

BUILDING RESILIENCE TO CLIMATE CHANGE IN ISLAND HOTELS: A DATA ENVELOPMENT ANALYSIS

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Abstract: Being to climate-sensitive sector, hotels require a holistic approach to increase their operational efficiency through sustainability and quality management. The location factor makes island hotels more vulnerable to climate change impacts compared with those located on the mainland. Based on data envelopment analysis, this study examines the operational efficiency before and after the occurrence of a climate change event to explore the adaptation strategies of island hotels in dealing with unexpected climate change risks. The findings revealed that different approaches are applied by the selected accommodation providers, which resulted with different efficiency levels. The implication of the findings is discussed based on the assumption of the resource-based view, which is applied by inefficient hotels to improve their operations by referencing the benchmark hotel. The ability of island hotels to optimise their existing resources is regarded as a crucial aspect to survive in the aftermath of an adverse climate event.

Keywords: Tourism development, climate change, business sustainability, hotels, adaptation strategy.

Climate change in Malaysia

The Intergovernmental Panel on Climate Change defined climate change as any change of climate that lasts for an extended period of time and has now brought consequences to many natural systems (Parry *et al.*, 2007). Climate change events include changes in the usual temperature, precipitation, or wind pattern, or a rise in sea level over a longer time frame (Arabadzhyan *et al.*, 2020). Over the past decades, these events have been observed to happen more frequently. A change in the climate is seen by some as beyond the control of human beings. However, some experts claim that increasing climate temperatures are the result of deforestation and human activities that have contributed to the release of gases such as carbon dioxide into the atmosphere (Kato & Lee, 2022). Such activities include the production and driving of vehicles, and the outputs of various types of factories. Industrial development has also been identified as another factor that is causing damage to the atmosphere through the release of methane gas (Norshidi, 2018). It is therefore highly likely

that because of such activities, Malaysia has witnessed several extreme weather events, including tsunamis, droughts, and floods across the country (Sivaratnam *et al.*, 2022).

It is undeniable that climate change has had many negative impacts on humankind (Arabadzhyan *et al.*, 2020), and it has economic, agricultural, social and environmental consequences for the quality of the daily life of populations around the world. In Malaysia, for example, an extreme flood in Penang in November 2017 caused by an abnormally heavy downpour has impacted the community very badly. It not only resulted in damage to public facilities and businesses and loss of shelter, but also loss of life. As this kind of event had never happened before, no one expected to having to deal with such a situation and, therefore, no one had prepared any contingency plan. It is estimated that almost 5,000 people fell victim to this extreme weather event. As a consequence, the Malaysian government had to spend almost RM1.7 million to help farmers and also provide an additional RM33.4

million to other flood victims (Norshidi, 2018). Climate change has also brought challenges to the Malaysian agriculture sector. Based on a report by the Malaysian Nature Society, the fruit seasons in Malaysia have become disrupted (Panirchellvum, 2017). The impact of climate change, such as invariability of rainfall, affects the crop yield and it has been reported that yield has dropped by 10 to 15 percent annually (Norshidi, 2018). Another Malaysian commodity that is reported to be affected by climate change is palm oil (Norshidi, 2018).

Experts have warned that the impact of climate change will worsen over time (Norshidi, 2018). It is clear that adverse climate events pose a challenge to the government and every member of society and that everyone has some responsibility to manage climate change impacts accordingly. As such, the impacts of extreme weather events require the government to improve the healthcare system so as to provide sufficient facilities and services to deal with any injury and diseases that arise during and as a result of such events. The situation may become severe if diseases are not treated quickly to avoid their spread. Similarly, the impacts of climate change may cause food scarcity because food sources are affected by unusual seasonal and weather characteristics. Furthermore, many types of business also have to bear the consequences of loss of revenue in an attempt to continue to operate in such circumstances. These are just some of the impacts of climate change events that can potentially arise if the event and the issues around it are not well managed.

