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MEASURING TECHNICAL EFFICIENCY AMONG DEPARTMENT OF TOURISM (DOT) ACCREDITED RESORTS IN DAVAO REGION: APPLICATION OF DATA ENVELOPMENT ANALYSIS (DEA)

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Abstract:
One of the most important players in the hospitality and tourism industries is the resort industry. Data envelopment analysis (DEA) allows measuring the variation in efficiency between resorts businesses and in a particular time period. Furthermore, this technique allows the identification of the possible sources of inefficiency. The study developed a methodology utilizing the capabilities of Data Envelopment Analysis that provides a reasonably accurate means of evaluating the technical efficiency of DOT-accredited resorts in the Davao Region. Results of the study reveal that 18 out of 23 DMUs classified as fully efficient comprising 82.61% while the other 5 DMUs are under-efficient constituting 17.39% in total. Moreover, demographic characteristic significantly contributes to the efficient performance of DOT-accredited resorts in the Davao Region. These demographic characteristics, such as provincial category, type of resorts, and accessibility, provide policymakers, industry stakeholders, and tourism associations with information regarding the state of the tourism industry in various provinces, the type of resorts, and the means of reaching the resorts (accessibility). These results enable more focused assistance and coordinated efforts to improve the region's competitiveness and sustainability.

Keywords: Data Envelopment Analysis (DEA), efficiency, dot-accredited resorts, Davao region

1. Introduction

Over the last two decades, there has been an increasing number of studies evaluating the performance of resorts businesses by applying efficiency measures that are dependent upon the consideration of multiple inputs and multiple outputs (Assaf *et al.*, 2012; Chen,

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2019; Chiang *et al.*, 2004; Hwang and Chang, 2003; Tsaur, 2011). Efficiency is critical for the administration of resorts businesses as they compete in an oligopolistic market where prices and costs are the key drivers to succeed (Barros, 2004). Given these calls for efficiency, it is of considerable interest to examine how resorts businesses could respond to the increased pressure. Data envelopment analysis (DEA) allows measuring the variation in efficiency between resorts businesses and in the time frame. Furthermore, this technique allows the identification of the possible sources of inefficiency.

One of the most important players in the hospitality and tourism industries is the resort industry. In 2020, the global resort industry was estimated to be worth $1.25 trillion, and it is anticipated that it will grow at a compound annual growth rate (CAGR) of 6.1% from 2021 to 2028 (researchandmarkets.com, 2021). This is according to a recent report that ResearchAndMarkets.com published. In recent years, the industry has been subjected to significant shifts due to the influence of several factors, including shifting consumer preferences, advances in technological capability, and the impact of the COVID-19 pandemic. The total value of the global resort market was estimated to be $902.0 billion in 2019. It is anticipated that it will reach $1,356.3 billion by 2027, expanding at a compound annual growth rate (CAGR) of 5.4% from 2020 to 2027 (Allied Market Research, 2020; Allied Market Research, 2019).

This expansion can be attributed to factors including an increase in consumers' discretionary income, a rise in travel and tourism-related activities, and an increase in the popularity of vacation travel. The COVID-19 pandemic, and other pandemics, have significantly affected the resort industry. As a result of the pandemic, resort operators have seen a decrease in their occupancy rates, revenues, and profitability (Deloitte, 2020). The report also notes that to ensure the safety of both guests and employees, resorts have been required to implement several health and safety measures. These measures include social distancing, increased sanitation, and contactless check-in and check-out systems.

In addition, the resort industry has a bright future ahead of it, with several trends and developments anticipated to play a significant role in shaping the industry. One such pattern is the ever-increasing demand for travel that emphasizes immersive experiences. When people go on vacation, they are looking for more immersive experiences, such as cultural excursions, adventures in the great outdoors, and wellness retreats (Skift, 2021). This trend will likely continue and affect the services and amenities that resorts provide their guests.

Another development to keep an eye on is the surging interest in eco-tourism and responsible vacationing. Over half of the world's travelers (53%) believe that sustainable travel is important, and almost half (46%) are willing to pay more for sustainable travel options (Booking.com, 2020). It is anticipated that this pattern will affect the day-to-day operations of resorts, leading to an increased emphasis on environmentally friendly practices such as reducing waste and conserving energy.

It is anticipated that technological developments will also play a role in shaping the future of the resort industry. The use of technology is expected to increase in the hospitality industry (Phocuswright, 2021). The report focuses on the importance of

personalized experiences, mobile apps, and artificial intelligence. Resorts will likely implement these technologies to improve their guests' overall experiences and operational efficiencies.

In conclusion, the resort industry is a significant player in the hospitality and tourism industries, providing lodging and other services to tourists and vacationers looking for a relaxing getaway or vacation. In recent years, the industry has been subjected to significant shifts due to the influence of several factors, including shifting consumer preferences, technological developments, and the impact of the COVID-19 pandemic. Several trends and developments are expected to shape the resort industry, such as the growing demand for experiential travel, sustainable travel, and technological advancements. Despite the challenges posed by the pandemic, the future outlook of the resort industry is promising.

2. Objectives of the Study

The general objective of this study is to develop a methodology utilizing the capabilities of Data Envelopment Analysis that provides a reasonably accurate means of evaluating the technical efficiency of DOT-accredited resorts in the Davao Region. Specifically, the study aimed;

1) To present the profile of resorts included in the analysis;
2) To pick out the resorts that are most inefficient under ideal conditions using DEA models and,
3) To provide intervention programs based on the technical efficiency score of DMUs (DOT Accredited Resorts in Davao Region) that can be the basis of all the intervention initiatives of the concerned private and government agencies.
4) To establish effective intervention programs and projects that can be provided among the DMUs, that can be categorized into three; (1) efficiency score of less than 1 (one) means not fully efficient, (2) efficiency score of 1 (one) means fully efficient and (3) efficiency score of zero (0) fully inefficient.

3. Review of Related Literature and Studies

The microeconomic theory states that producers aim to maximize their profits. They have to choose the most efficient combination of resources (allocative efficiency (AE)) that defines the optimal level of production (technical efficiency (TE)) with minimal costs. The DEA model measures technical and AE (Varian, 2014). As such, TE is the maximum production that the organization can reach considering its production function, whereas AE is the best combination of resources that the organization can reach, given the prices of the inputs (Varian, 2014). Therefore, the total efficiency (TTE) is the product of allocative and TE. A DEA estimate based on outputs allows an understanding of how marginal increases in outputs (or quantity produced) are a source of inefficiency. Although it is possible to estimate DEA through an input orientation that measures

technical inefficiency as the marginal decrease in input usage, this study adopts an output orientation to consider the shifts that the tourism demand has suffered over the last decade.

Traditionally, the production functions of resorts businesses are considered a Cobb Douglas function; this configuration allows constant or variable returns to scale. Return to scale refers to the rate of increase in output with the increase in inputs. In other words, returns to scale measure how much the output will increase if the utilization of inputs increases. Constant returns to scale mean that the output increases by the same proportion of the increase of the inputs used. In contrast, variable returns to scale mean that output could increase by less (decreasing returns to scale) or by more (increasing returns to scale) than the proportion of the increase of utilization of the inputs. Returns to scale are mainly related to TE (Varian, 2014).

To better utilize how the inputs are effectively used to produce outcomes, understanding the efficiency of operations in various aspects is critical to defining business strategies and enhancing competitiveness (Honma and Hu, 2012; Qi and Junhai, 2011). At the competitive level, efficiency is measured to compare competitors, and at the business strategy level, efficiency is measured to control performance (Chen, 2006). The primary purpose of any business is to maximize the number of revenues subject to constraints on quantities and prices. Efficiency happens when businesses reach the maximum level of revenues while maintaining minimal costs or an optimal combination of inputs (Lovell, 1993). As a result, cost control has become an essential dimension of efficiency for hotel businesses (Qi and Junhai, 2011).

From the perspective of a resorts business, efficiency models have been used to identify efficiency as well as sources of inefficiency that may contribute to defining strategies to reduce cost inefficiencies through a benchmarking assessment (Anderson *et al.*, 1999; Barros, 2004; Chen, 2006; Morey and Dittman, 1995). Businesses are inefficient when they fail to allocate resources most efficiently, AE, or when they fail to utilize resources efficiently, technical inefficiency (Anderson *et al.*, 2000).

Debreu (1951), Koopmans (1951), and Leibenstein (1966) were the first researchers to define inefficiency as the curve difference between the potential and the actual utilization of resources. The curve of the potential use of resources that maximizes the output or the revenue is defined as the efficiency frontier. This frontier has been estimated through different methods, the most usual being the stochastic frontiers approach (SFA) (Assaf, 2012; Chen, 2007; Barros, 2004) or DEA (Hwang and Chang, 2003; Barros, 2006). Furthermore, Honma and Hu (2012) analyze hotel efficiencies using SFA and DEA to conclude that the results are consistent. Both methods assume that the production function in the most efficient combination of resources is known.

Furthermore, Hjalmarsson *et al.* (1996) argue that despite some consistency within the results, DEA and DEA are less demanding as these models do not require distribution assumptions about efficiency. Further, DEA generates a range of optimal scales; SFA relies on a constant level of optimal scales and yields a constant return to scale.

Also, SFA is based on econometric models and is much more demanding in terms of data. DEA involves mathematical programming but is less demanding in terms of data (Barros and Santos, 2006). On top of that, DEA allows several inputs and outputs to be introduced without functional data restrictions or distributional assumptions for inefficiency (Barros and Santos, 2006). It also allows the efficient frontier to be estimated from the sample data, as is the case in this study.

