, about six times of other industries total expenses growth. Higher number of prediction was issued by Travel Weekly with 25% growth trend of the global market in the year 2012; with 473,000,000 USD per year (Stanford University 2013: 1).

The development of ecotourism is not only supported by the economic benefits, as stated by The National Ecotourism Strategy (NES) – which are: (a) provides employment; (b) increases the economy level of local community; (c) increases the length of stay of the tourists in destination areas; (d) develops district's infrastructure; (e) provides income for other natural conservation; and finally (f) increases national income (Beeton 1998: 7) – but also motivated by the awareness for conserving environment and the phenomena of global warming (Avenzora 2008; and Stanford University 2013: 1) which increased the demand of environmentally friendly activities;

as reported by UNEP (2011: 415), that more than 1/3 tourists prefer to d environmentally friendly tourism activities.

In many contexts, the terms ecotourism should not only be defines as tourisr activities in a natural, untouched, and remote destinations only, as describe by Page & Dowling (2002) and Ceballos-Lascurain (1996), but underline by avenzora (2008) also has to be understood as the soul and spirit of an tourism activities which is translated in the form of 7 main pillars – consists o (a) ecological pillar, (b) social-cultural pillar, (c) economy pillar, (d) experienc pillar, (e) satisfaction pillar, (f) memory pillar (g) educational pillar– to all are touched and accessed by the tourists to get optimal satisfaction in touring in the stage of planning, the journey to the destination, activities in th destination area, on the way back from the destination, and the recollectio stage (Avenzora 2013). The first three pillars are closely related to th continuing development paradigm, while the second three pillars are relate to the basic needs of the tourists. Educational pillar is the manifestatio of the high needs of having everyone's collective awareness (in cognitive affective, and motoric context) to consciously actualizing the developmen together.

Other than beside to synchronize the perception and orientation, a significant constraint in actualizing ecotourism is also in developing standarc of sustainable values in evaluating and controlling aspects (Weaver 2004) Evaluating and controlling standardization is difficult to develop since eacl destination has its own existing condition and different unique values whic will also need a site specific procedure for evaluating and controlling.

One of the procedure which considered and discussed globally to be important on implemented in maintaining the sustainability of ecotourism is the ecotourism carrying capacity. Some parties have agreed to interpret ecotourism carrying capacity as a maximum number of tourists which an area can carry in one time, without causing physical, economy, and social cultural destruction and the decrease of tourists' satisfaction level. (Clivaz *et al.* 2004; Inskeep 1991 in Liu 1994), however, by implementation, many people still trying hard to discover "the best way" to measure and determine the carrying capacity in a valid, trustworthy, and logical way.

A site specific and dynamic carrying capacity rely on the ecological condition of the site, which is directly influenced by the type of activities conducted, the intensity of activities, user characteristics, timing and time distribution (during low visits, condensed visits, and high visits); also the condition of the environment where the activities take place (Cooper *et al.* 1998; Pigram & Jenkins 1999; Seidl & Tisdell 1999). Soemarwoto (2004) emphasizes the importance of determining the destination's capacity in accepting tourists

and measure it "per space unit" and "per time unit". The unit determination is based on the distribution of tourists who can form groups in certain areas and also seasonality characteristic of tourism. While Avenzora (2008a) explains that besides space and time specific, the determination of carrying capacity unit value is also specific according to the type of activities.

For those reasons, the approach for measuring tourism carrying capacity in one tourism site, can be different with other site, especially if the sites have different characteristics. Carrying capacity measurement needs to consider ecological aspect, which is directly influenced by tourism activities: the type and intensity of the activity, and user's characteristics in each visit's condition. Visit's condition defined as differences during low visits, condensed visit, and high visits. Using that approach, the measurement is expected to be accurate. Any measurement done without considering those aspects can be interpreted as carrying capacity measurement which contradict the idea of specific and dynamic carrying capacity (in other word: might say not valid).

Carrying capacity measurement studies. There are many studies on carrying capacity measurement have been done, inside this Indonesia and in other Countries. However, most of them still make the same mistake of simplifying aspects to make an easy measurement technique, and also trapped in scientific ego. Even though the researchers have realized site specific characteristic of carrying capacity, the studies done in fact are still used general assumptions, particularly on the number of spaces used per person for different activities characteristics. Those studies using general space needs should be doubt as logical, valid, and trustworthy discoveries to be implemented. In order to follow the development and accomplishments in the carrying capacity studies, there are some advantages to analyze some results of studies done by researchers from different backgrounds with different approaches. With no attention to discredit some researches- but to gain comprehensive understanding– there are some results well enough to be considered.

Analysis on compatibility and carrying capacity of nautical tourism area in Polewali Mandar district. This study was reported by Bahar and Tambaru (2011). The study begins with analyzing land compatibility by using compatibility scoring method for several beach activities. Physical carrying capacity is calculated by dividing total area width by ecological potential defined by (2007). The formula used is:

$$ACC = E \times \frac{Wa}{Wu} \times \frac{Td}{Ta}$$

Notes:

ACC = area's carrying capacity

E = ecological potential (person), refer to ecological potential table by Yulianda

W_a = area's width/length can be utilized

W_u = unit's width needed for certain category per tourist

T_d = time provided by the area for tourism activity in one day

Ta = time spent by tourists for certain activity

In this study, tourism carrying capacity is measured by the physical conditior of the site with land's width correction factor for accommodation, freshwatei availability, and season changes. By analyzing the method and the results there may have been over estimation of the carrying capacity's value, as result of calculating carrying capacity per activity without considering the chance of overlapping use of spaces when there are more than one activity done at the same time and place. The most crucial thing in this study is that there are no unit for carrying capacity value, whether it is number of tourists/ day or number of tourists/year. Study results showed that there are three identified beach activities, which are: beach recreation carrying capacity (width: 385 ha for 154,000 tourists), snorkeling carrying capacity (width: 1,804 ha for 60.160 tourists), and fishing carrying capacity (width: 1,741 ha for 1.044.600 tourists). By analyzing this Bahar and Tambaru study (2011), at least it can be concluded that the process of determining carrying capacity is still in the static system framework and is still not final.

Analysis on tourism carrying capacity in natural park of Grojogan Sewu, Karanganyar district. This analysis is reported by Siswantoro (2012). In this study, carrying capacity is measured by Cifuentes formula, recommended by IUCN. The correction factors for biotic diversity are vegetation diversity (0.34) and bird's diversity is (0.8). While the correction factors for abiotic diversity is landscape potential (0.37), slope (0.5), tyoe of soil regarding erotion sensitivity (0.4), and wet/dry month ratio (0.57). Formula used is:

$$PCC = A \times \frac{V}{a} \times Rf$$

Notes:

PCC = Physical Carrying Capacity

A = effective area width for general utilization; which is total width minus building width, trees and bushes area width and total trees' trunks circumferences.

V/a = area needed for one person per m^2.

