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Impact Assessment of Tourism Construction in Cuba

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Abstract

This paper discusses a methodology for the environmental assessment of tourist facilities located in Cuban coastal zones in which the general aspects of the process are discussed, defined, and characterized, and examines the main processes that occur as a result of the negative impacts of construction activities. It establishes the theoretical conceptual framework underlying the research and includes a detailed analysis and processing of a sample of tourism projects located in coastal ecosystems. The methodology is complemented by results that include proposed strategic lines of action and a plan for managing negative environmental impacts throughout the life cycle of tourist facilities through prevention, correction and mitigation measures. It ends with conclusions and recommendations to guide tourism development toward environmental sustainability.

Keywords

Environmental Impact, Tourist Facilities, Coastal Ecosystems, Construction

1. Introduction

Man has developed much of what exists in the world through industrialization, and the construction industry has played an important role in this transformation. However, we are far from implementing all the fundamental concepts required by the environment, according to the ecological impact of the incorrect application of construction technologies [1].

Globally the construction industry is a major contributor to socio-economic development and also a major user of energy and natural resources [2]. The construction industry consumes 40% of the materials entering the global economy and generates 40% - 50% of the global output of greenhouse gases and the agents of acid rain [3].

International tourism is projected to nearly double by 2030. In 2012, international tourism arrivals reached

one billion for the first time, up from 25 million in 1950, 277 million in 1980 and 528 million in 1995 [4]. Travel and tourism in particular, as a form of entertainment or leisure [5], has a long history leading up to the 20th century when tourism developed into a multibillion dollar industry that spans virtually all countries [6], at the local, national and international levels [7].

Tourist facilities in coastal ecosystems often cause undesirable environmental impacts, also known as negative environmental impacts, and have severely affected natural vegetation, wildlife habitats, landscapes, soils and wetlands as a result of construction activities. The widespread development and use of quarries, excessive clearing of vegetation, filling of lakes, and other actions that cause severe damage to the environment can be avoided using design and technological measures that are appropriate for the valuable resources where it takes place [8].

Most tourist facilities that have been built do not include environmental and landscaping considerations in their planning and forecasting. This situation is due to ignorance or lack of environmental consciousness about how to intervene in coastal areas with high ecological fragility and sensitivity without causing severe environmental impacts, and a lack of integration of the conceptual ideas to harmonize necessary tourism development with sustainable approaches and practices.

The regional level has been recognized as a good scale for implementing actions towards sustainable development [9]. In this vein, one of the purposes of this research is to propose a methodology for analyzing construction activities that cause negative environmental impacts in tourism investments and propose strategic lines of action for managing those activities based on sustainability without stopping development.

The definition of the field of application of the research object relates to the variation of tourism construction activities on different geographical areas and ecosystems, and the need for integral management of ecological, social, economic and technological aspects of environmental impacts; the following research question is formulated as a problem to be solved:

- What are the necessary definitions, existing gaps and key actions that need to be considered in the methodology of environmental assessment of coastal areas for tourist facilities in coastal ecosystems in order to introduce sustainable development approaches?

1.1. Objectives

1) To specify the general concepts and considerations of tourist facilities that will permit an integrated impact analysis consistent with environmentally sustainable development approaches.

2) To design an appropriate methodology for evaluating the direct actions of construction technologies that cause negative environmental impacts, and propose management actions for tourism projects in sensitive coastal ecosystems.

1.2. System of Hypothesis

- If tourist facilities are to be rational long-term economic (environmental costs) initiatives that are culturally (identity) and socially (quality of life) appropriate, respectful of the protection of the natural environment and technologically appropriate, methodological tools that lead to sustainability will be required.
- Sustainable development can be achieved if existing management tools are improved, such as environmental assessment and other procedures to coordinate, act upon and effectively integrate environmental concepts with technological, sociocultural and economic concepts.

2. Materials and Methods

The analysis was carried out from the general to the particular, discussing domestic and foreign experience and the opinions of experts and of the author herself, and was organized according to the following tasks:

- Analysis of the current situation, statement of the problem, and definition of the objectives, assumptions and methodology employed.
- Definition of the concepts and general aspects of environmental assessment based on the characteristics of the process and its relationship with sustainable development approaches (dimensions, objectives, means, and tools).
- Analysis and discussion of the stages of environmental assessment and its relationship to the life cycle of

tourist facilities in coastal ecosystems.