There are several studies in the resorts industry adopting DEA to measure the efficiency of resorts businesses (Emrouznejad, A., De Witte, K., Tone, K., Kao, C., & Liu, S. T., 2011). A quick overview of the existing literature indicates the use of DEA as a measure of efficiency in the resorts industry a long list of variables used as inputs and outputs: input variables include operation cost, number of employees, number of rooms, square footage of the property and number of amenities while the output variables are as follow; revenue, occupancy rate, average daily rates and number of rooms rented (Emrouznejad, A., De Witte, K., Tone, K., Kao, C., & Liu, S. T., 2011)

In recent years, the resort industry has received significant attention in the published literature, with a particular focus on efficiency measurements. The researcher will provide a review of the related literature that was found to be relevant to this study in the following section.

Economies based on resorts travelers looking for a place to stay, activities to participate in, and other forms of amusement can often find what they need at a resort. The effectiveness of resorts is essential to their success because it directly impacts their profitability and the degree to which their guests are satisfied. A recent analysis of the relevant research literature draws attention to the significance of several factors that contribute to the effectiveness of resorts.

On the other hand, the resort industry is a significant contributor to the global economy, with an estimated value of $7.6 trillion in 2016 (WTTC, 2017). This makes the resort industry one of the most valuable industries in the world. It is essential to measure the technical efficiency of resorts to ensure the industry's continued growth and its ability to remain competitive. The ability of businesses to maximize their output given a set of inputs is referred to as technical efficiency, and it is a useful metric for measuring the productivity and effectiveness of resorts.

The technical effectiveness of resorts has been the subject of investigation in several different studies. For instance, Hsiao *et al.* (2019) used the data envelopment analysis (DEA) method to investigate the effectiveness of Taiwan's beach resorts. According to the study's findings, most of the resorts were operating at less-than-optimal levels of efficiency, which indicates that there is a need for improved management practices and the distribution of resources. Similarly, Ali and Park (2021) evaluated the technical effectiveness of beach resorts in Malaysia using the DEA method. According to the study's findings, the size of the resort, its ownership, and its location all influence its overall efficiency.

Several researchers have recently shed light on the significance of determining the level of technical efficiency in the hospitality industry. This has highlighted the

importance of determining the level of technical efficiency in the hospitality industry. According to Huang and Tsai (2017), measuring the efficiency of resorts can assist industry players and policymakers in locating areas that require improvement and optimizing the distribution of available resources. Similarly, Lee *et al.* (2017) suggested that measuring efficiency can provide insights into the performance of resorts and help in benchmarking against other businesses in the same industry. This is similar to the previous point.

The quality of the resort's services is one of the factors that influences its effectiveness. Guests' satisfaction with the resort as a whole and their propensity to come back can be affected by the quality of service they feel they receive there. According to a study conducted by Sathitwiriyawong *et al.* (2021), customer satisfaction and loyalty in Thai resorts are significantly influenced by service quality, which was evaluated based on tangible, reliable, responsiveness, assurance, and empathy dimensions.

Technology adoption is yet another factor that can affect resort efficiency. Technology has the potential to boost the effectiveness of resort operations, improve the quality of experiences offered to guests, and lower operating expenses. According to the findings of a study conducted by Lu *et al.* (2020), implementing technology in Chinese resorts, such as mobile applications, has the potential to increase customer satisfaction, loyalty, and willingness to pay.

In addition, the performance of employees and the training they receive can also impact the effectiveness of resorts. According to the findings of a study conducted by Bocarnea *et al.* (2017), the performance of employees, as measured by dimensions such as reliability, assurance, tangibility, empathy, and responsiveness, has a significant impact on the level of customer satisfaction and loyalty experienced in Romanian resorts. Employee performance can also be improved through proper training and development, improved customer service, and increased productivity.

The efficiency of a resort can also be impacted by factors such as its location and accessibility. The resort's location should be convenient for prospective guests, ideally close to major transportation nodes or well-known places of interest to tourists. According to a study conducted by Seng *et al.* (2017), customers' intention to return to and recommend Malaysian resorts is significantly impacted by location. In conclusion, the effectiveness of resorts can be influenced by various factors, including the quality of their services, their adoption of new technologies, the performance of their employees, and the training they receive, as well as their location and accessibility. The owners and managers of resorts need to consider these factors to enhance their operations, improve customer satisfaction, and ultimately increase their profits.

In conclusion, the hospitality industry is a significant contributor to the world's overall economy, and determining the industry's level of technical efficiency is critical to ensuring that it will continue to experience sustainable growth and remain competitive. Utilizing methods such as DEA can help provide insights into the productivity and effectiveness of resorts and assist in identifying areas in which improvements can be made. In addition, policymakers and industry players can benefit from the insights

provided by efficiency measures to optimize the allocation of resources and improve management practices. These benefits are made possible by the efficiency measures.

4. Theoretical Framework

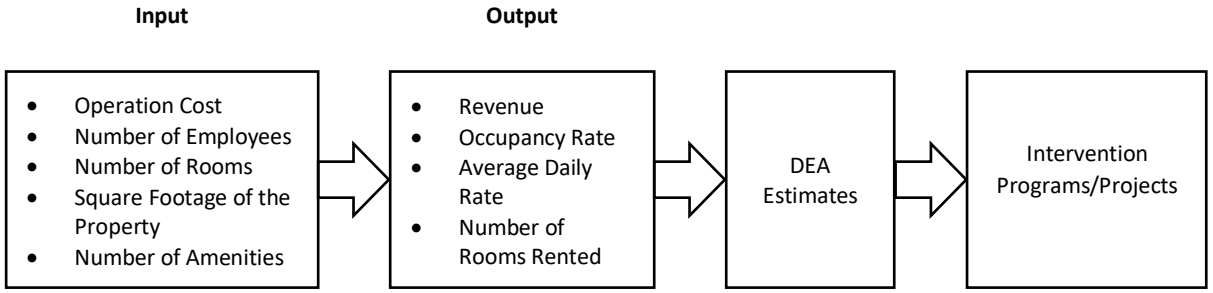
To assess the technical efficiency of resorts in the Davao Region that were granted DOT accreditation, the proposed research investigated the utilization of Data Envelopment Analysis techniques as a multi-dimensional and multi-criteria tool. The dynamic resource-based view (RBV) of strategic management provides the foundation for the usefulness of this assessment. According to the dynamic RBV, companies are assessed for their traits to pinpoint resources or assets that may give them a long-term competitive advantage (Maijoor and van Witteloostujn, 1996; Black and Boal, 1994). Conversely, this strategy looks at the company's resources and how they work together to form capabilities.

The RBV's core objective is to find the resources that will provide us with a competitive edge in the future. Internationalization is a process that includes learning, developing skills, and gaining experience (Pisano and Shuen, 1994). An organization's internal, external, and competitive market studies are all included in the RBV. Due to their restricted focus, other techniques frequently need to pay more attention to resources accounted for by this one. Two of RBV's strengths are its capacity to develop clever, diverse strategies and its capacity to explain why some businesses are more profitable than their competitors.

This study attempts to identify resorts that operate at less-than-optimal efficiency. The following Data Envelopment Analysis (DEA) approaches were employed: the Standard DEA. Figure 1 depicts the study's conceptual structure.

5. Conceptual Framework of Study

Figure 1: The Conceptual Framework of the Study



6. Methods of Study

6.1 Research Design

A non-parametric research design is being used for this study. Salkind (2010) believes a non-parametric study design is a way of measuring which does not depend on evidence that the data come from a certain distribution. A statistical conclusion is drawn from a study design that excludes parameters. This study examines how well DOT-accredited resorts in the Philippines' Davao Region do their respective duties. In reality, a parametric study design could give inappropriate outcomes if the evidence in the analysis is inconsistent.

On the other hand, the non-parametric research design analysis is more relaxed regarding distributional evidence (Salkind, 2010). On the other hand, the non-parametric research method is also called an "order test" or "ranking test." Many non-parametric tests use the order of the observations (called "classificatory data") as their data, while others can be used with data that can't even be ranked.

6.2 Research Subject

The general direction of this study is to measure and evaluate the performance of resorts businesses in Davao Region (XI) particularly among DOT accredited resorts. The Study will be focusing among the 17 listed accredited resorts in Davao Region that will be the subject of this research, and these resorts will be the Decision Making Units (DMUs) as the research subjects. The list of DMUs presented in Table 1 below is based on the existing and updated list of Accredited resorts in Davao Regions from the Department of Tourism Regional Office – XI. Table 1 shows the decision-making units or Resorts that meet the criteria to qualify for the study. Resorts in Davao Region, Philippines, and the Resorts is homogenous in inputs and outputs.

7. Decision-making Units

Table 1: Lists of DMUs subject for the 17 DOT-accredited resorts that will be studied (17 Resorts)

# DMU	Resorts	Province
DMU1	Resort 1	Davao City
DMU2	Resort 2	Davao Del Norte
DMU3	Resort 3	Davao Del Norte
DMU4	Resort 4	Davao City
DMU5	Resort 5	Davao Del Norte
DMU6	Resort 6	Davao Del Norte
DMU7	Resort 7	Davao Del Sur
DMU8	Resort 8	Davao Del Norte
DMU9	Resort 9	Davao Del Norte
DMU10	Resort 10	Davao Del Norte
DMU11	Resort 11	Davao Del Norte
DMU12	Resort 12	Davao Del Norte

DMU13	Resort 13	Davao Del Oro
DMU14	Resort 14	Davao Del Norte
DMU15	Resort 15	Davao City
DMU16	Resort 16	Davao Del Sur
DMU17	Resort 17	Davao Del Norte
DMU18	Resort 17	Davao Del Norte
DMU18	Resort 17	Davao De Oro
DMU20	Resort 17	Davao City
DMU21	Resort 17	Davao Oriental
DMU22	Resort 17	Davao De Oro
DMU23	Resort 17	Davao Del Norte

Sources: Department of Tourism Region 11.