According to Mustaffa (2022), Malaysia is moving towards managing the impacts of climate change through many efforts, including shifting the old notion of industrial practices and behaviour. One of the main targets of this effort is to cut carbon emissions by 40 percent by 2020. Moreover, it can be said that climate change has created a new positive relationship between humankind and nature (Guidotti & Cwikel, 2022). For instance, in response to the worst flood experienced in the country in 2014, which occurred in Malacca, Malaysia

conducted an awareness programme aimed at the general public of Malacca. Also, the state government of Malacca was the first to take the initiative to ban all plastic takeaway food packaging and carrier bags. The programme started in January 2016 as part of the effort to increase the involvement of wider society in dealing with a global phenomenon that may impact every person on the planet. In addition, Malacca also implemented the use of more public electric vehicles in the city and provided free charging stations for private electric car owners. In conjunction with its effort to support a sustainable environment, Malacca has also allocated RM285 million to green projects over the next five years.

At the international level, Malaysia has been recognised as among Southeast Asian countries that have good environmental policies and regulations (Tang *et al.*, 2014). In particular, the issue of climate change risks and their implications has been highlighted through the legislative efforts of the Ministry of Natural Resources and Environment. However, it does not seem that the matter is being taken seriously by every member of society, including business owners (Mat *et al.*, 2020). Although it has been reported that awareness of the impact of climate change in Malaysia is rising, the population as a whole lacks knowledge and proper operational guidance on how to deal with it (Abas *et al.*, 2017; Rashidi *et al.*, 2022). In fact, some countries treat this global phenomenon as a distant problem, or someone else's problem, because they may have not faced any extreme weather condition themselves. So, it follows that until an actual adverse climate event happens, it is unlikely that the public will take action to mitigate the adverse impacts of climate change by following the proper guidance given to them by the responsible parties.

While it is known that climate change has both social and economic impacts, adaptation strategies in the hospitality sector still constitute an under-researched area (Gao *et al.*, 2022). However, climate change is a global issue that potentially threatens all humankind. Therefore,

the development of adaptation strategies should be given due consideration by every member of society. This is especially true for industries, such as accommodation providers in island locations that are at high risk of adverse impacts of climate change events. By their very nature, potential climate change impacts, such as an increase in sea level, erosion of coastal areas and shorelines, damage to coral reefs and death of marine life (Sivaratnam *et al.*, 2022), all have direct consequences for island-based tourism. These are some attractions that if they are severely damaged or cease to exist, it could slow down the growth of the island hotel industry, or even destroy their principal business operations.

The Hotel Industry

Generally, the hotel industry is associated with tourism quality, which is assessed on the basis of strategic location, accessibility and accommodation. According to the World Tourism Organisation, tourism contributes almost 10% to the global gross domestic product and approximately one out of every 11 individuals has a job connected in some way to the tourism sector (Kumar & Hussain, 2022). Moreover, the global tourism industry accounts for approximately seven percent of exports and 30 percent of service exports globally, which in monetary terms equates to about US\$1.5 trillion in exports annually (Kumar & Hussain, 2022). Developments in the hotel industry tend to occur in tandem with those in the tourism sector. In other words, they complement each other, in that the hotel industry is one of the elements required to achieve tourism accessibility.

The tourism industry's involvement in efforts to combat global warming and climate change can be seen in the urge among players in the industry to achieve a sustainable environment (Johnston & Cooper, 2022). The elements of sustainability are related to the development of the green hospitality industry. Tourism players are closely involved in the implementation of this green industry. To date, green hospitality efforts include saving water and energy resources, reducing waste, and

conserving the ecosystem (Amoako *et al.*, 2022). Currently, hotels are being encouraged to design more effective and efficient marketing and green programmes. Such programmes will benefit not only hoteliers, but also customers, shareholders, communities and the environment.

The Malaysian tourism industry is known to be one of the important contributors to the national income. This is evidenced by the large amount of total investment made by private investors in the industry. These investors are mostly interested in investing in the sector due to its huge potential in generating income. For instance, in 2015, the total investment by private entities was reported to have been close to RM24.5 billion and has benefited the industry as a whole (Jala, 2016). Similarly, as a Malaysian strategic investor, Khazanah Nasional Berhad has invested RM6.7 billion into tourism projects in support of the economic and social development of Malaysia (Jala, 2016). This type of investment has taken place because of the good projections that have been made in respect of tourism industry development, which could benefit the country in many ways, especially in contributing to economic stability and social development (Idris, 2019; Ike *et al.*, 2020).

Since the purpose of this study is to investigate how and to what extent the hotels in the island tourism sector adapted to the impacts of the climate change event in Malaysia in 2014, data on this part of the industry is analysed for the period 2013 to 2016 to observe the influence of this event on the business environment during those particular years.