Rf = Rotation factor, which is a number of daily allowed visits to a location.

$$RCC = PCC \times \frac{100\text{-}Cf_1}{100} \times \frac{100\text{-}Cf_2}{100} \times \ldots \times \frac{100\text{-}Cf_n}{100}$$

$$Cf = \frac{M_L}{M_T} \times 100\%$$

Notes:

RCC = real carrying capacity

Cf = correction factor

M_L = limited variable measurement

M_T = total variable measurement

$$ECC = RCC \times MC$$

$$MC = \frac{\text{Available staff's capacity}}{\text{Ideal staff's capacity}} \times 100\%$$

Notes:

ECC = Effective carrying capacity

MC = Management capacity

In this study, area needed for one person used Fandeli & Muhamad assumption, which is 65 m^2/person for picnic activity. The result of physical carrying capacity on a 20.3 ha land area is 8.849 tourists/day, real carrying capacity 1.138 tourists/day, and effective carrying capacity is 1.002 tourists/day. Based on the results, there are several conclusions:

- The assumption of area needed per person is not accurate, and as a result, the value is irrational. The researchers (Fandeli and Muhammad who cited the number from Douglass) probably did not realize and understand that "space requirement number" of 65 m^2/person is actually not a number that describes "space utilization number" which is needed

to calculate the carrying capacity, but a "space requirement number" fc planning a picnic recreation site. "Space utilization number" is differer from "space requirement number." Within "space requirement numbe total requirement of spaces has already been calculated –from ticketin and parking in front area to the other parts of the site that are predicte to be accessed by visitors (such as pathways and toilets)– which will b used by a visitor to reach optimal satisfaction in recreation activity o planned site. In planning process, this number is usually calculated b ergonomic approach, visitor's behavior, and scenario and developmen concept planned. While "space utilization number" describes a certai area width factually used by a visitor to gain his/her recreation satisfactio in a certain site and in a certain condition. The real difference betwee these numbers is rarely known and understood by researchers, especiall those who do not formally fathom tourism planning field.

- The use of wet and dry month ration in this study is also considere inapplicable. In ecology context, it is necessary to recognize wet and dr month as one of important variable in analyzing ecological condition however, the implementation in determining carrying capacity needs tc be done correctly. In line with the determination of carrying capacity ir this study, which is in tourists/day unit, the use of this variable becam excessive correction; unless if the carrying capacity is determined b tourists/year unit. Further, the existence of wet month is in fact ha no influence is tourism carrying capacity/day; unless if the activitie measured is a water tourism, which is affected by the availability of wate influenced by wet/dry month. Psychologically, during wet month or rain season, the tourists usually reluctant to visit an open space destination. In brief, the existence of wet month is like a "restoration-period" in the dynamics of carrying capacity.

Analysis on compatibility and carrying capacity of mangrove ecosystem for developing ecotourism in islands of Tanakeke, Takalar district, South Sulawesi. Bahar's study (2004) started by identifying mangrove potential and analysis on compatibility of ecosystem referred to the standard of mangrove ecosystem compatibility by Murni (2000; in Bengen DG. 2002). Next, analysis on carrying capacity was done by using Yahya's space utilization (1985; in Bengen 2002) and Boullion formula (1985; in Bengen DG, 2002):

$$\text{Area Carrying Capacity} = \frac{\text{Area used by tourists}}{\text{standard of average individual space used}}$$

According to the methods used and the results provided, it can be concluded that this research has not consider the visit rotation factor or tourists' length of visit and the length of object operational time, but has calculated possible activities overlay in one time. In this study, the tourism carrying capacity of a 1,553.64 ha is only 269 tourists/day. It is reasonable that the management raised questions to show their objection on that very small number of carrying capacity. Based on the method used, the weakness of this study is in simplifying calculation of space utilization which is fragmented to provide facilities, such as bird watching towers, board ways, and interpretation spots; and not based on total area of the site. There are 13 bird watching towers with the size of 25 m^2 which can carry 39 tourists for bird watching, sightseeing, and take pictures. 2,200 m^2 board way facility which can carry 220 tourists for walking and take photographs. And there are 2 interpretation spots with the size of 100 m^2 which can carry 10 tourists. In this study, the correction factors which influenced tourism activity in mangrove ecosystem were not being analyzed.

Analysis on compatibility and tourism carrying capacity of Hari Island, Kecamatan Laonti, Konawe District, Southern Southeast Sulawesi Province. A study done by Ketjulan (2010), determining carrying capacity by using method and tourism compatibility scoring proposed by Yulianda (2007). Assumption of space requirement used is 500 m^2/tourist for snorkeling and 1000m^2/tourist for diving. Core zone width proposed is an area of 24.65 ha, which can carry 472 tourists/trip for diving and 513 tourists/trip for snorkeling. Besides the indescribable rotation effect factor in the carrying capacity, this study also failed to analyze correction factors which influenced the tourism activities in the beach/sea ecosystem. Other than that, the assumption of 500m^2/person space requirement or 1000 m^2/person space requirement also needs correction; the unit did not describes "space requirement" but actually describes "space accessed".

Physical Carrying Capacity of Ecotourism in Sibolangit Natural Park, Deli Serdang District. In this study, Khair (2006) determined carrying capacity by using Cifuentes formula, focused on studying trail track carrying capacity and parking lot capacity. Space utilized assumption is 1 m^2/ person for trail track, and 5 m^2/ car unit for parking lot. Correction factor for the parking lot is rainfall (34.12%), sunshine (42.14%), and wind velocity (26.84%). While correction factor on trail track location is rainfall (37.9%), wind velocity (26.84%), and wild animal disturbance (66.6%). The results of this study showed carrying capacity of a 1,500 m^2 parking lot is 751 persons and 1,200 cars/day. The 1,700 m trail track has effective carrying capacity of 87 persons/day.

The use of rainfall, sunshine, and wind speed were unusual to be imple-

mented for determination of parking lot's carrying capacity. Besides, based on the explanation above, rainy season is actually a "restoration-period" in the dynamics of carrying capacity. The results of this study is also unusual, with capacity of 1,200 cars unit/day, it is unlikely if the number of tourists' carrying capacity is only 838 tourists/day.

Small Island Resource Management for Nautical Ecotourism Based on Compatibility and Carrying Capacity- Study in Matakus Island, West-Southeast Maluku District, Maluku Province. This Solarbesain's study (2009) is also referred to Yulianda method. The study begun with land's compatibility analysis, and followed by carrying capacity calculation. In the compatibility analysis, beach recreation subzone (5,738 m) has been identified to have carrying capacity of 230 tourists/day, diving subzone (33.58 ha) has carrying capacity of 2.686 tourists/day, and water subzone (760.76 ha) has carrying capacity of 30.430 tourists/day. Next step was conducting ecological footprint analysis (carrying capacity concept which observe the level of community's consumption) and bio-capacity (tourism activity's food procurement), calculated by this formula:

$$\text{Ecology Footprint(ha/person)} = \frac{\text{consumption of tourism component products (kg/person)}}{\text{total components of local productivity}}$$

$$\text{Tourism Biocapacity} = \text{landcover width (ha)} \times \text{landcover factors yields}$$

Analysis showed the result for tourism footsteps is 6,579 m^2/year/tourist and the bio capacity is 31.43 ha/tourist. Carrying capacity value in this study is a calculated by dividing bio capacity by footsteps ecology, which is 47.7 years. With that result, there are too many things difficult to be explain and the validity and rationality is unreliable.

Ecotourism Model of Mangrove Forest Based on Physical Carrying Capacity of the Area and Ecological Resilience. This research conducted by Muhammad (2012) also used Cifuentes methods. Space requirement is referred to Douglass's space requirement. Correction factors used in this study are rainfall (56.7%), water area quality (55.7%), and seasonal flood (56.9%). While ECC used management capacity as correction factor (56.8%). As a result of this study, tourism effective carrying capacity for a 5 ha area is 825 tourists/day. Ecological capacity is then calculated by this formula:

$$\text{Carrying capacity} = \frac{D}{AR}$$

$$AR = \frac{D \times A}{CD \times TF \times 43{,}560}$$

Notes:

AR = area needed for a tourism activity

D = tourism demand for certain activity

A = area needed for one tourist

CD = total number of days used for certain activity (in 1 year)

TF = selection factor

Calculation result for carrying capacity for boating (26.9 ha) is 106 tourists/ha/day, camping (27.26 ha) is 174 tourists/ha/day, and picnic (13.12 ha) is 530 tourists/ha/day. By observing the results of these studies, it is clear how much loss a researcher will suffer if he/she does not know and understand the origin of a formula written in a reference book (including Douglass formula which is used in this research). As mentioned in the previous part, every researcher needs to realize the difference between "space requirement number" and "space utilization number." For Douglass formula used in this research, one thing that needs to be recognize is: "why in the formula, Douglass used coefficient 43,560 as denominator and where did it come from." If the origin of that number is understood, it is easy to understand that the formula was meant by Douglass to determine "space requirement number" and not "space utilization number."