7.1 Scale of Efficiency

Table 2: Scale of Efficiency for DEA Analysis Estimation (Output Oriented)

Efficiency Score (DEA)	Efficiency Classification
1	Fully Efficient
0.99 – 0.01	Under Efficient
0	Fully Inefficient

Sources: Cruz, E. D., & Sabado, J. R. F. (2022). Credit Risk and Performance Evaluation of Cooperatives in Region Xi Using Data Envelopment Analyses (DEA). European Journal of Economic and Financial Research, 6(1).

7.2 Instrumentation

The researcher utilized three approaches for the study. First, the researcher got first-hand statistics from the Department of Tourism (DOT-XI). Second, the researcher took parts of the first-hand data's input and output indicators from a previous study (Emrouznejad, A., De Witte, K., Tone, K., Kao, C., & Liu, S. T., 2011). Second, use the DEA model's important extensions to improve our estimates of performance efficiency. In particular, use the four-month window analysis to determine where an inefficient unit needs to improve and use output-oriented DEA models with constant and variable returns to scale to determine the efficiency scores from solving DEA model linear programming problems.

7.3 Data Treatment Approach

DEA efficiency assessment can be divided into technical efficiency, scale efficiency, pure technical efficiency, allocation efficiency, and overall efficiency. Enhancing overall efficiency in the DMU requires optimal technical efficiency. However, technical efficiency becoming optimal in the decision-making unit does not ensure overall efficiency optimization. In some cases, a DMU is limited on controlling inputs, making it difficult to determine the unit cost of inputs, which in turn causes difficulties in determining overall efficiency and allocative efficiency. Therefore, technical efficiency generally measures only performance of the DMU and so is used to evaluate the quality performance index of tourism service in this study.

The statistical treatment employed in this study will be the Data Envelopment Analysis (DEA), which is used to measure technical efficiency among DOT-accredited resorts in the Davao Region, the subject of this study.

7.3.1 Measurement of Efficiency

Increasingly, decision-makers must strike a balance between the growing demand for services and the limited resources available. According to economists, one important criterion for prioritization should be optimizing efficiency from scarce resources. Efficiency measures whether resources are being used as effectively as they can be. The relationship between resource inputs and intermediate outputs or outcomes is what efficiency is all about. The simplest definition of the efficiency of decision-making units with numerous inputs and outputs is as follows;

$$Efficiency = \frac{Weighted\ sum\ of\ outputs}{Weighted\ sum\ of\ inputs}$$

Technical efficiency and allocative efficiency are the two subcategories of a DMU's efficiency. Technical efficiency is an organization's capacity to produce the greatest amount of product with the fewest resources. In contrast, DMUs can produce a specific output level with the minimum inputs (Coelli, 1996). This is the actual connection between the inputs (work and capital) and the outputs. A technical position is reached when a group of resource inputs results in the greatest potential output improvement. If the same (or better) effects could be obtained with less than one input, then the intervention is technically ineffective.

7.3.2 CCR Model

The CCR model is the basic DEA model. This model is an efficient evaluation model for multiple inputs and outputs, and the evaluation unit has constant returns to scale in assumptions and draws an isoquant from appraisal earnings to find the evaluated unit's maximum output efficiency. This forms the efficient frontier, which is used to assess organization efficiency from DMUs.

7.3.3 BCC Model

Banker, Charnes, and Cooper (1984) modified the BCC model with fewer restrictions on constant returns of scale. The BCC model measures not only production efficiency (PE), but also technical efficiency (TE) and scale efficiency (SE). Selection of a DEA model is based on the purposes of analysis for user needs and the properties of input and output items. User analysis purposes should consider the goals of efficiency/effectiveness, static/comparative static, and improve/forecast. Efficiency is the relationship between inputs and outputs; therefore, general DEA can assess efficiency. Technical efficiency, scale efficiency, congestion, and the allocation efficiency model explain the efficiency evaluation results from diverse points of view for overall analysis. Chang, Hwang, and

Cheng (1995) proposed performance improvement as the goal for analyzing performance; therefore, the DEA model must input 1 instead.

Decision makers control input and output variables, divided into controllable variables and uncontrollable variables. In a typical input-output DEA model, decision makers assume the input and output variables. If input and output variables are exogenous, decision makers cannot control them and improve their values.

7.3.4 DEA Mathematical Programming Formulation

DEA describes the empirical evaluation of the relative efficiency of a DMU based on S (Xj, j = 1, 2....., s) inputs and M (Yi, i = 1, 2....., m) outputs. To estimate for DMU-K, Vj and Ui represent output í and input j as the unknown weight for calculating the ratios of inputs and outputs to determine efficiency. Input-oriented and output-oriented are used to estimate the efficiency of each unit. The following shows the empirical input-oriented model to evaluate efficiencies of DMUs:

Model 1:

$$\text{Max } h_k = \frac{\sum_{i=1}^{m} U_i Y_{ik}}{\sum_{j=1}^{s} V_j X_{jk}}$$

Subject to:

$$\frac{\sum_{i=1}^{m} U_i Y_{ik}}{\sum_{j=1}^{s} V_j X_{jk}} \leqq 1, U_i \geqq 0, V_j \geqq 0$$

$$(i = 1,2,3,\ldots\ldots m; j = 1,2,3,\ldots\ldots s; k = 1,2,3,\ldots\ldots n)$$

Therefore;

K	DMU
hk	relative efficiency of DMU
Yik	i output of kth DMU
Xjk	k output of jth DMU
Vj, Ui	weight of i output of kth DMU and k output of jth DMU

Because it is difficult to solve nonlinear programming in fraction programming having an infinite context, the denominator of the fraction is set to "1" and substituted into the constraints and converted into a linear programming model, as follows:

Model 2:

$$\text{Max } h_k = \sum_{i=1}^{m} U_i Y_{ik}$$

Subject to:

$$\sum_{j=1}^{s} V_j X_{jk} = 1$$

$$\sum_{i=1}^{m} U_i Y_{ir} - \sum_{j=1}^{s} V_j V_{jr} \leqq 0$$

$$U_r \geqq \zeta > 0, V_i \geqq \zeta > 0$$

$$(i = 1,2,3,\ldots\ldots m; j = 1,2,3,\ldots\ldots s; k = 1,2,3,\ldots\ldots n)$$

Under this assumption, the CCR model measures the relative efficiency of returns to scale under constant scale efficiency. Considering the technical efficiency of DMUs, this scale efficiency is not suitable for the CCR model. Therefore, Banker *et al.* (1984) revised the CCR model. They substituted the Uk item into the CCR model and production function eliminating the need to pass through the original point for the developed BBC model to measure technical efficiency and scale efficiency. The BCC model is divided into inputs and outputs oriented to the relative performance of "Inputs oriented" DMUs shown below:

$$\text{Max } h_k \sum_{i=1}^{m} U_i Y_{ik} - U_k$$

Subject to:

$$\sum_{j=1}^{s} V_j X_{jk} = 1$$

$$\sum_{i=1}^{m} U_i Y_{ik} - \sum_{j=1}^{s} V_j X_{jk} - U_k \leqq 0$$

$$U_i \geqq \zeta > 0, V_i \geqq \zeta > 0$$

$$(i = 1,2,3,\ldots\ldots m; j = 1,2,3,\ldots\ldots s; k = 1,2,3,\ldots\ldots n)$$

Therefore,

k	DMU
hk	relative efficiency of DMU
Yik	i output of kth DMU
Xjk	k output of jth DMU
ζ	Non-Archimedean small number
Vj, Ui	weight of i output of kth DMU and k output of jth DMU

According to Uk, we investigated the scale of efficiency in decision units. If Uk = 0, the production-based scale is constant production efficiency; and if Uk > 0, under the optimal production environment, production will decrease. If Uk < 0, under the optimal production environment, production will increase.

7.4 Presentation, Analysis, and Interpretation of Data

This section presents the analysis of results, interpretation of data that includes the presentation of data used, the DEA results and the intervention programs and projects for the DOT – accredited resorts in Davao Region (DMUs)

7.4.1 Presentation of Data

Table 3: Distribution of DOT-accredited resorts in Davao Region, by Operation Cost, by Month

Operation Cost Classification	Number of DMUs	% to Total
100,000,0001 and over	1	4.35
50,000,001 – 100,000,000	0	0
10,000,001 – 50,000,000	3	13.04
1,000,001 – 10,000,000	0	0
500,001 – 1,000,000	2	8.70
< 500,000	17	73.91
Total	**23**	**100**

Table 3 presents the distribution of DOT-accredited resorts in the Davao Region based on their operation costs, offering valuable insights into the economic landscape of local attractions. The classification highlights the diversity in operation costs and sheds light on their potential impact on the regional tourism industry.

The data reveals that the majority of resorts in the Davao Region operate on a tight budget, with 73.91% having operation costs of 'less than 500,000.' In contrast, the high-end resorts with operation costs of '100,000,0001 and over' constitute only 4.35% of the total. Notably, the middle-range categories, '10,000,001 - 50,000,000' and '500,001 - 1,000,000,' account for 13.04% and 8.70% of resorts, respectively. This distribution underscores the prevalence of cost-effective management among DOT-accredited resorts in the Davao Region. The dominance of lower operation cost brackets suggests an opportunity to enhance operational efficiency further. Additionally, the varying operation costs may influence the competitive dynamics of the region's tourism industry, with higher-cost resorts likely employing distinct business strategies and services, contributing to a diverse visitor experience.