Tourist arrivals to Malaysia increased between 2010 and 2014, from 24.6 million to 27.4 million, and the country has continued to be one of the world's leading tourist destinations. It has also been forecast that accommodation providers, as part of the hospitality industry, are expected to generate the largest proportion of income for Malaysia in the future (Han, 2021). The development of the hospitality industry in Malaysia is strongly linked to the development of island hotels, as they are one of the main tourism attractions. However, accommodation providers

that operate in an island setting are extremely vulnerable to the impacts of climate change, such as beach erosion, severe weather events, including heavy rainfall, and rising sea levels and temperatures, as well as the degradation of marine biodiversity (Belias *et al.*, 2022).

The Resource-based View and Climate Change

The resources and assets owned by an organisation exert a strong influence on the implementation of an organisational strategy to accomplish organisational goals. An organisation may utilise its own resources to gain a competitive advantage, especially in a dynamic business environment. The resource-based view (RBV) has been widely used as a primary concept to underlie the hospitality and tourism research (Kruesi & Bazelmans, 2022). The RBV framework consists of three main dimensions, namely dynamic capabilities, knowledge management, and intellectual capital that act as a bridge between people management practices and the core competence of companies (Wright *et al.*, 2001). The integration of the resources of employees and employers is achieved through the company's capability of developing its employees' skills and abilities to support future innovations. The RBV of competitive advantage is an illustration of the need for the systematic management of resources and capabilities to attain competitive advantage (Nayak *et al.*, 2022). Based on the RBV assumption, organisational resources, capabilities and systems collectively develop an organisation's competitive advantage.

One of the main attractions of the RBV concept is the idea that the organisation can develop heterogeneous resources and capabilities to add value to its products or services, which can then contribute towards establishing the organisation's sustainable competitive advantage (Chun, 2016). This is done by utilising and exploiting current resources and competencies owned by the organisation for better growth and profitability. Essentially, an organisation's success and trade secrets cannot be imitated easily if their resources are

valuable, rare and non-substitutable. In this regard, the most cited work of Barney's (1991) noted that organisational resources include tangible and intangible assets that are owned by the organisation. Also, these resources include other internal and external resources, such as employees' skills and abilities, intellectual capital and even customer relationship management.

The ability to utilise current and existing resources allows the organisation to compete in the short term and sustain its position in the market over the long term (Panda & Reddy, 2016). This can be achieved through the usage of existing resources without additional cost to the current business process or future plan. As a result, the organisation is able to operate more efficiently to maximise its output by utilising its current resources (Xu *et al.*, 2014). Furthermore, the process of developing and implementing a new plan can be done effectively because it is made in line with the capabilities and competencies that are already being used. This is then likely to increase the ability of the organisation to predict its future direction and reduce risks if it attempts to innovate products or services for future business development (Tomas & Juan, 2018). For instance, the strengths of the organisation's human resources can be tailored according to specific products or service developments, while their weaknesses can be overcome through adopting an appropriate talent management approach. Thus, the organisation can reduce the detrimental effect of incompetent employees on the organisation's achievements.

The intellectual capital in a firm is associated with the skills of its employees and the systems used. This includes the human capital that produces knowledge, skills and abilities that could assist an organisation in achieving its goals (Wright *et al.*, 2002). However, the investment in people management in terms of increasing the knowledge and skills of the workforce and the connectedness of human capital may create path dependence, social complexity and time-compression diseconomies. Therefore, difficulties may arise in implementing the

RBV in organisations (Chen *et al.*, 2022). As organisational performance is mainly correlated with the functions of human capital as a valuable resource, an effective strategy is needed so that those resources can be utilised.

According to Darcy *et al.* (2014), the RBV is suitable for small- and medium-scale enterprises (SMEs) that aim to gain sustainability as the application of the RBV leads to novel, exciting and fruitful undertakings. Some SMEs agree that the use of the RBV in their operational implementation provides dramatic outcomes in terms of growth and operations (Darcy *et al.* 2014). Moreover, the survival of SMEs has been proved to be much longer due to the sustained competitive advantage that can be achieved from adopting a RBV (Tomas & Juan, 2018). Also, technology business equipment and industrial development is gaining interest in terms of studying the RBV perspective (Grant & Yeo, 2022). Thus, it is important for a business to utilise its valuable internal resources to gain a competitive edge in their business operations.