- Analysis of the problem of tourist facilities and planning, and their relationship to the proposed hypotheses.
- Analysis and discussion of effective tools for the sustainable development of tourist facilities.
- Final conclusions.

A critical analysis of the environmental process of tourism projects and construction research provided the necessary information for identifying existing problems, their causes and proposing theoretical and methodological solutions.

The selection of tourism projects has several characteristics, such as multi-objectives, multi-attributes and multi-criteria. These criteria can be considered relative to society, economy, finance, human resources, environment, market, and politics [10].

The application of environmental analysis methods to the field of architecture and construction design allowed us to study and evaluate the actions involved in planning, designing and executing projects, and using and abandoning or recycling buildings in order to identify, predict, interpret and communicate the negative environmental impacts caused by these activities under current conditions to achieve a social model with sustainability approaches for tourism. The table below shows the methods and techniques most commonly used in environmental studies (**Table 1**).

Methods involving matrices are often used in environmental analyses and studies. It is also common to use the compared scenario method because it allows the comparison of projects in selected ecosystems or different environmental scenarios. Compared environmental scenarios are the most appropriate qualitative method for comparing observation projects in different ecosystems and geographic regions. This method is based on monitoring and assessing changes in the environment [11], over a fixed period, and allows other complementary analyses to be incorporated, such as the matrix methods mentioned.

3. Results

Tourism development plans were presenting a development stereotype that would be in conflict with important biological resources, and not in agreement with the evolution of the tourism market in the Caribbean. Tourism is recognized as an important source of foreign currencies in Cuba. Given the current status of economy, and the good health of coastal ecosystems, tourism based on the environment is the compatible option of development [12].

In the sample studied, 100% of the available background information from environmental assessments of nominal tourism investments was selected over a 4 year period. Projects involving hotel accommodations, villa resort, services, and recreation in new tourism development areas of the principal tourism construction projects

Table 1. Methods and techniques commonly used in environmental studies.

Methods	Techniques
Statistical information processing	Statistical: non-parametric.
	Statistical: parametric
Comparison of environmental scenarios impact monitoring	Techniques for collecting and analyzing samples
	Modeling techniques
	Comparison techniques
	Mapping techniques
Predictive modeling	Mathematical analysis techniques
	Mapping techniques
	Modeling techniques: graphs and networks, matrices
	Analytical modeling techniques
	Graphic and cartographic modeling techniques
	Physical-mathematical modeling techniques

were analyzed (**Table 2**).

In order to establish an analytical process based on deductive and comparative statistical tools to permit the identification of construction activities that negatively impact each ecosystem most significantly, statistical processing was performed on projects selected based on non-parametric statistics. Principal component analysis was used, due to the characteristics of the study variables (discrete, qualitative and measured on an ordinal scale). Computer modelling has also shown its usefulness in theoretically predicting environmental parameters under different conditions and challenges [13].

Before applying the method, the correlation coefficients were calculated to reduce the dimensions of the problem and apply the above test; it is the recommended method for data tables with calculated qualitative components that correspond to the nature of the variables, since these coefficients can be used to construct correlation matrices for developing the main components. Ruiz, (1999) [14], suggest that several types of correlation coefficients can be applied. However, when there are more than 20 variables, it is recommended that the Spearman range coefficient be applied using automated means. With knowledge of the functional relationship matrix and the project sequence chart, the correlated variables can be linked. The values and vectors, variance ratio, and contribution of each variable to each calculated component were calculated, and the variables that contributed significantly to the ecosystem were selected in the matrix that was obtained.

The most significant actions were ranked in order of importance based on the magnitude of the negative environmental impacts in accordance with the mathematical values obtained for the coefficients, which were transformed into percentages for ease of analysis. The results were classified according to the mathematical magnitude of the Spearman range coefficients that were closest to 1. Spearman range coefficients with values between 0.700 and 1 were grouped in a first range or level of importance and coefficients with values 0.600 and 0.699 were included in a second range or level of importance (**Table 3**). Spearman range coefficients with values below these ranges were not considered due to the low relevance of the figures, although they are also present to a lesser degree in construction activities that cause environmental impacts.