These findings hold significance for Davao Region authorities, industry stakeholders, and resort owners. Understanding the distribution of operation costs enables the development of targeted strategies for tourism development, resource allocation, and quality improvement. Tailoring interventions to address the specific needs and challenges faced by resorts in different cost brackets can foster the growth and sustainability of the regional tourism sector. Moreover, Table 3 provides a comprehensive

overview of the financial landscapes of DOT-accredited resorts in the Davao Region. The observed economic variety serves as a valuable reference for regional policymakers and industry players aiming to enhance operational efficiency and competitiveness across different cost classifications, ultimately contributing to the overall growth and sustainability of the regional tourism sector.

Table 4: Distribution of DOT-Accredited Resorts in Davao Region, by Number of Employees

Number of Employees	Number of DMUs	% to Total
300 and over	1	4.35
201 – 300	1	4.35
101 – 200	3	13.04
51 – 100	1	4.35
<50	17	73.91
Total	**23**	**100**

Table 4 outlines the workforce composition of DOT-accredited resorts in the Davao Region, offering a comprehensive view of the human resource structure within these tourism establishments. The data indicates a diverse distribution of employees among resorts, revealing that 73.91% of them have fewer than 50 employees. Conversely, only one resort (4.35%) falls into the category of '300 and over' employees, while another (4.35%) is classified with '201 - 300' employees. The '101 - 200' and '51 - 100' employee categories account for 13.04% and 4.35% of the total resorts, respectively. This distribution emphasizes the prevalence of small-scale tourism firms in the Davao Region, as the majority of resorts operate with fewer than 50 employees. The presence of a resort employing 300 or more people suggests the existence of larger-scale operations with potentially more sophisticated offerings. These larger resorts may play a substantial role in shaping the economic and social dynamics of the regional tourism industry.

The workforce size groups also have implications for policy formulation and resource allocation. Smaller resorts with fewer employees may face unique challenges and opportunities, necessitating tailored support mechanisms. Conversely, addressing the needs of larger resorts may involve different strategies to enhance their contributions to the local tourism sector. Finally, Table 4 underscores the diverse employment structures within DOT-accredited resorts in the Davao Region. This variation in employee size has significant implications for resorts, regional policymakers, industry players, and labor market dynamics. Understanding the distribution based on the number of employees allows for targeted actions to stimulate growth, employment, and service quality within the tourism sector, fostering a more competitive and sustainable industry.

Table 5: Distribution of DOT-Accredited Resorts in Davao Region, Number of Rooms Available for Use

Number of Rooms	Number of DMUs	% to Total
201 and over	1	4.35
101 – 200	1	4.35
50 – 100	7	30.44
21 – 49	6	26.09
<20	8	34.77
Total	**23**	**100**

Table 5 provides an overview of the room capacity within DOT-accredited resorts in the Davao Region, offering insights into their accommodation offerings. The data reveals a diverse range of room capacities among the approved resorts. The majority, constituting 34.77% of the total, have fewer than 20 rooms. In contrast, one resort (4.35%) falls into the category of '201 and over' rooms, and another (4.35%) has '101 - 200' rooms. The '50-100' and '21-49' room categories account for 30.44% and 26.09% of the total resorts, respectively. This distribution highlights the varied room capacities within DOT-accredited resorts in the Davao Region, with smaller resorts potentially catering to a more specialized market, providing a personalized experience. Larger resorts with greater room capacity may target a broader audience, accommodating a higher volume of guests. The distribution of resorts across room capacity categories directly influences the region's ability to accommodate guests, cater to different market segments, and enhance overall guest experiences. Resorts with larger capacities may attract significant events or conferences, contributing to the economic vitality of the Davao Region.

Understanding this distribution is crucial for policymakers and industry stakeholders. It can inform decisions related to infrastructure development, marketing strategies, and event planning initiatives, ensuring that the tourism industry in the region meets diverse accommodation demands. In conclusion, Table 5 underscores the diverse room capacity of DOT-accredited resorts in the Davao Region, showcasing their versatility and market positioning. This knowledge allows regional stakeholders to tailor efforts to meet the needs of various market groups, contributing to a more competitive and robust tourism sector in the Davao Region.

Table 6: Distribution of DOT-Accredited Resorts in Davao Region, by Area in Hectares

Area in Hectares	Number of DMUs	% to Total
100 and over	2	8.70
50 – 99	3	13.04
21 – 49	1	4.35
10 – 20	2	8.70
2 – 9	12	52.17
< 1	3	13.04
Total	**23**	**100**

Table 6 offers insights into the geographical dimensions of DOT-accredited resorts in the Davao Region, summarizing the land area occupied by these tourism facilities. Examining the data reveals a diverse range of land area sizes among the approved resorts. Notably, 52.17% of resorts fall within the '2 - 9' hectares category, signifying a prevalence of medium-sized land footprints. Two resorts (8.70%) each occupy '100 and over' and '50 - 99' hectares, respectively, while one (4.35%) spans '21 - 49' hectares, and two (8.70%) are on '10 - 20' hectares. The '1 - 2' hectares category accommodates three resorts, representing 13.04% of the total. This distribution has implications for the regional tourism economy, as larger resorts may offer more extensive facilities, recreational spaces, and enhanced guest experiences, suitable for large-scale events or conferences. The prevalence of resorts with '2 - 9' hectares suggests a balance between ecological sustainability and commercial profitability. Smaller land sizes in the '1 - 2' hectare category may indicate a preference for a boutique or intimate environment.

In addition, the variety in land area sizes among DOT-accredited resorts has substantial consequences for the region's tourism industry, impacting overall capacity, market positioning, environmental conservation, land use planning, and infrastructure development. Larger resorts may necessitate distinct regulations, infrastructural requirements, and conservation measures compared to smaller enterprises. Finally, Table 6 showcases the adaptability and market positioning of DOT-accredited resorts in the Davao Region based on their land area sizes. Regional policymakers and industry stakeholders can leverage this distribution to inform policies related to land use, environmental conservation, and infrastructure development, fostering a more dynamic, sustainable, and competitive tourism sector in the Davao Region.

Table 7: Distribution of DOT-Accredited Resorts in Davao Region, by Number of Amenities

Number of Amenities	Number of DMUs	% to Total
20 and over	1	4.35
16 – 19	1	4.35
10 – 15	5	21.74
5 – 9	9	39.12
< 4	7	30.44
Total	**23**	**100**

Table 7 offers a detailed breakdown of the amenities provided by DOT-accredited resorts in the Davao Region, showcasing the diverse landscape of services and facilities offered by these tourism establishments. A comprehensive analysis of the data reveals that 39.12% of resorts fall into the '5 - 9' amenities category, indicating a well-equipped provision to meet the varied needs of a broad customer base. Following closely is the '10 - 15' amenity category, representing 21.74% of the total, indicating a significant portion of resorts offering a wide range of services.

Additionally, 30.44% of resorts provide 'less than 4' amenities, suggesting a focus on specialty or simplified products. Resorts offering '16 - 19' and '20 and over' amenities each account for 4.35% of all resorts, highlighting a small but notable segment offering a

comprehensive array of services. The distribution across these amenity categories has substantial implications for the region's tourism industry, influencing competitiveness and appeal. Resorts with more amenities may attract customers seeking all-inclusive experiences, while those with fewer amenities may cater to specific niches or prioritize a more intimate atmosphere.

This distribution is crucial for marketing, guest experience, pricing structures, and the overall economic impact of tourism in the Davao Region. Resorts with extensive amenity offerings have the potential to attract a broader range of tourists, generate more revenue, and contribute significantly to the local economy. In conclusion, Table 7 underscores the adaptability and market positioning of DOT-accredited resorts in the Davao Region based on their amenity offerings. This diversity plays a pivotal role in shaping the competitiveness, attraction, and economic impact of the regional tourism industry, highlighting the importance of personalized marketing strategies and awareness of resorts' distinct value propositions based on their amenities.

Table 8: Distribution of DOT-Accredited Resorts in Davao Region, by Revenue, by Month

Amount in Php	**Number of DMUs**	**% to Total**
100,000,0001 and over	1	4.35
50,000,001 – 100,000,000	4	17.40
10,000,001 – 50,000,000	1	4.35
1,000,001 – 10,000,000	1	4.35
500,001 – 1,000,000	1	4.35
< 500,000	15	65.2
Total	**23**	**100**

Table 8 provides a detailed breakdown of the monthly revenue distribution among DOT-accredited resorts in the Davao Region, offering critical insights into the economic landscape of these tourism establishments. A thorough analysis of the data indicates a diverse range of revenue generation capabilities among the approved resorts. The majority, constituting 65.22% of the total, reported a monthly income of 'less than 500,000' PHP, suggesting a prevalence of smaller-scale operations possibly catering to specialized customers or emphasizing cost-effective operations.

In contrast, four resorts (17.40%) fall into the '50,000,001 - 100,000,000' PHP monthly revenue category, signifying a substantial group of businesses with higher financial turnovers. The income categories '100,000,0001 and over,' '10,000,001 - 50,000,000,' '1,000,001 - 10,000,000,' and '500,001 - 1,000,000' each account for 4.35% of total resorts.