Carrying capacity in the tourism industry: a case study of Hengistbury Head. Simon, Narangajavana, and Marques (2004) in this journal proposed an idea to determine and apply carrying capacity concept in regional tourism planning. The method used is content analysis method, done by interviewing key persons of regional tourism. In calculating carrying capacity, Simon et al. (2004) proposed to use Limit of Acceptable Change (LAC) method. He said that indicator used in calculating LAC should be environmental indicators (site width, garbage size, level of noise, water quality, sedimentation level, number of tourists) and recreation indicators (destination income, sharing cost of employee's salary for tourism, tourists' level of satisfaction,

level of comfort, number of complaints, number of complaints being handled). Those data will be gathered through a questionnaire, which will be asked only to the key persons.

Based on the observation of the methods and results of this study, it can be concluded that this study is only able to determine the psychological carrying capacity; and did not consider any ecological correction factors of the site and the real utilization of the site. Another weakness is that this study did not consider individual perception theory which can be influenced by many things, such as their personal experiences, and as well as time and place where the perception is being made.

Recreation Carrying Capacity Estimates for Protected Areas: A Study of Termessos National Park. This research on carrying capacity done by Sayan and Atik (2011) also used Cifuentes formula with assumption of space requirement of 1 m^2/tourist. Correction factors used are sunshine (37.5%), rain (7%), storm (3%), erosion (68.5%), and accessibility (42%), and wildlife disturbance (25%). While effective carrying capacity correction factors is management capacity (0.27). As result of this study, the carrying capacity of 3,136 m trail is calculated as 97 tourists/day. Therefore, we can learn another mistake; especially on how significant the effect of not counting Turn over factor as an important variable in calculating a carrying capacity.

Recreation carrying capacity estimations to support beach management at Praia de Faro, Portugal. This study, conducted by Zacarias, Williams, Newton (2011), described two type of carrying capacity, which are physical-ecological carrying capacity and social-cultural carrying capacity. Calculation of physical-ecological carrying capacity used Cifuentes method and the tourist's space requirement referred to Sole's assumption. Correction factors used are rainy days (67.12%), wind speed (66.58%), sunshine (34.25%), level of beach erosion (96.6%), and temporary closure factor (33.42%). This study showed that physical-ecological carrying capacity from an area of 90.000 m^2 is 4,473 tourists/day.

For social and cultural carrying capacity analysis, the researchers analyzed perception, motivation, satisfaction, and aspiration of the tourists. In this study, the result of social and cultural analysis described in tourists satisfaction level: 77% satisfied, 15% not satisfied, and 9% abstain. With that result, at least we can say that this study is not finished in analyzing the relation between physical carrying capacity and social carrying capacity.

Establishing the social tourism carrying capacity for the tourist resorts of the east coast of the Republic of Cyprus. A study done by Saveriades (2000) has an objective of explaining carrying capacity concept and its important role as a management tool in tourism planning and development

process, and for calculating regional sociological capacity. Sociological capacity meant in this study is maximum utilization (in terms of number and activities) acceptable by the site without decreasing tourists' experience quality and without harming the society who live in the area.

Two components of social carrying capacity being analyzed are: visitor's experience quality and local community's tolerance level for tourists' presence. Data gathered are: people's perception regarding "experience quality" and "level of density that made the visitors seek for other destination." Unfortunately, the result of this study is only percentage of perceptions gained through a Likert scale method; therefore, the relation between experience qualities of the tourists with the community's tolerance level remains unexplained.

Tourism monitoring system based on the concept of carrying capacity – The case of the regional natural park Pfyn-Finges (Switzerland). Clivaz, Hausser dan Michelet (2004) explained that the existed carrying capacity calculation did not include 3 dimension of sustainability (ecological, economy, and social) and most of the methods determine carrying capacity based on the ecological dimension only. They say that before calculating ecological dimension, one must know the purposes of the research area (in this case is the objective of Pfyn-Finges tourism site existence), which are: social and cultural vitality, economy vitality, natural and landscape, information and education, and administration and policy.

Even though their writing enriched the knowledge to the reader, objective conclusion was that the normative view failed to torch many researchers who are looking for the best way and a perfection. In normative context, actually there are many people have accomplished "knowledge satisfaction," but very few of them really capable of delivering an efficient method to calculate carrying capacity which can be accepted by everyone.

Up to those experiences above considering the result of the studies mentioned above, and for the progress of future studies about carrying capacity, it is best to firmly state that there have been too many domino mistakes done by many party (by the students as junior academic and lecturer and researchers as senior academics). After a meticulous observation and contemplation, it appears that those mistakes (which was passed on from one author to another author) came from several crucial matter: (a) no formal education of the authors in tourism planning aspect; (b) the loss of curiousity and meticulousity of the authors in understanding the references; and (c) the lack of capability in analysing the origin of a formula and its application. The absence of formal education in tourism planning aspect is the reason why there are many authors only "know" a formula without having a good understanding on the topic nor master an origin and a formula application

technique. Many simplification done by those authors, strongly suggested a "reluctancy" psychology in building research methodology process took a place among researchers.

CASE STUDY: CARRYING CAPACITY IN BOGOR BOTANICAL GARDEN

Botanical garden is a plantation conservation area which has documented plantation collection and compiled based on taxonomycal classification, bioregion, themes, or combination of those patterns (Perpres no 93 year 2011). Besides conservation purpose, a botanical garden is also made for research, education, environmental service, and ecotourism (Darnaedi 2012).

A botanical garden is a potential ecotourism destination because of its high resource of recreation in perspective of plantation collection variation. Botanic Garden Conservation International (BGCI) estimated that the number of plantation collection all over the world is more than 90,000 species, with 12,000 endangered species number of plantation collection. (NABG 2006: 6). With green open space and those variation of plantation collection, botanical garden became a very potential object of urban natural recreation. The tourism potential can be seen by the number of tourists, which reached ± 6 million people every year in 130 botanical garden all over the world (Dood & Jones 2010: 1). North American Botanic Garden (NABG) was estimated to be visited by 70 million tourists every year (NABG 2006: 3).

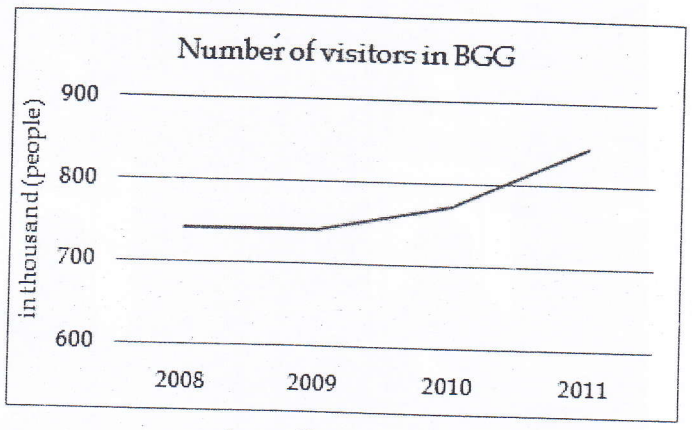
Picture 1. Bogor Botanical Garden as recreation resource of Bogor City

Courtesy : Special

Bogor Botanical Garden (BBG) is one of the oldest botanical garden in Indonesia. It was built in the year 1817. BBG is one of the main icons of Bogor City. Geographycally, BBG is located inbetween 106° 3' 30" - 106° 52' 00" Northern Latitudes and 6° 30' 30" - 6° 41' 00" Southern Latitudes (Wijayanti 2009). BBG is located at 260 m above the sea level. Its rainfall is between 3,000 – 4,300 mm per year (Apriyanti 2011: 17) with a cool daily temperature and high humidity. Since its establishment, BBG has been able to functioned as tropical botanical garden: for plantation collection purpose, research, and also for fulfilling the need for green open space in Bogor City which can be used as community's recreation park.