The following main problems were detected from processing research data based on analyses of the development schemes and master plans of several tourism projects, existing environmental impact studies, the analysis of 54 projects, and in particular, statistical processing of construction activities in fragile coastal ecosystems that was validated by numerous field observations:

- To determine the main aspects to be considered in analyzing the negative and potential environmental impacts during the life cycle phases of tourist facilities (**Table 4**), it was seen that project design and technological and technical aspects caused most of the impacts.
- Therefore appropriate measures need to be taken to manage environmental impacts during the planning and projection stage and the execution of works to prevent, mitigate and correct many of the most severe impacts.
- During the construction phase, the principal activity that causes impacts is the opening of trails to allow passage of drilling equipment for engineering-geological studies. Technologies and practices with a low environmental impact need to be introduced to avoid these effects.
- During the operation phase, impacts are related to the number of tourists and workers due to high water and energy consumption, liquid and solid waste generation, social interactions and leisure and recreational activities in public areas.
- During the abandonment phase, environmental impacts relate to the presence of temporary facilities and the failure to restore the areas where they are located, as well as unused quarries and trails.

A total of 54 projects were reviewed and the following elements were obtained from the analysis:

- 80% of the projects were located in highly ecologically fragile ecosystems [12], of which 45% involved small islands or cays. The urban area of the entire tourism unit or sector was studied in only 13% of the cases. The synergy of the environmental impacts of nearby projects was not considered.
- 65% of the projects are villas and 74% are similar in their type and floor plan, regardless of the site or the natural landscape where they are located. There is a tendency to standardize tourism architecture.
- Only 12% of the projects reviewed included a technology transfer analysis of construction systems and other equipment for the implementation and operation phases. Only 8 projects had a detailed engineering and architectural assessment. The rest were limited to a brief description that did not analyze the technological impacts of the projects in the necessary depth.
- There was partial public participation and consultation in 19% of the environmental impact studies. Only 17% evaluated the impacts on cultural heritage.

Table 2. Tourism projects selected for statistical processing in Cuba.

Project	Typology	Features
1. Vials Coloradas	Vial	Located in Cays
2. Golf Palma Real	Golf course	Located in Cays
3. Punta Rasa	Beach restaurant	Located in Cays
4. Gregorio	Villa resort	Located in Cays
5. Las Terrazas	Villa resort	Located in Cays
6. Punta Periquillo	Villa resort	Located in Cays
7. La Laguna	Villa resort	Located in Cays
8. El Manglar	Villa resort	Located in Cays
9. Arena Real	Villa resort	Located in Cays
10. Sol Club	Villa resort	Located in Cays
11. El Peñón	Park	Located in Cays
12. Cayo Coco	Landfill	Located in Cays
13. Coco Rojo	Villa resort	Located in Cays
14. Coco II	Villa resort	Located in Cays
15. SPA Thalasso	Health center SPA	Located in Cays
16. Villa Blanca	Villa resort	Located in Cays
17. Lindarena	Villa resort	Located in Cays
18. Riu Tortuga	Villa resort	Located in Cays
19. Villa Capricho	Villa resort	Located in Cays
20. Pelícano II	Villa resort	Located in Cays
21. Villa Iguana II	Villa resort	Located in Cays
22. Arena Real	Beach restaurant	Located in Cays
23. Vial Cuatro Caminos	Vial	Located in Cays
24. Puerto Casasa	Port	Located in Cays
25. Golf Varadero	Golf course	Located in Peninsula
26. Varadero	Villa resort	Located in Peninsula
27. Internacional I y II	Hotel	Located in Peninsula
28. Internacional III	Hotel	Located in Peninsula
29. Taínos III	Villa resort	Located in Peninsula
30. Taínos IV	Villa resort	Located in Peninsula
31. Taínos V	Villa resort	Located in Peninsula
32. Taínos VI	Villa resort	Located in Peninsula
33. Los Taínos	Villa resort	Located in Peninsula
34. Viales Punta Hicacos	Vial	Located in Peninsula
35. Hicacos	Villa resort	Located in Peninsula
36. Reserva Varahicacos	Protected area	Located in Peninsula
37. Piedra del Chino	Park	Located in Peninsula
38. Hotel Kawama	Hotel	Located in Peninsula