This distribution holds significant implications for the local tourism industry and the regional economy. Resorts with larger monthly earnings contribute significantly to the economic vibrancy of the Davao Region, potentially investing in infrastructure, personnel development, and marketing to enhance competitiveness and attract a broader range of tourists. The prevalence of resorts with monthly sales 'less than 500,000' PHP underscores the importance of supporting smaller-scale companies, which may fill

distinct market niches, create job opportunities, and contribute to the region's cultural and natural diversity.

Understanding this distribution is crucial for regional governments, industry stakeholders, and resort operators. It influences resource allocation, tourism development, and marketing strategies. Recognizing the distribution of resorts based on monthly revenue allows for tailored interventions to address the unique requirements and challenges faced by resorts in different revenue categories, fostering a more competitive, varied, and resilient tourism sector in the Davao Region. In conclusion, Table 8 highlights the various revenue capacities of DOT-accredited resorts, showcasing their adaptability and market positioning to serve a wide range of guest preferences and economic sectors. This information is valuable for policymakers and industry players aiming to develop policies that enhance the economic impact and competitiveness of the regional tourism industry while recognizing and supporting the distinctive contributions of smaller-scale resorts.

Table 9: Distribution of DOT-Accredited Resorts in Davao Region, by Occupancy Rate

In Percentage (%)	Number of DMUs	% to Total
90 – 100	3	13.04
75 – 90	4	17.39
50 – 74	12	52.17
30 – 49	2	8.70
<29	2	8.70
Total	**23**	**100**

Table 9 provides a detailed breakdown of the monthly revenue distribution among DOT-accredited resorts in the Davao Region, offering critical insights into the economic landscape of these tourism establishments. A thorough analysis of the data indicates a diverse range of revenue generation capabilities among the approved resorts. The majority, constituting 65.22% of the total, reported a monthly income of 'less than 500,000' PHP, suggesting a prevalence of smaller-scale operations possibly catering to specialized customers or emphasizing cost-effective operations.

In contrast, four resorts (17.40%) fall into the '50,000,001 - 100,000,000' PHP monthly revenue category, signifying a substantial group of businesses with higher financial turnovers. The income categories '100,000,0001 and over,' '10,000,001 - 50,000,000,' '1,000,001 - 10,000,000,' and '500,001 - 1,000,000' each account for 4.35% of total resorts. This distribution holds significant implications for the local tourism industry and the regional economy. Resorts with larger monthly earnings contribute significantly to the economic vibrancy of the Davao Region, potentially investing in infrastructure, personnel development, and marketing to enhance competitiveness and attract a broader range of tourists. The prevalence of resorts with monthly sales 'less than 500,000' PHP underscores the importance of supporting smaller-scale companies, which may fill distinct market niches, create job opportunities, and contribute to the region's cultural and natural diversity.

Understanding this distribution is crucial for regional governments, industry stakeholders, and resort operators. It influences resource allocation, tourism development, and marketing strategies. Recognizing the distribution of resorts based on monthly revenue allows for tailored interventions to address the unique requirements and challenges faced by resorts in different revenue categories, fostering a more competitive, varied, and resilient tourism sector in the Davao Region. In conclusion, Table 8 highlights the various revenue capacities of DOT-accredited resorts, showcasing their adaptability and market positioning to serve a wide range of guest preferences and economic sectors. This information is valuable for policymakers and industry players aiming to develop policies that enhance the economic impact and competitiveness of the regional tourism industry while recognizing and supporting the distinctive contributions of smaller-scale resorts.

Table 10: Distribution of DOT-Accredited Resorts in Davao Region, by Average Daily Rate

In Percentage (%)	Number of DMUs	% to Total
90 – 100	5	21.74
75 – 90	5	21.74
50 – 74	7	30.44
30 – 49	3	13.04
<29	3	13.04
Total	**23**	**100**

Table 10 offers a comprehensive view of the Average Daily Rates (ADR) charged by DOT-accredited resorts in the Davao Region, shedding light on their pricing strategies and economic landscape. A thorough examination of the data reveals a diverse range of ADRs among the resorts. Notably, 30.44% of resorts operate within the '50 - 74%' ADR range, indicating a substantial presence in the mid-range pricing bracket.

Additionally, 21.74% of resorts are evenly distributed in both the '90 - 100%' and '75 - 90%' ADR categories, reflecting a focus on high-quality service delivery and luxury guest experiences. The remaining 26.08% of resorts are divided between the '30 - 49%' and '<29%' ADR categories, showcasing establishments with more cost-effective pricing practices.

This distribution has significant implications for the competitiveness and economic impact of the regional tourism industry. Resorts with higher ADRs may generate increased revenue per guest, fostering economic growth and enabling investments in service quality. These establishments are likely to attract customers seeking more upscale amenities and personalized experiences. Conversely, the prevalence of resorts in the '50 - 74%' ADR group emphasizes the importance of the mid-range pricing sector, catering to a diverse audience and strategically positioning the region in the market.

Understanding resort distribution by ADR is instrumental in influencing strategies for optimizing prices, managing demand, and enhancing guest experiences. It plays a crucial role in positioning the Davao Region within the competitive tourism

business landscape, allowing for tailored plans that capitalize on the economic potential across various pricing categories. In conclusion, Table 10 highlights the adaptability and market positioning of DOT-accredited resorts in the Davao Region, showcasing their ability to serve a wide range of visitor preferences and economic segments through diverse Average Daily Rates. This information serves as a valuable resource for regional policymakers, industry partners, and resort operators, enabling them to develop plans that enhance the economic impact and competitiveness of the local tourism sector across various pricing categories.

Table 11: Distribution of DOT-Accredited Resorts in Davao Region, by Number of Rooms Occupied/Rented

Range	Number of DMUs	% to Total
100 and over	2	8.70
81 – 99	0	0
61 – 80	0	0
41 – 60	2	8.70
21 – 40	7	30.43
<20	12	52.17
Total	**23**	**100**

Table 11 provides a comprehensive view of the number of rooms occupied or rented in DOT-accredited resorts in the Davao Region, offering insights into their utilization levels, demand patterns, and operational efficiency. A detailed analysis reveals a diverse range of room occupancy levels among the resorts. Notably, 52.17% of resorts have 'less than 20' rooms occupied or rented, indicating a prevalence of smaller-scale establishments that may prioritize more intimate and individualized client experiences.

Additionally, 30.43% of resorts fall into the '21 - 40' rooms occupied or rented category, representing mid-sized establishments that strike a balance between capacity and personalized services. A smaller proportion, 8.70%, is distributed between the '100 and over' and '41 - 60' rooms occupied or rented categories, suggesting the presence of a segment of enterprises with higher occupancy levels, possibly due to larger room inventories.

The absence of resorts in the '81-99' and '61-80' categories indicates an opportunity for the regional tourism industry to develop resorts with room inventories in these size brackets, catering to specific demand segments. The distribution of resorts across these room occupancy categories has significant implications for the competitiveness, economic impact, and market positioning of the regional tourism industry. Resorts with higher room occupancy levels are poised to generate increased profits, contribute to local employment, and enhance the overall economic vibrancy of the Davao Region.

Conversely, the prevalence of resorts with 'less than 20' room occupancy levels suggests a focus on niche markets or more intimate capacity, contributing to the region's diversified and individualized guest experiences. This distribution is crucial for regional governments, industry stakeholders, and resort operators to understand as it influences resource allocation, marketing strategies, and service quality improvements. In

conclusion, Table 11 illustrates the wide range of room occupancy levels across DOT-accredited resorts in the Davao Region, showcasing their adaptability and market positioning to satisfy varied degrees of demand and visitor preferences. This information is a critical resource for regional policymakers and industry players seeking to enhance the economic impact and competitiveness of the local tourism sector while recognizing and supporting the distinct contributions of resorts with various room occupancy levels.

8. Standard DEA Results

Table 12 presents the results of the Data Envelopment Analysis (DEA) efficiency rankings for DOT-accredited resorts in the Davao Region. The Efficiency Scores, a crucial indicator of technical efficiency, reveal that resorts labeled as DMUs 1 to 9 achieved a perfect score of 1.000, classifying them as 'Efficient.' This signifies optimal resource utilization, positioning them at the forefront of operational efficiency in delivering services and amenities to guests.

Conversely, a subset of resorts (DMUs 10, 12, 14, 16, and 23) received Efficiency Scores below 1.000, categorizing them as 'Inefficient.' These establishments, falling short of perfect efficiency, warrant further investigation to pinpoint areas for improvement in their operations. The mean Efficiency Score for all resorts is calculated at 0.976, indicating a generally high average efficiency level. The identification of a few inefficient resorts underscores the potential for enhancing overall operational efficiency within the regional tourism industry. This analysis offers valuable insights: firstly, it highlights specific resorts with room for improvement, suggesting that targeted efforts can be directed to enhance their efficiency. Secondly, the recognition of efficient resorts serves as a benchmark for others, encouraging the adoption of best practices and promoting industry-wide technological efficiency improvements.

Table 12: Summary of DOT Accredited Resorts in Davao Region, by Efficiency Score

DMUs Number	Efficiency Score	Classification
1	1.000	Efficient
2	1.000	Efficient
3	1.000	Efficient
4	1.000	Efficient
5	1.000	Efficient
6	1.000	Efficient
7	1.000	Efficient
8	1.000	Efficient
9	1.000	Efficient
10	0.668	Inefficient
11	1.000	Efficient
12	0.894	Inefficient
13	1.000	Efficient
14	0.975	Inefficient
15	1.000	Efficient
16	0.999	Inefficient

17	1.000	Efficient
18	1.000	Efficient
19	1.000	Efficient
20	1.000	Efficient
21	1.000	Efficient
22	1.000	Efficient
23	0.910	Inefficient
Mean	**0.976**	

Moreover, Table 12 provides a comprehensive snapshot of the technical efficiency levels among DOT-accredited resorts in the Davao Region. The perfect scores achieved by many resorts underscore operational excellence, while the identification of inefficient resorts signals opportunities for enhancement. This data-driven analysis supports informed decision-making, fostering competitiveness and sustainability in the tourism sector of the Davao Region.