In the tourism industry, the RBV is seen as crucial as the nature of services provided require direct interactions with customers in providing those services. The employees are involved in the provision of some of the services in hotels specifically, include receptionists, hotel managers and waiters/waitresses. According to Fubah *et al.* (2022), education, experience and performance are valuable employee attributes in the service industry. Other than the capability to complete their main tasks, such as fulfilling customers' needs and wants, employees in the service industry can be trained to provide a unique identity that distinguishes their services from those of other players within the same industry (Chikán *et al.*, 2022). From the business perspective, the uniqueness of products or services can enable the organisation to expand its business locally and internationally because the quality of "rareness" is often sought by customers, which can consequently enable the organisation to gain a foothold in different markets (Chen *et al.*, 2022). Also, Horng *et al.* (2022) stated that the achievement of innovation

in the tourism sector, especially in hotel companies, could influence the development of a firm's business strategy. This effort includes engaging in business activities with people or entities outside the organisation. It is believed that doing so has a positive impact on the existing knowledge in a company and enables the company to develop beyond its usual organisational boundaries.

Research Problem

The uncertainties of climate change impact have an effect on tourism industry development, particularly because of the safety issues and adaptation strategies that need to be considered when facing unexpected weather events (Arabadzhyan *et al.*, 2020). These factors are especially pertinent to the ability of tourism players in the hotel sector. This is related to the effort to gain competitive advantage because in the aftermath of an adverse weather event, the stability of the hotel structure itself, the scenery of that can be viewed from the hotel and the attractions that draw tourists to stay in the hotel may have been damaged or even destroyed beyond repair. Thus, climate change has a significant effect on the tourism industry. From a different perspective, Belias *et al.* (2022) stated that the attention given to the study of the impact of climate change on the agricultural and manufacturing sectors has declined due to the potential of the service industries. Moreover, the huge potential of the tourism industry in particular in contributing towards the sustainable development goals of many countries is encouraging more exploration of the challenges facing tourism entities, such as hotels, today and in the future in managing the impact of climate change as compared with other industries.

Researchers suggest that climate change could influence the innovation and positioning of tourism offerings. It may even deteriorate tourism development if key attractions disappear due to the climate change impact (Belias *et al.*, 2022). It has been shown that changes to natural resources as one of the main tourism attractions

is considered to be among the causes of decline in tourism. This is because the loss of natural resources makes it harder to encourage tourists to visit a country. Also, the empowerment and promotion of the well-being of local communities need to be emphasised because the development of the tourism business also depends on those factors (Kang, & Jang, 2022). Hence, the preservation of natural resources and culture is critically important to maintain the well-being of communities. In this regard, the proper management of natural parks and reservations, as well as the strategic prevention of environmental degradation caused by tourism activities are just some of the crucial issues that need to be addressed by tourism practitioners.

Therefore, this study attempts to investigate the efficiency level of hotel operations in relation to the impact of climate change and to propose a benchmark hotel that can be referred to in order to guide the operational activities of other hotels in adapting to climate change impacts. This research focuses on island hotels/resorts in three islands in East Coast Peninsular Malaysia, namely Perhentian Island, Redang Island and Tioman Island. These three islands are chosen based on its attractions and popularity among tourists in Malaysia. For instance, Tioman Island has been recognised as one of the most beautiful islands in the world by *TIME* magazine (Tourism Malaysia, n.d.).

Perhentian Island is situated in the north of Kuala Terengganu, and to the east of the town of Besut. It is made up of two main islands, namely Perhentian Island Besar and Perhentian Island Kecil. In the Malay language, Perhentian literally means “stopover”. This is because the island has long been used as a sanctuary by fishermen and is among one of the earliest trading stops on the old trade routes that connected Thailand and Terengganu. Perhentian Island is the most popular island in Malaysia for diving and snorkelling, especially among tourists who enjoy underwater activities (Tourism Terengganu, n.d.). The clear appearance of the aquamarine water, the sandy beaches, and the natural beauty of the island are among the attractions that make

tourists want to visit the island again and again. In fact, Perhentian Island is recognised as being among the world’s best scuba diving spots, and was ranked the 13th Best Beach in the World in 2013 by CNN. Other than that, Perhentian Island was also described as the “5th Best Beach to Swing a Hammock” by the *Lonely Planet Travel Guide Book* in 2010 (Tourism Terengganu, n.d.). Somewhat unusually, there is no road for land transportation in Perhentian Island; the only way to commute is by taxi boat or by walking. Perhentian Island is also very famous among nature lovers due to the quality of its natural environment.