Nowadays, the community has realized the important value of BBG. Right now, BBG is estimated to have collected more than 14,499 plantation speciments (KRB – LIPI 2010). Besides its function as a plantation conservation area and ameliorating the climate of Bogor City, BBG also has a role of tourism destination for the community. There are only a few green open space within Jakarta-Bogor-Depok-Tanggerang and Bekasi (JABODETABEK) area, which makes BBG very popular for tourists; and BBG is nationally known. Visits to BBG showed an increasing trend every year with its peak on weekends (Picture 2). The increase showed a positive value for financial provit, which also indicates an income increase of the management and nearby community who rely on the recreation and ecotourism activities in BBG. However, if the number of visitors exceeds the capacity limit, this would pose a threat for the plantation conservation as well as for the tourist's satisfaction.

Picture 2. Number of tourist's visits in BBG in four years (2008-2011)



Source: BBG – LIPI (2010)

The increase of public interest to spend time for recreation in BBG must be balanced with the needs of space utilization effectivity which has to accomodate specific challenge of BBG's natural condition. The increase of public interest has potential effect of creating more density. The number of visitors which exceeds the carrying capacity will give pressure to ecological aspects of the site. Moreover, intolerable number of visitors may cause a decrease of tourist's satisfaction level (Cooper *et al.* 1998). Number of tourist's visits must be harmonized with the principal of ecotourism sustainability, it is necessary to do a research on ecological and psychological carrying capacity of ecoturism in BBG. Carrying capacity research must be conducted with consideration of the type of activities, utilization pattern, and the seasonal characteristic of tourism.

METHODOLOGY

Research in Bogor Botanical Garden (BBG) conducted on July-October 2012. The first step was identifying the most utilized locations in BBG, and using those locations as samples of the highest tourism activity. Identification result showed that the locations of the highest tourism activity in BBG are Gunting Pond area as well as Randu & Astrid area.

On each location, data on tourists and ecological conditions were collected. Tourists' data collection consisted of 3 activities: (1) observation of in and out pattern of the tourists, (2) observation of space utilization per tourism activity, and (3) delivering quetionnaire on tourist's satisfaction and motivation. Those three activities were conducted at the same time on three different type of visit day, which were low visit, condensed visit, and peak visit day and repeated three times during operational hours. During 1 day of obser-

vation and questionnaire deployment, recording process were devided into 4 time period, which are period I (08.00 – 10.00 am), period II (10.00 – 12.00 am), period III (12.00 – 14.00 am), and period IV (14.00 – 16.00 am). Day type categoryzation (low, condensed, and peak visits) was made for calculating seasonality aspects in tourism, while observation period categoryzation was made as an approach to determine number of visitors per time point per day type related.

Data collected were questions about motivation and satisfaction of the tourists in the form of a close ended questionnaire. The number of respondents recruited on each time period was 30 respondents. Therefore, the difference of satisfaction per day type per period can be seen. Questionnaire scoring system used the Likert Scale which was modified from 1 - 5 to 1 - 7 scale, considering the characteristic of Indonesian people who rarely choose extreme values (Avenzora 2008b).

Ecological data sampling was focused on ecological components which are directly influenced by tourism activities, which are: (1) physical condition of the site, represented by the physical quality of the ground soil and (2) biological condition of the site, represented by the macro characterisitcs of grass vegetation Ground soil physical quality and grass vegetation visual quality were observed because there were direct impact from the tourists' footsteps and they were easly observed. Potential disturbance towards the animals and vulnerable plantations were not calculated since there were no certain animal which is vulnerable to the impact of recreation activities and also because the management of BBG has applied a special procedure for plantation collection which is vulnerable towards human disturbance and micro climate changes, and therefore those vulnerable plantation has been protected from the impact of tourism activities.

Data collection of the soil and grass were conducted to 3 conditions of the soil: (a) condition-1, is the control condition, where the tourists have never step on this soil, (b) condition-2, is the soil condition with normal intensity of utilization, and (c) condition-3, is the soil condition with high intensity of utilization. Soil data collection included the water level of the soil (%) and soil penetration (Mega Pascal/MPa). While the visual grass quality taken is the height of grass and the number of grass in the sample plot sized 20x20 cm. Sampling of each soil condition were done 5 times.

Finally, regarding the impact of the management intensity of a recreation site towards the carrying capacity of that site for this research concluded that the BBG management intensity was in "low" level. "Low level management" defined as a management intensity where the allocation of the budgeting mostly (more than 70%) is used for routine expenses such as the salary of the employees and mantainance of building and vehicles. This fact can be seen from the budget of BBG in the year 2010 which was only 7,905,852,000 IDR; where the budget for education and technical training

was only 57,000,000 IDR (BBG-LIPI 2010).

Data Analysis

Type of activities and the size of space utilization per activity per tourist. Data from the observation of space utilization patterns were analysed per activity per time period per day type. After data collection, a proper equation were sought between the number of tourists (x) and the size of space utilized (y), whether it is linear, exponential, logaritmic, or polynominal with the highest correlation level (highest R^2). After a model has been picked up, average value of the size of space utilized with values of X_{max} and X_{min} was calculated based on the observation data.

Ecological Carrying Capacity. Ecological carrying capacity was calculated through physical carrying capacity calculation and real carrying capacity calculation which referred to Cifuentes formula (Ceballos-Lascurain 1996). Physical carrying capacity was elaborated by 4 formula below:

$$\textbf{Equation 1:}\quad PCC = A \times \frac{V}{a} \times Rf$$

Notes:

PCC = Physical Carrying Capacity

A = area width available for tourism

V/a = area utilized by one tourist per m^2

Rf = area's rotation factor

$$\textbf{Equation 2:}\quad Rf = \frac{object\ operational\ time\ length\ (hour)}{time\ spent\ by\ tourist\ inside\ object\ (hour)}$$

$$\textbf{Equation 3:}\quad RCC = PCC\ x\ \frac{100 - Cf_S}{100}\ x \frac{100 - Cf_G}{100}$$

Notes:

RCC = Real Carrying Capacity

Cf_S = Soil correction factor

Cf_G = Grass correction factor

$$\textbf{Equation 4:} \quad Cf_i = \frac{M_{Li}}{M_{Ti}} x\ 100\%$$

Notes:

Cf_i = i correction factor

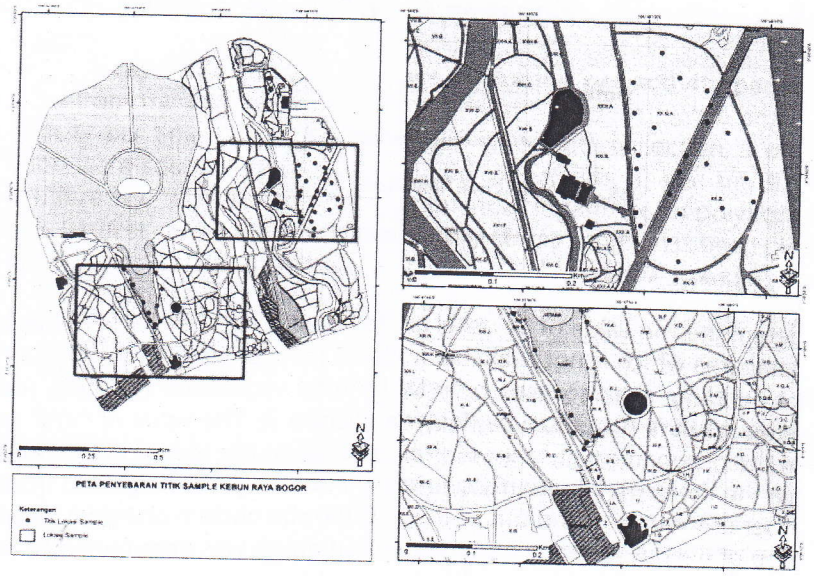
M_{Li} = magnitude limitation

M_{Ti} = total magnitude

To determine the value of "A", total area of BBG (75.48 ha) has been reduced by total area which is not available for tourism activity, such as the management building, sites covered by total vegetation (bushes), road width, etc, and the result is A = 30.19 ha (Picture 3). The value of "V/a" was calculated from the observation of space utilization per tourist in the previous analysis. While the time spent by tourists inside object was gained from the result of number of tourists in and out of the site pattern analysis. The point of intersection of overlay in graph and out graph was determined as the time spent by tourists inside the object.

Psychological Carrying Capacity. In many literatures, psychological carrying capacity is also called perception carrying capacity or behaviour carrying capacity (i.e Pigram & Jenkins 1999). Perception in this case is the perception of tourists towards the absence/existence of other tourists in the site at the same time and perception towards "crowdiness effect." In this research, not only tourists' satisfaction data was collected but also the tourists' motivation; since tourists' perception is closedly related to the tourists' motivation (Manning 1985 in Hall & Page 1999). Motivation data gathered were then overlayed with the satisfation data per period. Data were processed statistically by using variance examination (ANOVA) with significancy level 0.05. Whenever there is a significant effect per period ($p<0.05$), the analysis was continued with Duncan test.

Picture 3. Map of observation location in BBG



Courtesy : Special

RESULTS AND DISCUSSION

Type of Activities and Space Utilization Size per Activity per Tourist

As a result in this research, there is a pattern of space utilization size for several activities at different time period (represented the change in number of tourists). Space utilization size is closedly related to the availability of spaces in BBG to carry tourists at a certain time point. Field observation result identified five tyoe of activity available in BBG, which is sitting around, playing, picnic, eating, and gathering. Overall, the average of proportion per time period are 21 % at period I, 33 % at period II, 32 % at period III and 15% at period IV.

The pattern of space utilization sie for sitting activity can be seen in Picture 4. In this activity, the number of the smallest group (X_{min}) and the largest

(X_{max}) are 1 person and 57 persons. Space utilization size for sitting activity per time period can be seen in Table 1. By calculating the proportion of each event per time period, the number of average space utilization for sitting activity is 0.82 m^2/person. Statistically, analysis showed that the change of time period has a significant effect on space utilization size for sitting activity ($P<0.000$), and the sequence of the smallest μ to the largest μ are period II, III, I and IV.

Picture 4. Space utilization pattern for sitting activity

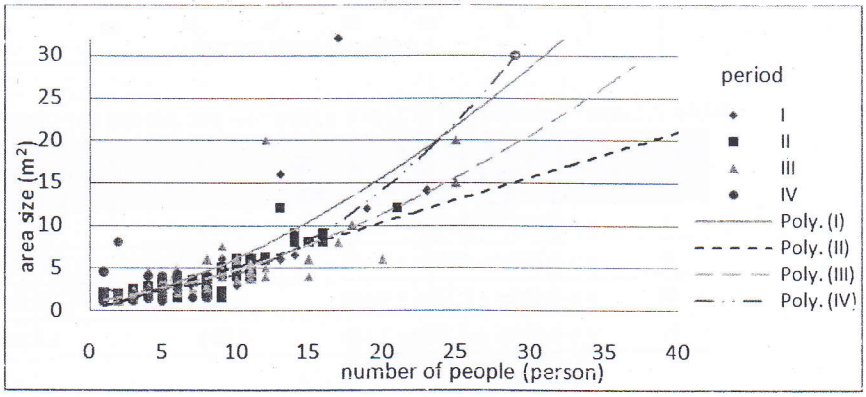


Table 1. Linear equation (y) of space utilization per person for sitting activity

Period	Space utilization (y)	Correlation (R^2)	Space utilization size/person (m^2)
I	$y = 0.017x^2 + 0.423x + 0.127$	0.570	0.9263
II	$y = 0.000x^2 + 0.510x + 0.012$	0.928	0.5110
III	$y = 0.013x^2 + 0.245x + 1.023$	0.636	0.7051
IV	$y = 0.040x^2 - 0.236x + 2.649$	0.917	1.1391

Space utilization pattern for playing activity can be seen in Picture 5. The number of X_{min} is 2 persons and X_{max} is 25 persons. Space utilization size for playing activity per period can be seen at Table 2 with the number of average size is 2.72 m^2/person. ANOVA test at playing activity showed that the change of time period significantly affect the space utilization size ($P<0.000$) from time period II to period III, and from time period III to period IV.

Picture 5. Space utilization pattern for playing activity

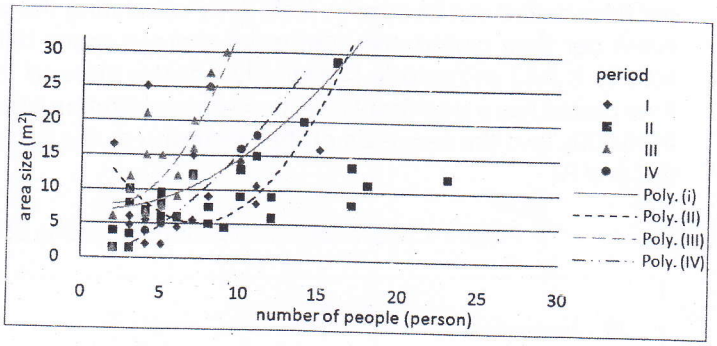


Table 2. Linear equation (y) of space utilization per person for playing activity

Period	Space utilization (y)	Correlation (R^2)	Space utilization size/person (m^2)
I	$y = 0.088x^2 - 0.119x + 6.906$	0.655	1.8793
II	$y = 0.280x^2 - 4.076x + 19.91$	0.520	2.0401
III	$y = 0.423x^2 - 1.725x + 9.652$	0.630	5.1180
IV	$y = 0.092x^2 + 0.758x - 1.225$	0.994	1.8563

Space utilization size for picnic activity can be seen in Picture 6. The numbe of X_{min} is 2 persons and X_{max} is 48 persons. Space utilization size for picnic ac tivity per time period can be seen in Table 3 with the number of average siz is 1.37 m^2/person. In this activity, the change of time period has a significan effect on space utilization size ($P < 0.000$) from period I to period II, and fron period II to period III.