Table 13: Distribution DOT-Accredited Resorts (DMUs) in Davao Region by Efficiency Level

Efficiency Classification	**Number of DMUs**	**% to Total**
Fully Efficient (1.00)	19	82.61
Under Efficient (0.99 – 0.01)	4	17.39
Fully Inefficient (0.00)	0	0
Total	23	100
Mean Efficiency	**0.976**	

Table 13 presents a comprehensive breakdown of the efficiency levels among DOT-accredited resorts in the Davao Region, offering valuable insights into their operational effectiveness. The Efficiency Classification highlights the percentage distribution of resorts across different efficiency categories based on their scores.

The majority of resorts, constituting 82.61% of DMUs, are classified as 'Fully Efficient (1.00).' This indicates that these establishments operate at or near optimal efficiency, utilizing resources effectively to provide high-quality services and amenities to guests. In the 'Under Efficient (0.99 – 0.01)' category, four resorts (17.39% of DMUs) exhibit slightly lower efficiency scores, suggesting minor operational areas for improvement. These businesses can further enhance their efficiency by refining resource allocation and service delivery practices.

Importantly, no resorts fall into the 'Fully Inefficient (0.00)' category, reflecting positively on the overall efficiency of the regional tourism economy. The absence of fully inefficient resorts suggests a proactive engagement in resource optimization and operational effectiveness.

The mean efficiency score of 0.976 for all resorts in the Davao Region signifies a commendable average efficiency level. This analysis serves as a roadmap for targeted improvements, guiding inefficient resorts to identify specific areas for enhancement. Beyond individual resorts, the findings contribute to the broader understanding of the region's competitive landscape, fostering collaborative efforts to enhance overall

efficiency, competitiveness, and sustainability. Finally, Table 13 lays the foundation for informed decision-making in the local tourism industry, encouraging resorts to strive for higher efficiency levels, deliver superior guest experiences, and contribute to the economic and environmental sustainability of the Davao Region. The insights provided can guide future developments and interventions to strengthen the industry's position in the competitive tourism landscape.

8.1 Demographic with DEA Results Discussion

Table 14 presents a comprehensive analysis of DOT-accredited resorts in the Davao Region, categorized by province and delineated by their efficiency scores. This breakdown facilitates a nuanced understanding of how efficiency levels vary across provinces, offering valuable insights for strategic planning and decision-making.

Davao Del Norte, which boasts the highest number of resorts (57% of total DMUs), the majority (69%) are classified as 'Efficient,' signifying strong operational performance. This province presents an opportunity for focused interventions to enhance the operational efficiency of the four 'Inefficient' resorts.

Davao City stands out with all four of its DMUs classified as 'Efficient,' showcasing a highly optimized tourism industry. This suggests that Davao City serves as a standard for efficiency within the region.

Davao De Oro, with three DMUs (13% of the total), demonstrates a commendable performance as all resorts fall under the 'Efficient' category, emphasizing a robust tourism sector in the province.

Davao Del Sur, comprising 9% of the total DMUs, presents a mixed picture with one 'Efficient' and one 'Inefficient' resort. This indicates room for improvement in the province's tourism establishments.

Davao Oriental, with one DMU (4% of the total), exhibits high efficiency, representing a positive contribution to the regional tourism landscape.

Table 14: Distribution of DOT Accredited Resorts (DMUs) in Davao Region, by Province, by Efficiency Score

Provinces	Number of DMUs	Percentage (%)	# of Efficient DMUs	# of Inefficient DMUs
Davao Del Norte	13	57	9	4
Davao City	4	17	4	0
Davao De Oro	3	13	3	0
Davao Del Sur	2	9	1	1
Davao Oriental	1	4	1	0
Total DMUs	**23**	**100**	**18**	**5**

The cumulative analysis across all provinces reveals a regional scenario where 78% of DMUs are classified as 'Efficient,' showcasing a generally well-performing tourism industry. The presence of five 'Inefficient' resorts underscores specific areas for improvement and targeted interventions.

These findings offer practical implications for the Davao Region's tourism industry. 'Efficient' resorts can serve as benchmarks, promoting best practices and fostering collaborative learning. The identification of 'Inefficient' resorts directs attention to opportunities for improvement, encouraging a more competitive and sustainable regional tourism sector. In a broader context, this data equips policymakers and industry stakeholders with region-specific insights, enabling targeted support and coordinated efforts to enhance overall competitiveness and sustainability. Table 14 contributes to the collective knowledge base, fostering an environment where resorts can share experiences, learn from each other, and collectively contribute to the growth and efficiency of the Davao Region's tourism sector.

Table 15 offers a comprehensive analysis of the efficiency levels of DOT-accredited resorts in the Davao Region, categorized by resort classification. This breakdown provides valuable insights into the variations in efficiency across different types of resorts, highlighting opportunities for improvement and best practice sharing within each category.

Beach Resorts: Representing the majority with 65.2% of the total DMUs, beach resorts showcase a predominantly efficient operation, with 11 out of 15 classified as 'Efficient.' The four 'Inefficient' resorts in this category present specific targets for operational enhancement, emphasizing the potential for resource optimization in these beachfront establishments.

Inland Beach Resorts: Comprising 8.7% of the total, the two inland beach resorts are both classified as 'Efficient,' indicating effective resource utilization in their unique settings.

Mountain Resorts: Similarly, the two mountain resorts, accounting for 8.7% of the total, both achieve an 'Efficient' classification, emphasizing their operational effectiveness within the distinct mountainous environment.

Resorts and Restaurant: Accounting for 8.7% of the total DMUs, the two resorts in this category are both classified as 'Efficient,' showcasing successful management of both resort and restaurant operations.

Garden Resorts: The two garden resorts, also contributing 8.7% to the total, exhibit a varied efficiency range. While one is labeled 'Efficient,' the other is categorized as 'Inefficient,' indicating a need for improvement in the latter.

Table 15: Distribution of DOT Accredited Resorts (DMUs) in Davao Region, by Resorts Classification, by Efficiency Score

Classification	Number of DMUs	Percentage (%)	# of Efficient DMUs	# of Inefficient DMUs
Beach Resorts	15	65.2	11	4
Inland Beach Resorts	2	8.7	2	0
Mountain Resorts	2	8.7	2	0
Resorts and Restaurant	2	8.7	2	0
Garden Resorts	2	8.7	1	1
Total DMUs	**23**	**100**	**18**	**5**

Cumulatively, the analysis across all resort classifications reveals 18 'Efficient' DMUs and five 'Inefficient' DMUs, underscoring the overall effectiveness of the region's resorts. Inefficient resorts, spread across various categories, represent potential areas for growth and improvement. 'Efficient' resorts serve as models and benchmarks, fostering knowledge-sharing to enhance the industry collectively. This data equips policymakers, industry stakeholders, and tourist groups with nuanced insights into the state of the tourism business within specific resort categories. The findings facilitate targeted assistance and coordinated efforts to enhance the region's overall competitiveness and sustainability.

Moreover, table 15 provides valuable information on the efficiency levels of DOT-accredited resorts in the Davao Region, categorized by resort classification. It underscores the diverse efficiency landscape and encourages resorts to learn from one another, fostering collaboration for higher efficiency and a more competitive and sustainable tourism sector in the Davao Region.

Table 16 offers a comprehensive analysis of the efficiency levels of DOT-accredited resorts in the Davao Region, categorized by the type of accessibility and segmented by their efficiency scores. This breakdown provides valuable insights into the variations in efficiency based on the means of access, emphasizing opportunities for improvement and best practice sharing within each accessibility type.

By Land and Sea: This category, representing 57% of the total DMUs with 13 resorts, showcases a majority of efficient operations. Nine of these resorts are classified as 'Efficient,' indicating a high degree of resource optimization. However, the presence of four inefficient resorts suggests room for operational enhancement, presenting opportunities for targeted improvements and increased efficiency.

By Land: Comprising 43% of the total DMUs with ten resorts, the 'By Land' category predominantly demonstrates efficiency, with nine resorts labeled as 'Efficient' and one as 'Inefficient.' Resorts relying solely on land access exhibit overall high levels of operational effectiveness, emphasizing successful resource utilization.

Table 16: Distribution of DOT Accredited Resorts (DMUs) in Davao Region, by Type of Accessibility, by Efficiency Score

Accessibility	Number of DMUs	Percentage (%)	# of Efficient DMUs	# of Inefficient DMUs
By Land and Sea	13	57	9	4
By Land	10	43	9	1
Total DMUs	**23**	**100**	**18**	**5**

Cumulatively, the study of both accessibility types reveals 18 'Efficient' DMUs and five 'Inefficient' DMUs in the Davao Region. This overall distribution underscores the region's efficiency, irrespective of the means of accessibility. The five inefficient resorts across both accessibility categories represent specific areas for operational improvement, highlighting opportunities for targeted enhancements. These findings are of practical significance for Davao Region resorts. 'Efficient' resorts can serve as benchmarks, sharing

best practices to enhance the industry collectively. Meanwhile, 'inefficient' resorts gain valuable insights for targeted upgrades, optimizing operations and resource allocation to improve efficiency. This information equips policymakers, industry stakeholders, and tourism groups with insights into the state of the tourism industry concerning accessibility types on a regional scale. This knowledge facilitates focused assistance and coordinated efforts to enhance the region's overall competitiveness and sustainability.