Continued

39.	Trinidad del Mar	Villa resort	Located in Peninsula
40.	María Aguilar	Villa resort	Located in Peninsula
41.	María La Gorda	Villa resort	Located in Peninsula
42.	Vial Los Morros	Vial	Located in Peninsula
43.	Cayo Blanco del Norte	Villa resort	Located in Peninsula
44.	Los Morros	Port	Located in Peninsula
45.	Golf Club	Golf course	Located in Mainland coastal ecosystems
46.	Marina Hemingway	Villa resort and marina	Located in Mainland coastal ecosystems
47.	Río de Oro	Villa resort	Located in Mainland coastal ecosystems
48.	Hotel Pasarela	Villa resort	Located in Mainland coastal ecosystems
49.	Santa Lucia	Villa resort	Located in Mainland coastal ecosystems
50.	Marina de Vita	Villa resort and marina	Located in Mainland coastal ecosystems
51.	Las Dalias	Villa resort	Located in Mainland coastal ecosystems
52.	Playa Pesquero	Villa resort	Located in Mainland coastal ecosystems
53.	Villa Megano	Villa resort	Located in Mainland coastal ecosystems
54.	Covarrubia	Villa resort	Located in Mainland coastal ecosystems

Table 3. Statistical information processing.

Constructive actions that cause severe environmental impacts on coastal ecosystems	First range or level of importance (values between 0.700 and 1)	Second range or level of importance (values between 0.600 and 0.699)
Cays ecosystems		
Excavation for deep foundations	0.970	
Compaction of soils	0.810	
Opening of trails with asphalt	0.775	
High occupancy of land and naturall and scapes	0.774	
Uniform design architecture (villas)		0.679
Extraction of raw materials		0.670
Foundations		0.611
Peninsula ecosystems		
Seas and mining	0.904	
Solid construction waste	0.807	
Extraction of raw materials	0.761	
Uniform design architecture (villas)		0.613
Temporary facilities		0.601
Mainland coastal ecosystems		
High water consumption	0.880	
High energy consumption	0.802	
Air pollution	0.705	
Noises		0.674
Solid construction waste		0.605
Extraction of raw materials		0.601

Table 4. Potential environmental impacts during the life cycle phases of tourist facilities.

Construction activities in fragile coastal ecosystems	Planning and projection phase	Construction phase	Operation phase	Abandonment phase
Trails to allow passage of drilling equipment for geological studies	•	•	•	•
Uniform design architecture (villas)	•	•	•	
Temporary facilities		•	•	•
Compaction of soils		•	•	
High occupancy of land and naturall and scapes		•	•	
Air pollution		•	•	
Noises		•	•	
Excavation for deep foundations		•		
Extraction of raw materials		•		
Foundations		•		
Seas and mining		•		
Solid construction waste		•		
Total	2	12	7	2

4. Conclusions

Similar technologies, materials and designs are used in all tourism projects, and in general, the architecture is poorly integrated with the cultural and natural image of natural coastal ecosystems. Tourism architecture appropriate for the exclusive cultural and natural values of these ecosystems should be found in order to avoid standardization and monotony in new areas of development.

The studies show that environmental impacts occur, which, in the future, will lead to a decrease in the available natural resources and consequently lower income due to resource depletion in sensitive coastal areas. The sources of non-natural or manmade (anthropogenic) environmental impacts are related to the purpose, location, type of construction and size of the projects, and determine the origin and development of the impacts caused by socio-economic activities.

The application of this methodology will help analyze the economic costs from an environmental standpoint of adopting preventive rather than remedial environmental measures, and economize on materials, labor, energy and time by focusing on the problem in advance and estimating the environmental costs that should be included in the long-term assessments of feasibility studies.

By delving into environmental assessment aspects and its relationship to the sustainable development of tourist facilities, the methodology suggests and defines actions to be undertaken to influence the development of tourist facilities according to sustainable approaches that contribute to improving the methodological approach and institutional and legal structures regarding the concepts and tasks of environmental regulatory activity.

The paper supports greater effectiveness in designing tourist facilities and considers environmental impacts in the process of prior analysis and decision making for planning, analysis of alternatives, selection of models, land use planning and design.

An analysis of information on investments on cays, peninsulas and in the mainland coastal ecosystems showed that the technological and technical aspects of direct construction activities above and below the ground (earthworks, filling, excavation, compaction and others) caused the greatest impact on fragile ecosystems, as well as the disposal of liquid and solid waste from construction. If the design and execution of these activities are properly managed, the impacts can be avoided or mitigated to a large extent.

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