Picture 6. Space utilization for picnic activity

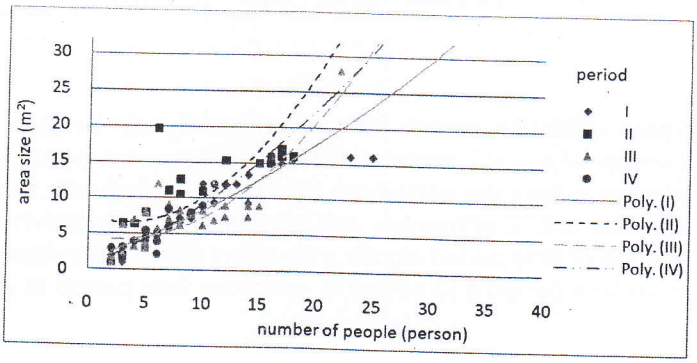


Table 3. Linear equation (y) of space utilization per person for picnic activity

Period	Space utilization (y)	Correlation (R^2)	Space utilization size/person (m^2)
I	$y = 0.012x^2 + 0.569x + 1.419$	0.955	0.9734
II	$y = 0.071x^2 - 0.440x + 7.231$	0.771	1.8671
III	$y = 0.052x^2 - 0.250x + 4.540$	0.728	1.3841
IV	$y = 0.023x^2 + 0.622x + 0.617$	0.916	1.2424

Space utilization size pattern for eating activity can be seen in Picture 7. The number of X_{min} is 2 persons and X_{max} is 20 persons. Space utilization size for eating per time period can be seen in Table 4 with the number of average size is 0.64 m^2/person. In this activity, the change of time period also has a significant effect on space utilization size ($P < 0.001$) from time period I to period II only.

Picture 7. Space utilization size for eating activity

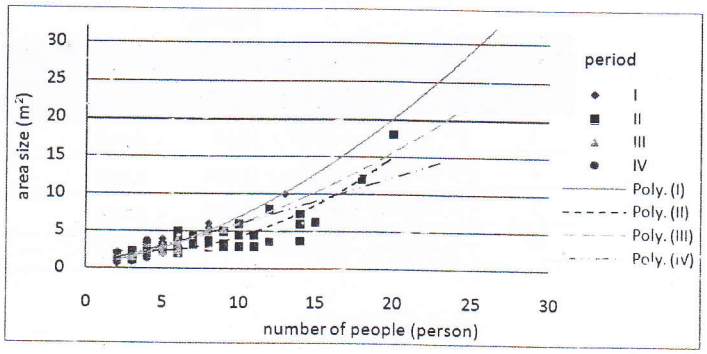


Table 4. Linear equation (y) space utilization per person for eating activity

Period	Space utilization (y)	Correlation (R^2)	Space utilization size/person (m^2)
1	$y = 0.031x^2 + 0.354x + 0.226$	0.917	0.7263
2	$y = 0.045x^2 - 0.298x + 2.686$	0.830	0.5642
3	$y = 0.021x^2 + 0.300x + 0.884$	0.809	0.6519
4	$y = 0.003x^2 + 0.531x + 0.375$	0.850	0.6153

Space utilization size pattern for gathering activity can be seen in Picture The number of X_{min} is 7 persons and X_{max} is 250 persons. Space utilization siz for gathering activity per time period can be seen in Table 5 with the numb of average size is 2.2 m²/person. In this activity, the change of time peric has a significant effect on space utilization size (P< 0.000) from period I t period II and from period III to period IV, while space utilization size fro period II to period III has no difference.

Picture 8. Space utilization pattern for gathering activity

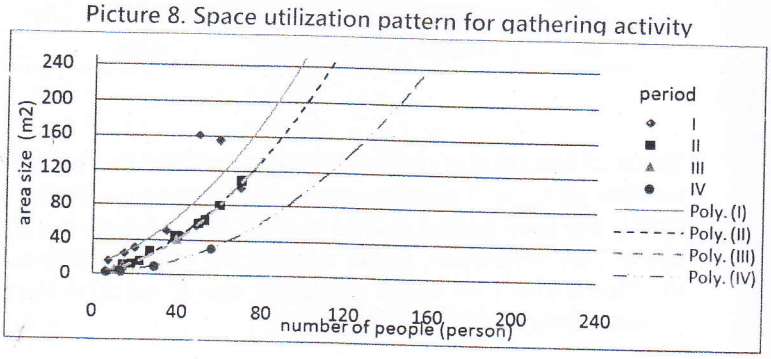


Table 5. Linear equation (y) of space utilization size per person for gathering activity

Period	Space utilization (y)	Correlation (R^2)	Space utilization size/person (m²)
1	y = 0.016x2 + 0.72x + 10.50	0.945	2.9331
2	y = 0.014x2 + 0.472x + 0.164	0.992	2.2735
3	y = 0.017x2 + 0.258x + 1.457	0.998	2.4643
4	y = 0.009x2 - 0.054x + 2.312	0.997	1.1371

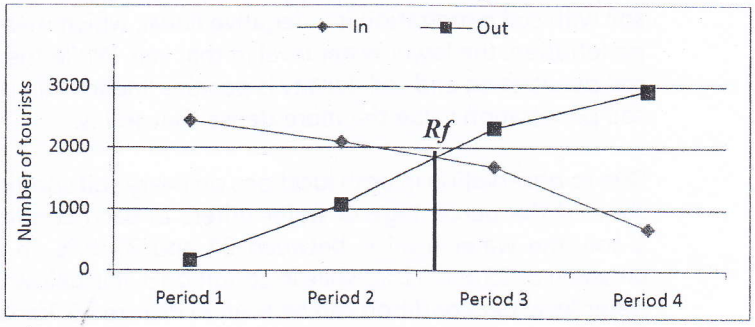
Ecological Carrying Capacity

Physical Carrying Capacity Analysis. In calculating physical carrying capacity, index value of area's rotation factor is needed. In this study, rotation factor was taken from the point of intersection resulted from the average number of tourists coming in and out of the site. Based on the field observation, the number of visitors reached the highest level during period I and keep decreasing until period IV; with 2,441 persons, 2,094 persons, 1,696 persons and 688 persons. In contrast with in pattern, since period I until period IV, the number of visitors out was increasing with 159 persons, 1,075 persons, 2,322 persons and 2,931 persons. From the point of intersection of

in and out graph (Picture 9), the average time spent in the object was 4.75 hours. Since the daily operational time of BBG is 9 hours/day, the value of index Rf of the area is 1.9.

$$Rf = \frac{9}{4.75} = 1.9$$

Picture 9.In-out pattern of tourists in Bogor Botanical Garden



With the "A" value of 30.19 ha and "Rf" 1.9, using space optimizing utilization approach, physical carrying capacity of BBG for 5 activities identified can be seen in Table 6.The final value of physical carrying capacity for ecotourism in Bogor Botanical Garden is 369,998 tourists/day. Proportions of space used for activities are playing (35%), gathering (28%), picnic (18%), sitting (11%), and eating (8%).

Table 6. Space utilization per tourist for recreation in Bogor Botanical Garden

Type of activities	Space requirement/tourist	Correlation (R^2)	Space utilization size/person (m^2)
Sitting	0.82	38,949	31,953
Playing	2.72	38,946	106,067
Picnic	1.37	38,946	53,229
Eating	0.64	38,948	24,904
Gathering	2.20	38,947	85,761
Total		369,998	301,914
Remaining size			0 (zero)

Real Carrying Capacity Analysis. Real carrying capacity defined as physical carrying capacity reduced by correction factor from ecological and psychological aspects. Many recreation or ecotourism activities require a

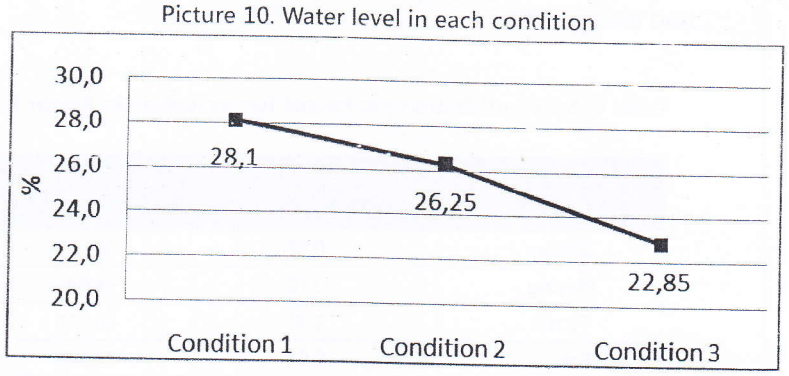
space. Actually, any activity always requires a space (Avenzora 2008a: 14). A space has physical and biological components which became the ecological indicators. In this study, indicators used are soil and grass. Soil and grass get a direct impact from tourism activities of trampling tourist foot step. Those correction factors are describe below:

a. Correction Factor of Soil (Cf_S)

Variables observed as correction factor of soil (Cf_S) is water level in the soil (Cf_{S1}) and soil penetration (Cf_{S2}). Percentage relation of water level in the soil with soil penetration is a negative linear, which means the higher soil penetration, the lower water level in that soil. While the relation between soil penetration and soil density is positive linear, which means the higher soil penetration value the more dense that soil is.