Finally, table 16 provides a meaningful view of the efficiency levels of DOT-accredited resorts in the Davao Region, organized by accessibility type. It emphasizes the diversity of efficiency levels and the potential for additional growth and collaboration within the context of accessibility. This analysis encourages resorts to learn from one another and work together to improve efficiency, contributing to a more competitive and sustainable tourism sector in the Davao Region, regardless of the mode of access.

9. Summary Conclusions and Recommendations

9.1 Summary of Findings

The following is the summary of the results and findings of the study:

- In the presentation of data used as input variables, operation costs, comprising 73.91% of the total, have running costs of 'less than 500,000. In comparison, the resorts with the highest operating costs, 100,000,0001 and up, account for only 4.35% of the total. The middle groups, 10,000,001 - 50,000,000 and 500,001 - 1,000,000, account for 13.04% and 8.70% of the total resorts, respectively. Second, 73.91% of the employees employ fewer than 50 people, putting them in the '50' employee group. In comparison, only one resort (4.35%) is defined as having '300 and over' employees, while another (4.35%) is categorized as having '201 - 300' employees. The employee categories '101 - 200' and '51 - 100' account for 13.04% and 4.35% of total resorts, respectively. Third, as to the number of rooms available, 34.77% of the total have fewer than 20 rooms, categorizing them as '20'. In contrast, one resort (4.35%) is classified as having '201 and over' rooms, while another (4.35%) is classified as having '101 - 200' rooms. The room categories '50-100' and '21-49' account for 30.44% and 26.09% of the total resorts, respectively. Fourth, regarding area (hectares), resorts with '2 - 9 hectares of land occupy the largest section, accounting for 52.17% of the total. In comparison, two resorts (8.70%) fall into the '100 and over' and '50 - 99' hectares categories, respectively. One resort (4.35%) is located on 21 - 49' hectares, while the other two (8.70%) are on 10 - 20' hectares. Three enterprises occupy the '1 - 2' hectares category, which accounts for 13.04% of all resorts. Lastly, 39.12% of the total amenities provide '5 - 9' amenities, making them well-equipped to meet the needs and preferences of a varied range of customers. This is followed by the '10 - 15' amenity category, which accounts for 21.74% of the total, demonstrating that a considerable fraction of resorts provide a wide range of services. Furthermore, nine resorts (30.44%) provide 'less than 4' amenities, emphasizing specialty or more simplified products. Resorts offering '16

- 19' amenities and '20 and over' amenities each account for 4.35% of all resorts, suggesting a small but significant section of resorts offering a wide range of services and facilities.

- In the presentation of data used as output variables, on monthly revenue, 65.22% of the total had a monthly income of 'less than 500,000' PHP. This means many resorts will operate on a smaller scale, possibly catering to specialized customers or focusing on cost-effective operations. In comparison, four resorts (17.40%) earn monthly sales ranging from '50,000,001 - 100,000,000' PHP, indicating a considerable group of businesses with a higher financial turnover. Furthermore, the income categories '100,000,0001 and over,' '10,000,001 - 50,000,000,' '1,000,001 - 10,000,000,' and '500,001 - 1,000,000' each account for 4.35% of total resorts. Second, regarding occupancy rate, 52.17% of the total maintain occupancy rates ranging from 50 - 74%.' This means that many resorts run at moderate utilization levels, responding to a balanced demand. In comparison, 17.39% of resorts have an occupancy rate of '75 - 90%,' suggesting a prominent group of institutions with higher patronage. Furthermore, 13.04% of resorts have occupancy rates in the '90 - 100%' range, demonstrating their success in obtaining near or full occupancy. The remaining 17.4% of resorts are divided into the 30 - 49%' and '29% occupancy rate categories, indicating the presence of a section of enterprises with lower demand levels. Third, average daily rate (ADR), 30.44% of the total, use ADRs ranging from 50 - 74%.' This suggests a significant number of businesses that operate in the mid-range pricing bracket. 21.74% of resorts are equally represented in both the '90 - 100%' and '75 - 90%' ADR categories. These resorts fetch high ADRs, which could be attributed to a concentration on high-quality service delivery and luxury guest experiences. The remaining 26.08% of resorts are divided into '30 - 49%' and '29%' ADR categories, demonstrating the existence of enterprises with more cost-effective pricing practices. Lastly, the number of rooms occupied or rented, 52.17% of the total, have 'less than 20' rooms occupied or rented. 30.43% of resorts have occupied or rented 21 - 40' rooms, placing them in the mid-sized category. A lower proportion of resorts, 8.70%, are classified into '100 and over' and '41 - 60' rooms occupied or rented. Resorts in the '81-99' and '61-80' categories suggest a possible opportunity for the regional tourist industry to create resorts with room inventories in these size brackets, catering to certain demand segments.
- The results of Data Envelopment Analysis (DEA) provide the summary of the technical efficiency score of 23 DUMs, as identified as DOT-Accredited Resorts in Davao Region, DMUs 1 to 9, received a perfect Efficiency Score of 1.000, classifying them as 'Efficient.' This indicates that these establishments are operating at or near the frontier of efficiency, making the most of their resources to provide services and amenities to guests. However, the analysis identifies a group of resorts (DMUs 10, 12, 14, 16, and 23) with Efficiency Scores below 1.000, classifying them as 'Inefficient.' These resorts, rated below perfect efficiency, may benefit from further investigation into their operations to identify areas where they can improve their

efficiency. The average Efficiency Score for all resorts in the Davao Region is calculated to be 0.976, suggesting that the accredited resorts operate on average at a relatively high efficiency level.

- DOT-accredited resorts in the Davao Region, sorted by province and segmented by efficiency scores, Davao Del Norte province has the most resorts, with 13 DMUs accounting for 57%. Nine are classified as 'Efficient,' while four are classified as 'Inefficient. Davao City has four DMUs, accounting for 17% of the total. All four resorts are classified as 'Efficient.' Davao De Oro, this province has three DMUs, which account for 13% of the total. All three resorts in Davao De Oro are classified as 'Efficient.' Davao Del Sur, two DMUs are located in Davao Del Sur, accounting for 9% of the total. One of these resorts is classified as 'Efficient,' while the other is classified as 'Inefficient.' Davao Oriental has one DMU, which accounts for 4% of the total. This resort is classed as 'Efficient,' signifying high efficiency.
- DOT-accredited resorts in the Davao Region, classified by resort classification. Beach Resorts: This category comprises the vast majority, with 15 DMUs accounting for 65.2%. Among these, 11 are categorized as 'Efficient,' while four are labeled 'Inefficient'. Inland Beach Resorts, this category contains two DMUs, accounting for 8.7% of the total. Both resorts in this category are rated as 'Efficient.' Mountain Resorts, similarly, two DMUs make up 8.7% of the total in the mountain resorts category. Both resorts are classified as 'Efficient'. Resorts and Restaurants are two DMUs in this category, accounting for 8.7%. Both resorts in this category are categorized as 'Efficient.' Garden Resorts, this category also has two DMUs, accounting for 8.7% of the total. One resort is labeled 'Efficient,' while another is labeled 'Inefficient'.
- The DOT-accredited resorts in the Davao Region are classified by the type of accessibility (how these resorts are reached) and segmented by their efficiency scores. By Land and Sea, this category comprises the majority, with 13 DMUs accounting for 57% of the total. Among these, nine are rated as 'Efficient,' while four are labeled 'Inefficient' while, by Land, this has ten DMUs, which account for 43% of the total. Nine resorts in this category are rated as 'Efficient,' while one is classified as 'Inefficient.'

9.2 Conclusions

- As discussed in Chapter 4, all the input variables, namely, operation cost, number of employees, number of rooms available, and area of the resorts (in hectares), provide a valuable impact on the efficient operations of the DOT-accredited resorts in the Davao Region. To be more specific, higher-cost resorts may have distinct business strategies, services, or market positioning than lower-cost resorts, resulting in a diverse visitor experience and regional tourist scene. Workforce size groups also have ramifications for policy formulation and resource allocation. Addressing the requirements and challenges of smaller resorts with fewer staff may necessitate different tactics and support mechanisms than larger resorts.

Creating training and capacity-building programs customized to the specific needs of resorts in each category could be a critical step toward improving the local tourism industry's competitiveness and sustainability. In addition, room capacity categories directly impact the area tourism industry's ability to accommodate guests, cater to various market segments, and improve overall guest experiences. Resorts with greater hotel capacity may attract larger events or conferences, contributing to the Davao Region's economic vitality. Lastly, different land area categories have far-reaching consequences for the regional tourism economy. Larger resorts can provide more comprehensive facilities, recreational spaces, and increased guest experiences. They may be appropriate for large-scale events, conferences, or eco-tourism activities.