Redang Island is the largest of the three islands selected for this study. The island is situated on the east side of Peninsular Malaysia and 45 km from Kuala Terengganu (Tourism Terengganu, n.d.). It takes just half an hour by taxi boat to travel from Kuala Terengganu to Redang Island. Tourists can also reach the island from Shahbandar Jetty or Merang Jetty, but the journey from those departure points takes up to one and half hours. Known for its astonishing marine environment, clear blue water and sandy beaches, Redang Island attracts many tourists from all over the world. One of the factors that makes the island so attractive is that it lies in the Terengganu Marine Park area. This area is protected and managed by the Department of Marine Parks, which is responsible for protecting the wildlife and the marine environment throughout Malaysia. The island is also known for having the most beautiful coral reefs that are rich in many forms of tropical, exotic marine life. Redang Island is seen as a heaven by environmental activists because of its mangrove forest that is very helpful in sustaining the natural ecosystem of the island. The island is also home to preserved plant fossils of the Upper Palaeozoic Age, which means that they are at least 250 million years old. Clearly, Redang Island has a long history, but nowadays it is most famous among travellers who wish to stay in a luxury island. It has many luxurious resorts that offer international standard services. Similar to Perhentian Island, there is no land transportation in Redang Island.

The other island included in this study is Tioman Island, which is recognised as a geological wonder, known as a tear-shaped island paradise (Tourism Pahang, n.d.). The island is located 80 km from Kuala Rompin in the state of Pahang and 80 km from Mersing town in the state of Johor. The island has a total land area of about 133.6 sq feet. It attracts visitors with its warm sandy beaches, blue seas and beautiful coral reefs. In addition to its unique marine ecosystem, the island has also been gazetted by the state government of Pahang in efforts in protecting the flora and fauna on the island. As a result of such efforts, many protected species can be found on the island, such as the binturong (bear cat), red-giant flying squirrel, black squirrel, python, unique bird species, and many more. Unlike the other islands, Tioman Island can be visited all year round and the island is not closed during the monsoon season. Even when the monsoon winds blow from October to January, ferries still operates once per day and certain big resort and hotels still run their businesses by offering a discount to tourists to encourage them to stay.

Research Method

Nine hotels were involved in this study: three small and medium hotels for each of the above-described three islands. To evaluate the operational efficiency of small and medium hotels, this study employed a nonparametric approach, namely, data envelopment analysis (DEA). DEA is a linear programming approach that is used to calculate the efficiency scores of decision-making units (DMUs), relative to other similar DMUs to estimate a “best practice” frontier or to identify high-performance DMUs. In the context of this study, efficiency was considered to be present when the amount of inputs used by a hotel was at its lowest to create the greatest amount of output. Two basic models have been developed for measuring efficiency using the DEA, namely the Charnes, Cooper and Rhodes (CCR) and the Banker, Charnes and Cooper (BCC) models, previously known as the constant return-to-scale (CRS) and the variable

return-to-scale (VRS) models, respectively. In this study, CCR, which is input-oriented, was used because this study aims to minimise the inputs required to achieve an improvement to attain a certain output level (Ko *et al.*, 2017). A DMU with a score of 1 (or 100%) is considered efficient (located on the efficiency or best practice frontier), while a DMU with a score of less than 1 is categorised as inefficient (located beneath the frontier). Hence the DMU/DMUs with a score of 1 have become a benchmark for inefficient DMUs and the DEA is able to calculate how much input should be decreased in order for inefficient DMUs to gain a place on the efficient frontier.

As mentioned earlier, this study uses CCR to explore the efficiency of the operations of small and medium hotels on three islands. The CCR input-orientation implies that the organisation is focusing on making improvements to the performance of its inputs to achieve efficiency. In this study, the input variables were salaries and non-current assets, while the output variables were total revenue and profit. Total revenue was chosen as the financial output variable because revenue or total revenue has been used in most of the studies that have been conducted to assess organisational performance (Chmielewska *et al.*, 2022).