Due to observation in both locations on every soil condition, data analysis showed the percentage of water differs in each condition. In condition 1 soil, the water level is between 24 and 37,35%, in condition 2, it is between of 23 and 31 %, while in condition 3, it is below 25%. The average water level per condition can be seen in Picture 10. Variance examination (ANOVA) analysis showed that soil condition (represents intensity of soil utilization), has a significant effect towards the percentage of soil water level ($P<0.037$, $\alpha=0.05$) only in condition 3 (the smallest μ), while in condition 1 and 2 there are no significant difference.

Picture 10. Water level in each condition

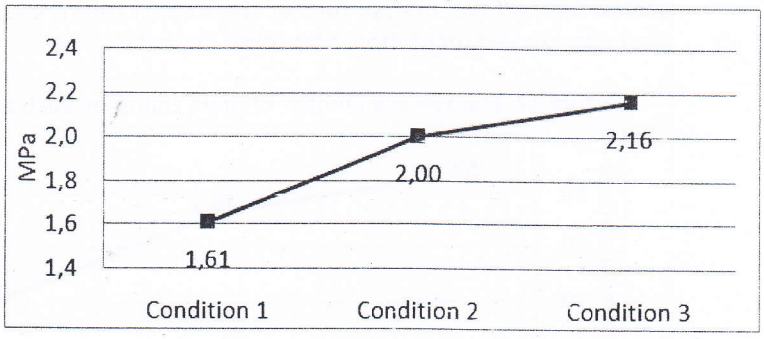


In calculating correction factor of the water level (Cf_{S1}), since there were no significant difference between condition 1 and 2, the average number from both condition became ideal measurement (M_T), and its value is 27.18%. While limitation measurement (M_L) is the difference value between M_T value with limitation measurement value in limitation condition (condition 3), and its value is: M_L: 4.33%. From those values, the conclusion was:

$$Cf_{S1}=\frac{M_L}{M_T}\times 100\%=\frac{4.33}{27.18}\times 100\%=15.92\%$$

Soil penetration capacity defined as the capacity of the soil to react towards a pressure or burden (Purwowidodo 2000). Soil penetration observation and ANOVA analysis showed that soil utilization intensity has a significant effect on soil penetration ($P<0.000$, $\alpha=0.05$) only in condition 1 (the smallest μ), while in condition 2 and 3 there are no significant difference. The increase of penetration pattern on each condition can be seen in Picture 11.

Picture 11. Soil penetration capacity on each condition



In the process of calculating soil penetration correction factor (Cf_{S2}), condition 1 which has a significant difference with the other conditions became the M_T (1.61 MPa), and since there were no significant difference between condition 2 and 3, the average number from both condition became the value in limitation condition, so M_L value is 0.47 MPa. Therefore, it can be concluded that the value of Cf_{S2} is:

$$Cf_{S2}=\frac{M_L}{M_T}\times 100\%=\frac{0.47}{1.61}\times 100\%=29.19\%$$

From both correction factor, Cf_S value is the average number from Cf_{S1} and Cf_{S2}; and therefore the Cf_S value result is:

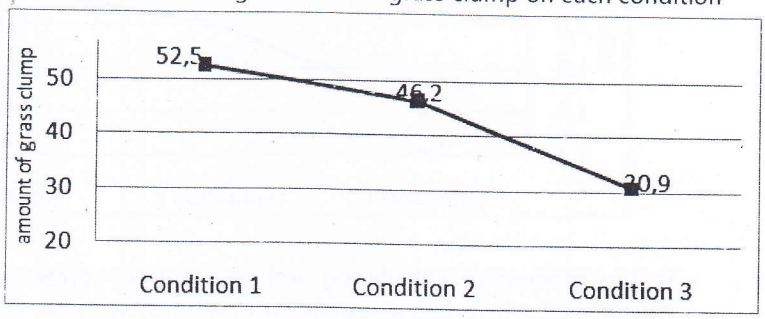
$$Cf_S=\frac{Cf_{S1}+Cf_{S2}}{2}=\frac{15.92\%+29.19\%}{2}=22.55\%$$

b. Correction Factor of Grass (Cf_G)

Based on observation, The grass in BBG is dominated by elephant grass (*Axonopus compressus*). In both location, sampling were done in three soil condition classified by utilization intensity. Visual quality variable observed were the amount of grass clump and its height.

Picture 12 and 13 showed that there has been changes in the amount of grass clump and its height from condition 1 to condition 2 and to condition 3. However, ANOVA analysis showed that a significant change only happened to the amount of grass variable ($P<0.047$) from condition 2 to condition 2, while the grass height variable has no significant difference ($P<0.138$). The significantly decreasing amount of grass showed that there is a potential threat of the tourism activity towards the site's ecology. The decreasing amount of grass means the lost of soil surfaces. If we analyse further the impact might cause soil erosion downstream sedimentation, and other impacts.

Picture 12. The average number of grass clump on each condition

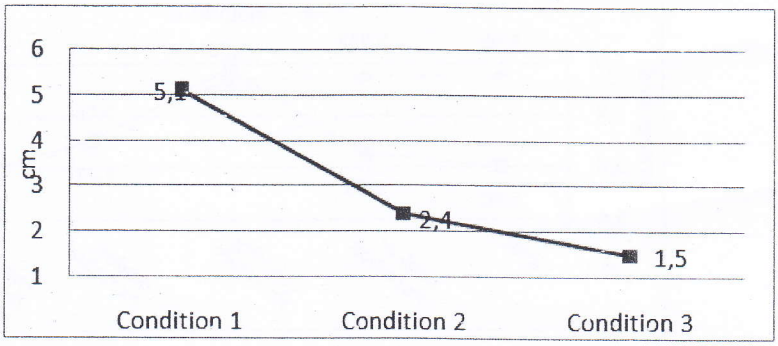


In Picture 12, the changes of the amount of grass clump can be seen. Since the significant result after statistic test is only condition 1, the value of M_T for Cf_G is the value of condition 1 (52.5 clumps). While the M_L value for Cf_G is the M_T value reduced by limitation condition which is the average of condition 2 and 3, so the M_L value is 14. Based on those numbers, the value of Cf_G is:

$$Cf_G = \frac{M_L}{M_T} \times 100\% = \frac{14}{52.5} \times 100\% = 26.67\ \%$$

In Picture 13 we can see the change of the grass clump's height on each soil condition. However, since ANOVA test did not show any significant changes, this correction factor was ignored.