- Regarding output variables, Resorts with more amenities may appeal to customers looking for all-inclusive leisure experiences. In comparison, those with fewer amenities may cater to specific niches or prioritize a more intimate and customized atmosphere. Resorts with larger monthly earnings contribute considerably to the Davao Region's economic vibrancy. They are more likely to be able to spend on infrastructure, personnel development, and marketing, leading to more competitive offers and potentially attracting a broader range of tourists. Resorts with higher occupancy rates are frequently better positioned to generate higher profits, sustain local employment, and contribute to the Davao Region's overall economic strength. They are likely to have created effective marketing strategies, efficient operations, and high levels of guest satisfaction. Resorts with greater ADRs may earn higher revenue per guest, encouraging economic growth and service quality investment. These resorts will likely appeal to customers looking for more upscale amenities and personalized experiences. Resorts with better room occupancy levels can generate higher profits, promote local employment, and contribute to the Davao Region's overall economic vibrancy.
- The Data Envelopment Analysis (DEA) becomes a powerful instrument to measure operation efficiency by calculating the efficiency score. The study results revealed that the average Efficiency Score for all resorts in the Davao Region is calculated to be 0.976, suggesting that the accredited resorts operate on average at a relatively high-efficiency level. However, the presence of a few inefficient resorts shows that the general efficiency of the regional tourism business can be improved. These discoveries have several significant consequences. To begin, resorts with Efficiency Scores less than 1 represent areas for improvement where efforts can be directed to increase operational efficiency. Identifying the causes of inefficiency might help these resorts optimize resource allocation and service delivery. Second, identifying efficient resorts (Efficiency Score of 1.000) emphasizes best practices and serves as a standard for other enterprises to strive for. The analysis can be used to promote successful solutions and stimulate industry-wide technological efficiency improvements.

- The demographic characteristic significantly contributes to the efficient performance of DOT-accredited resorts in the Davao Region. These demographic characteristics, such as provincial category, type of resorts, and accessibility, provide policymakers, industry stakeholders, and tourism associations with information regarding the state of the tourism industry in various provinces, the type of resorts, and the means of reaching the resorts (accessibility). These results enable more focused assistance and coordinated efforts to improve the region's competitiveness and sustainability.

9.3 Recommendations

Based on the findings of the study, the following recommendations were proposed:

- To improve the area of inefficiency, the researcher may recommend that all resorts conduct frequent operational audits and efficiency analyses in partnership with industry specialists. These audits will aid in identifying specific areas of inefficiency, such as resource allocation, energy usage, or marketing tactics, and encourage resorts to undertake self-assessments and identify bottlenecks in their operations that impede efficiency. This self-awareness will be a critical first step toward progress.
- DMUs may conduct Benchmarking in developing a centralized data-sharing platform where resorts can access performance benchmarks within and across efficiency categories. Resorts can share best practices and discover performance gaps. Encourage a benchmarking culture by encouraging peer-to-peer knowledge sharing. Resort associations can organize regular meetings and workshops to discuss industry best practices and key performance indicators (KPIs).
- To sustain and maintain profitability the researcher may recommend among completely efficient resorts to preserve or grow their profitability by focusing on cost reduction and resource optimization. DMUs are encouraged to invest in revenue diversification and chances for upselling. Inefficient resorts' primary focus should be improving cost efficiency, recognizing profit margins, and applying yield management measures. The key goal for fully inefficient resorts should be to minimize operational costs and enhance profitability. Emphasize the need for thorough financial planning, pricing strategies, and revenue development activities.
- On the other hand, to improve customer satisfaction the researcher recommends that all resorts invest in customer service training and development programs aimed at increasing client experiences, communication, and tailored services. Encourage resorts to solicit guest input via surveys, reviews, and direct interactions. Use this feedback to make informed service-improvement decisions. To maintain and increase service standards across all resorts, use quality assurance systems that include mystery shopper assessments.
- Finally, to achieve sustainability the researcher recommends promoting environmentally friendly behaviors in areas such as energy conservation, trash

management, and water utilization. To encourage environmental responsibility, create a sustainable tourism certification program for resorts. This endeavor should be incorporated into the overall intervention strategy. Regional and local sustainability activities should be supported, such as beach and environmental clean-up campaigns, wildlife protection, and reforestation programs.

9.3.1 Intervention Programs and Projects Plan

The study's general findings can be used to tailor intervention programs and project plans based on the specific efficiency categories: Fully Efficient, Under Efficient, and Fully Inefficient. Each category will have its own set of emphasis areas and programs to satisfy their specific demands.

A. Fully Efficient Resorts

In an ambitious move to sustain and elevate the efficiency of fully efficient resorts in the Davao Region, a comprehensive plan has been laid out under the overarching goal of continuous improvement and innovation.

- **Continuous Improvement & Innovation:** To maintain and enhance the existing efficiency gains, a multifaceted approach is proposed. Knowledge-sharing workshops are envisioned, creating a platform for peer-to-peer learning and the exchange of best practices among fully efficient resorts. Moreover, a pilot testing initiative for cutting-edge technologies will be launched, supporting the exploration and implementation of emerging advancements in renewable energy, water management, waste reduction, and smart automation. The resorts will also be encouraged to pursue sustainability certification programs, such as LEED or Green Globe, providing them with internationally recognized credentials and a competitive edge in accessing new markets. The inspiration for these initiatives is drawn from reputable sources like the International Tourism Partnership (ITP), the Global Sustainable Tourism Council (GSTC), and the World Future Council (WFC).
- **Leadership Development & Capacity Building**: Recognizing the pivotal role of the resort staff in maintaining and improving efficiency practices, a robust plan for leadership development and capacity building is proposed. Targeted training programs will be implemented, focusing on areas such as energy management, water conservation, waste minimization, guest education, and sustainable procurement. Leadership development workshops are designed to equip resort managers and staff with essential skills in sustainability leadership, change management, and employee engagement. Additionally, mentorship programs will be established, connecting experienced sustainability professionals with resort staff to provide guidance and support. These initiatives draw inspiration from esteemed organizations such as the UNWTO Sustainable Development of Tourism Programmed, the International Centre for Responsible Tourism (ICRT), and the Tourism Education and Training Institute (TETI).

B. Under-Efficient Resorts

In a concerted effort to assist under-efficient resorts in reaching full efficiency, a comprehensive intervention plan has been devised with a clear goal of targeted interventions.

- **Efficiency Audits & Benchmarking**: The first step in this plan involves conducting thorough resort efficiency audits. This includes a comprehensive analysis of energy consumption, water usage, waste generation, and operational practices to pinpoint areas of inefficiency. Drawing inspiration from leading resorts, benchmarking against industry standards and best practices will be implemented to set realistic improvement goals. The subsequent phase involves the development of customized action plans, tailored for each under-efficient resort. These plans will outline specific interventions and investments required to achieve efficiency goals. Sources for guidance in this initiative include the ASEAN Centre for Energy (ACE), the World Council on Tourism, Hospitality & Education (THE-ICE), and The Climate Registry.
- **Financial Incentives & Technical Assistance**: To overcome financial barriers and provide necessary support, a multifaceted approach is proposed. Grant programs will be introduced to offer financial assistance to under-efficient resorts, enabling them to invest in energy-efficient equipment, water-saving technologies, and waste-reduction infrastructure. Technical assistance programs will provide expert guidance and support throughout the implementation process, covering aspects such as project design, procurement, and training. Moreover, public-private partnerships will be fostered to collaborate with private sector partners, accessing both financing and expertise for under-efficient resorts. The UN Environment Program Finance Initiative (UNEP FI), the Global Green Grants Fund (GGGF), and the World Wildlife Fund (WWF) are identified as valuable sources of financial and technical support in this endeavor.

This targeted intervention plan is designed to empower under-efficient resorts, addressing their specific challenges and paving the way for a transformation towards full efficiency. Through a combination of rigorous audits, benchmarking, financial incentives, and expert guidance, these resorts are poised to embark on a journey toward sustainability and operational excellence.

C. Fully Inefficient Resorts

With the goal of guiding fully inefficient resorts toward improved operational efficiency, a targeted intervention plan has been developed, encompassing various programs and projects.

- **Regulatory Compliance, Community Engagement & Awareness:** The foundation of this plan lies in ensuring regulatory compliance, fostering community engagement, and raising awareness. Compliance workshops will be conducted to educate resort owners and operators on relevant environmental regulations and best practices. Simultaneously, awareness campaigns will be launched to educate

the public about the importance of sustainable tourism and responsible resort operations. Community engagement initiatives will involve collaboration with local communities to develop sustainable tourism practices that benefit both resorts and residents.

- **Resource Efficiency Training:** A crucial aspect of the plan involves providing resource efficiency training programs specifically designed for fully inefficient resorts. These programs will focus on cost-effective resource allocation, lean operations, and waste reduction, aiming to equip resorts with the skills needed to enhance their overall efficiency.
- **Government and Private Sector Collaboration:** Facilitating collaborations with government agencies and private sector partners is essential. This includes assisting fully inefficient resorts in grant applications and accessing available incentives. By leveraging partnerships, these resorts can secure funding and support for their transformation efforts.
- **Operational Restructuring:** To address the root causes of inefficiency, close collaboration with fully inefficient resorts is required. The plan involves working closely with these resorts to implement substantial operational restructuring, providing guidance on staffing, resource management, and marketing strategies. This comprehensive approach aims to bring about a fundamental transformation in the operational dynamics of fully inefficient resorts.

Sources for guidance and support in these endeavors include the Department of Environment and Natural Resources (DENR), the Davao Region Tourism Authority (DRTA), Tourism Economics, The International Society of Hospitality Management (ISHM), and the Green Hotels Association (GHA). Through these programs and collaborative efforts, fully inefficient resorts are guided towards a path of improved efficiency, sustainable practices, and enhanced community engagement.

In all circumstances, a framework for monitoring and evaluating the progress and impact of interventions should be devised. The ultimate goal is to increase Davao Region resorts' overall competitiveness and sustainability, regardless of their efficiency level, and contribute to the region's economic and environmental well-being.

Conflict of Interest Statement

The authors declare no conflicts of interest.

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