Input and output data were extracted from the small and medium hotels’ annual reports for the years 2013 and 2015 to estimate their operational efficiency. In 2014, Malaysia experienced unexpected weather events, including floods in several states of the country, especially in the East Coast of Peninsular Malaysia. As these events occurred in December 2014, the operational data for the year 2014 was excluded from this study. However, the impact after these climate change events was observed through the annual data for the year 2015. Therefore, by using the timeframe of 2013 and 2015, this study was able to observe changes in the operations of the selected small and medium hotels before and after the occurrence of a climate change event.

Table 1: List of decision-making units (DMUs) on the islands

Island	DMUs (Small and medium hotels)
Perhentian Island	DMU 1
	DMU 2
	DMU 3
Redang Island	DMU 4
	DMU 5
	DMU 6
	DMU 7
Tioman Island	DMU 8
	DMU 9

Efficient Hotels in Perhentian Island and Tioman Island

According to the DEA model, a hotel with a value of 1 is relatively efficient and considered to be a high-performance or best-practice hotel. In contrast, a hotel with a value of less than 1 is assumed to be inefficient in its operations. From Table 2, which shows the efficiency scores for 2013, it can be seen that DMU 3 and DMU 8 are efficient hotels/resorts because they have a score of 1, meaning that they have achieved 100% efficiency in 2013 as compared with the other DMUs. DMU 3 is located in Perhentian Island, while DMU 8 is situated in Tioman Island. The small and medium hotel with the lowest efficiency (0.1338) is DMU 7, which is also located in Tioman Island. The results of the

DEA show that none of the DMUs in Redang Island was able to achieve an efficient level of operations in 2013. The best efficiency score among the DMUs in Redang Island is DMU 6, which had achieved only 70% efficiency in its operations.

Interestingly, the operations of the DMUs improved in 2015 despite the extreme flooding that occurred in the East Coast of Peninsular Malaysia in 2014. This suggests that the impact of climate change is less likely to influence the operations of small and medium hotels in these three islands. Hence, there are improvements in the efficiency score of the hotels in comparison to before and after the climate event. Table 3 shows the efficiency score for all DMUs in 2015. Based on the table, four DMUs achieved

Table 2: Efficiency Scores for 2013

No.	DMU	Score	Rank
1	DMU 8	1	1
2	DMU 3	1	1
3	DMU 6	0.70382	3
4	DMU 2	0.62381	4
5	DMU 4	0.38704	5
6	DMU 9	0.31181	6
7	DMU 5	0.31016	7
8	DMU 1	0.18124	8
9	DMU 7	0.1338	9

Table 3: Efficiency scores for 2015

No.	DMU	Score	Rank
1	DMU 2	1	1
2	DMU 8	1	1
3	DMU 9	1	1
4	DMU 3	1	1
5	DMU 4	0.54749	5
6	DMU 5	0.51097	6
7	DMU 7	0.42657	7
8	DMU 1	0.39675	8
9	DMU 6	0.21677	9

efficiency in their operations, namely, DMU 2, DMU 8, DMU 9, and DMU 3. Also, the overall operations of the other DMUs showed improvement compared with 2013. Importantly, two DMUs – DMU 8 and DMU 3 – remained efficient in both of the years under study.

The average efficiency scores for all DMUs are provided in Table 4. From the ranking of the DMUs, it can be seen that two DMUs were able to maintain their operational efficiency after the climate change event. DMU 3 and DMU 8 achieved 100% efficiency by utilising their existing resources. This suggests that the climate change impact did not influence the operations of these hotels/resorts. The results also revealed that none of the DMUs in Redang Island can be

considered efficient (score of less than 1) in their operations. In addition, the efficiency scores for all DMUs in Redang Island are less than 50% and the scores are almost similar. In contrast, the DMUs in the other two islands have huge differences in terms of their efficiency scores. This implies that different approaches are used by each DMU in Perhentian Island and Tioman Island in managing their resources for their operations, either with or without taking into account the climate change impact. Therefore, the results indicate that the operations of DMU 3 and DMU 8 can be used as a reference by inefficient DMUs for improvements.