Picture 13. The average height of elephant grass clump on each condition



After the values of correction factors which influenced the carrying capacity of BBG were found, the calculation of real carrying capacity which is the ecological carrying capacity was carried out. Correction factors calculated were Cf_G = 26.67% and Cf_S = 22.55%. After those correction factors calculations, the final result of ecological carrying capacity in BBG value is:

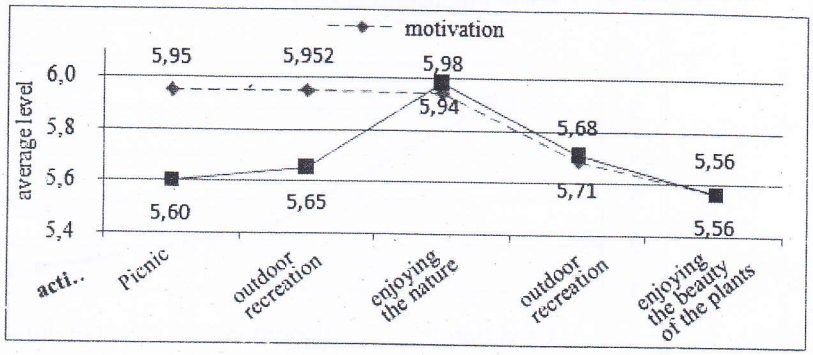
$$RCC = PCC \times \frac{100\text{-}Cf_S}{100} \times \frac{100\text{-}Cf_G}{100}$$

Psychological Carrying Capacity

Psychological carrying capacity also called perception carrying capacity because it is closedly related to the total tourists' satisfaction perception. Before we discuss about tourists' satisfaction, we need to know tourists' motivation in visiting BBG. Based on the type of visit days, the highest motivation of the tourists in BBG during low visit time is picnic (6.21; very high), during condensed visit is outdoor recreation (5.94; high), and enjoying the nature (6.00; high).

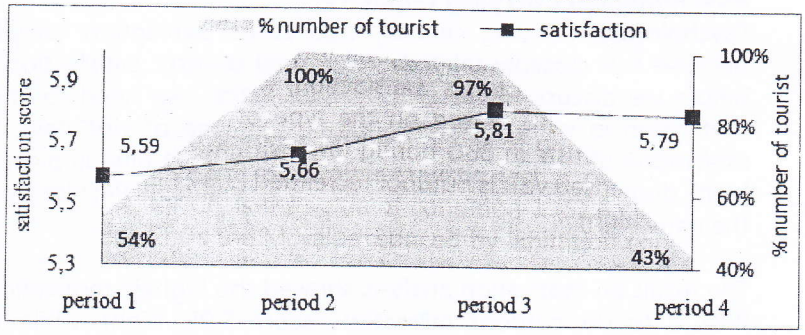
The result on motivation analysis showed the highest motivation in visiting BBG is to do outdoor recreation (score 5.95; high), while the highest satisfaction is enjoying the beauty of the plants (score 5.98; high). Even though simple regretion test showed no correlation between motivation and tourists' satisfaction (R^2=0.176), phenomenologically we need to questioned what can cause the activities difference between the highest motivation and the highest satisfaction. Further, in Picture 14 we can see that the satisfaction level in picnic activity and recreation is still below the motivation level of the tourists. The average level of tourists' satisfaction in BBG is high (score 5.7).

Picture 14. Motivation and satisfaction in Bogor Botanical Garden



When the tourists' satisfaction level and the percentage of tourists per time period was overlayed in one graph (Picture 15) and analyzed using ANOVA test, it turned out that time period (which affect the number of tourists) has no significant effect to the tourists satisfaction level ($P<0.12$, $\alpha=0.05$). Even though Pigram and Jenkins (1999) argued that tourists' satisfaction level is closedly related to an object's density, the dynamics of tourists found in this research does not support that theory; the satisfaction level was found to be in line with the number of daily visit of BBG which is still below the ecological carrying capacity of the site.

Picture 15. The level of tourists' satisfaction overlayed with the percentage of total visitors in Bogor Botanical Garden



The absence of effect of the density towards tourists' satisfaction can descriptively explained as a result of one of the high motivation in visiting BBG; which is to make social contact (score 5.56, "high"). The existence of this motivation eplains the phenomena. It can be concluded that if density level is not reached yet, then the visitors density psychologically interpreted as a higher chance to make social contact; which also increased the satisfaction level.

CLOSING

There are five activities generally done by ecotourists in BBG, which are: sitting, playing, picnic, eating, and gathering; with the highest proportion of space utilization size is for playing. Referring to the utilization size on each activity and considering the correction factors explained above, the ecological carrying capacity of BBG can be calculated as 210,137 tourists/ day.

Even though the study result showed that in context of tourists psychological carrying capacity, the carrying capacity value in BBG has not yet exceeded, to increase tourists' satisfaction, the management is still expected to develop ticketing system which able to make sure the daily ecological carrying capacity value will not be exceeded; especially during peak seasons on holidays. The concept about density's effect on satisfaction are not applicable in this site; in terms of visit motivation nor total number of visits. It is strongly predicted as the result of high motivation among visitor to have social contact up a certain visitor number, the crowdiness still positively affect the visitors satisfaction. For this reason, we can say that the intensity of crowdiness between a tourist and another tourist is still not exceed the level of visitor's psychological acceptance; so that the satisfaction level of 5.7 (high) is acceptable, and can be concluded as something that is not yet necessary to be included as a correction factor in determining final carrying capacity of BBG.

However, if we observed the proportion of over-lay space between the satisfaction level and the number of visitors in Picture 15, we can strongly suggest that the final value of carrying capacity (ecological carrying capacity which has been corrected with psychological carrying capacity value) of BBG will tend to have maximum number of 5 to 10 times current average number of daily visit. Even though the calculation of ecological carrying capacity in this study reached the number of 210 thousands visitors (as explained above), that number tend to be corrected significantly by the level of tourists' satisfaction. The position and pattern of tourists' satisfaction level which reached 2/3 total visitors in Picture 15 must be interpreted as an alert that the visitors' satisfaction peak is nearly reached; where during period 3 and 4, the pattern of visitors' satisfaction has already showe a decrease.

To sharpen the analysis on psychological carrying capacity, a further study should be done regarding the components of tourists' pschology which mostly affect tourists' acceptance in BBG. Also need to be done is a study regarding social carrying capacity and managerial carrying capacity in BBG in order to apply the ecological carrying capacity which close to the real carrying capacity.

Recently, there are many issues regarding ecotourism carrying capacity which are still interesting and have been discussed by many parties in various space and activities scope. 20-30 years ago, the academic staffs still need to work had in convincing many parties (businessmen and beaurocrats) about the important role of determining carrying capacity in ecotourism activities, but today every one has aware and has shared the same spirit on the importance of determining carrying capacity. However, based on the above accomplishments, it appears that the issue on carrying capacity still has to go through a long way to be factually implented in the field, not only because there are a lot of redundant efforts in determining a carrying capacity value, but also because there are other requirements which have not included in carrying capacity research and its implementation management.

We need to realize that carrying capacity issue will not quit on one value which is believed to be able to fulfill the criteria of sustainability (ecologically and socially) but also needs to be continued to the thought of economical and financial carrying capacity which can guarantee an ecotourism business sustainability. Further more, a carrying capacity value is also must be manifested in the existed management structure and system. Without those things mentioned above, the term carrying capacity would only be a "lip service."

If all this time, studies on ecotourism carrying capacity in site scale have been redundant, then it is hard to imagine the complexity in determining ecotourism carrying capacity in a regional scale. For that reason, the discussion of carrying capacity and related studies needs to be well developed. In line with the transdiscipline and transectoral characteristics of ecotourim science, every one (from any science) deserves and also needed to contribute their thoughts in this aspect. However, a maxim "if you are too shy to ask, you will get lost" should be kept, to avoid various domino effects.

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