The DEA computation also provides a projection of the reduction in inputs needed by

Table 4: Average efficiency scores for 2013 and 2015

Island	DMU (Small and medium hotels)	Efficiency score (2013)	Efficiency score (2015)	Average efficiency score	Rank
Perhentian Island	DMU 1	0.18124	0.39675	0.288995	8
	DMU 2	0.62381	1	0.811905	3
	DMU 3	1	1	1	1
Redang Island	DMU 4	0.38704	0.54749	0.467265	5
	DMU 5	0.31016	0.51097	0.410565	7
	DMU 6	0.70382	0.21677	0.460295	6
Tioman Island	DMU 7	0.1338	0.42657	0.280185	9
	DMU 8	1	1	1	1
	DMU 9	0.31181	1	0.655905	4

the inefficient DMUs to enable them to achieve the status of an efficient DMU (i.e., a DMU on the efficiency frontier). Table 5 summarises the reduction amount in percentage terms. Note that a value of zero in the table denotes that for the efficient DMUs, no reduction of inputs is required. It can be observed from the table that, in line with the better efficiency scores achieved in 2015, the percentage of input reduction required by the inefficient DMUs is also lower for 2015 than 2013. The results also show that in 2013, the underutilisation of fixed assets is a major concern because the inefficient DMUs have to reduce this input by almost 61% to enable them to operate efficiently. On the other hand, the projection indicates that the inefficient players have to reduce only their fixed assets by about a third in 2015, which implies that they made better use of their fixed assets in 2015 than 2013. Similarly, a smaller reduction in salaries is required for 2015 than 2013, implying that hotel operators have learned from their experience of the climate change event of 2014. In short, the experience translated into better utilisation of inputs and consequently a higher efficiency level.

Research shows that many factors can influence the efficiency of the operations of small and medium hotels (Mat *et al.*, 2019). For instance, the proximity of the coastal area to the hotel makes a significant contribution to hotel performance (Glaveli *et al.*, 2021). In fact, this could possibly explain why the related hotels were not badly affected by the climate change event in 2014. As such, accommodations located in low-lying areas may face higher risks due to sea level rise and other extreme weather events compared with the others (Keen *et al.*, 2022). This likely signal the need for unique disaster responses and adaptation strategies to be applied by every accommodation provider in different islands. Another factor that influences the efficiency of small and medium hotels in these islands is the main attractions that encourage visitors to visit islands, namely their beaches and seashore. The information gathered by potential tourists on the situation in the islands after climate events and the attractions of the islands themselves may develop confidence among visitors to visit the islands and stay in the hotels, regardless of the situation. The type of hotel also contributes to hotel efficiency, where branded hotels at the

Table 5: Projection of reduction of inputs required to achieve efficiency status

Island	DMU	2013		2015	
		Salaries (%)	Fixed assets (%)	Salaries (%)	Fixed assets (%)
Perhentian Island	DMU 1	-81.88	-81.88	-60.33	-60.33
	DMU 2	-37.62	-82.50	0.00	0.00
	DMU 3	0.00	0.00	0.00	0.00
	DMU 4	-61.30	-61.30	-45.25	-45.25
Redang Island	DMU 5	-68.98	-68.98	-48.90	-48.90
	DMU 6	-29.62	-88.54	-78.32	-91.66
	DMU 7	-86.62	-88.21	-57.34	-57.34
Tioman Island	DMU 8	0.00	0.00	0.00	0.00
	DMU 9	-68.82	-76.93	0.00	0.00
	Average reduction	-48.31	-60.93	-32.24	-33.72

national level are found to be more efficient compared with hotels with an international brand (Esmaeili *et al.*, 2021). However, the relationship between hotel size and efficiency is still unclear, although some researchers argue that size does influence hotel operations (Kim *et al.*, 2021). In relation to the size factor, large and chain hotels have been found to be more efficient compared with smaller and non-chain hotels (Wu *et al.*, 2022). This is especially true in regard to the sustainability efforts, which are often integrated with businesses' adaptation strategies for environmental changes, like climate change. Previous studies have reported that most managers of small- and medium-sized enterprises are unclear about the efforts and their linkages to the business (Fonseca & Carnicelli, 2021). This could influence their perception and behaviour towards climate change events when it happens. Star rating is another factor that is found to influence the efficiency of the small and medium hotels. Mixed responses are reported from previous studies, but mainly suggest that the star rating is not the main indicator of customer loyalty (Kajla *et al.*, 2022). Lower star rating hotels can also perform better because the concentration in fulfilling customer's satisfaction differ as they are focusing more on reducing complaints (Dwi Lestari & Saputra, 2018). This suggests equal opportunity for accommodations providers to sustain their business regardless of the star rating, particularly in the aftermath of adverse impact of environmental challenges. In the current situation, for instance, the adaptation strategy that is likely work for the accommodation providers is through understanding the important attributes demanded by tourists, including employees, location, rooms, food, and hygiene (Kajla *et al.*, 2022).

Conclusion

Being a climate-sensitive sector, hotels are moving towards a holistic approach to increase efficiency through sustainability development and quality management (Carlisle *et al.*, 2021; Jones & Comfort, 2020). The findings of this

study suggest that the effective utilisation of resources owned by small and medium hotels will influence their efficiency level, regardless of the situation. The assumption of the RBV is therefore relevant to explain the adaptation strategies that need to be applied by island-based small and medium hotels, especially in dealing with the impact of climate change. This is important because awareness of the impact of climate change is still low among managers and the public. As such, although Malaysia's climate was known for its uniform temperatures, high humidity and rainfall throughout the year, these have changed due to unexpected extreme weather conditions. The extreme flood that happened in 2014 is just one example of the changes that are taking place in terms of climate events as it shows the difference in the rainfall patterns compared with usual climate events. Many researchers have urged that more action be taken, especially in developing an adaptation strategy to cope with the impacts of climate change. Importantly, although many transformative adaptations are technological, they can also be behavioural, which affects how individuals and organisations make decisions and allocate resources efficiently to manage the impacts of climate change so that organisational performance is not harmed. Thus, although the efficiency of small and medium hotels can be identified through the DEA model, finding an explanation for the causal relationship between contextual elements and the performance of small and medium hotels should also be considered in future investigations. While each and every small and medium hotel is unique according to its own resources and characteristics, these contextual elements may have a huge influence on the working arrangements of small and medium hotels that influence the efficiency level of their operations.

Theoretical implications

Efficiency is regarded as an important indicator to form theoretical comprehensiveness about organisational performance, particularly for hotels to sustain their service mix through

times (Kim *et al.*, 2021). This study adds to the understanding of improving organisational performance through the linkages of input and output, which is tailored towards each accommodation provider's own goals and resources. The DEA model used in this study provides insights for exploring hotel's resources to gain a comprehensive service mix through operational control. Furthermore, as a theoretical gap of small islands research has been identified (Scott & Verkoeyen, 2017), this study offers evidence and fieldwork's proof on the behaviour of service providers in small islands in facing environmental changes, such as climate change. This is important, as realising the potential earnings of coastal tourism in small islands is significant for many countries such as Malaysia. This is particularly true following the pathway towards endemic status of COVID-19, where the demand for tourism activities in the coastal areas is projected to increase tremendously (Kajla *et al.*, 2022). While operational efficiency can be achieved through multiple operating inputs, this study provides observation on the influence of contextual elements that influence a hotel's efficiency score. Identifying important attributes of customer needs and wants suggest the findings of this study support the application of the RBV framework in tourism research. This is due to the nature of tourism sector being dynamic and highly influenced by environmental changes, which require the optimisation of the current resources for hotels to response in due time (Del Chiappa & Baggio, 2015). An exploration of the efficiency level of the operations of small and medium hotels through the relationship between organisational input and output provides a huge potential to transform a short-term strategy into long-term achievements. This can be done by investigating an organisation's ability to optimise their resources to gain competitive advantage through times (Peprah & Ayaa, 2022).

Practical Implications

Knowing that Malaysia is one of the countries that applies tight cost control measures (Mat *et al.*, 2019), findings on the efficient use of existing

resources are of relevance as they increase the ability of hotels to utilise and expand the potential of their resources to deal with unknown risks from climate change events. While the chance of adding new resources may be limited because of the tight hold on financial expenditure, the findings of this study offer some insights for hotel management into how to deal with the impacts of climate change without adversely affecting operational costs. This study also found that awareness of the impacts of climate change is somewhat limited among tourism operators until a real event has occurred. This signals a need for tourism authorities to promote more programmes to prepare tourism players so that they possess sufficient knowledge on the possible risks of climate change. This is very important as evidence from certain countries shows that climate change can manifest in many ways, and while some manifestations have not been experienced in Malaysia, this does not mean that they will not occur in the future.

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