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Developing a mud crab ecotourism business model in the mangrove forest ecosystems of Belitong UNESCO Global Geopark, Indonesia

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Abstract. *Mahbubi A, Fatoni A, Iskandar. 2025. Developing a mud crab ecotourism business model in the mangrove forest ecosystems of Belitong UNESCO Global Geopark, Indonesia. Asian J For 9: 13-23.* The traditional mud crab business model, which involves trading fresh mud crabs, exhibits limited sustainability, particularly in the Belitong UNESCO Global Geoparks (Belitong UGGp) mangrove area. *Scylla tranquebarica* (Fabricius, 1798) is more abundant than *Scylla serrata* (Forskål, 1775) and other mud crab species in the Belitong UGGp. This study aims to develop a mud crab ecotourism business model within the Belitong UGGp mangrove forest ecosystem. This study employs a qualitative approach. Data were collected through interviews with mud crab catchers and mangrove forest tourists, as well as focus group discussions with Belitong UGGp management, the Indonesian Tourism Association, and the tourism and creative economy office of the Belitong District Government. The data analysis in this study used content analysis involving the Business Model Canvas (BMC), empathy map, and value innovation framework. The qualitative analysis procedure covered the phases of data condensation, presentation, and conclusion or verification. The reliability of the study, tested using the kappa coefficient, yielded an excellent score of 0.81. Promoting innovation in business models involves creating diverse products and mud crab ecotourism programs, such as culinary offerings, snacks, souvenirs, educational tours, and tracking; fostering activities, such as mud crab processing; and establishing resources, such as mud crab galleries. In addition, it will enhance customer relationships and stakeholder collaboration, reduce the trade of fresh mud crabs with consumers outside the region, and eliminate small mud crab fishing.

Keywords: Business model, ecotourism, innovation, mangrove forest, mud crab

INTRODUCTION

Indonesia leads the global mangrove forest area, with a staggering 20% of the 147,359 km^2 (United Nations Environment Program 2023). Mangrove and seagrass forests in Indonesia are the main focus of achieving sustainable coastal ecosystems (Sidik et al. 2023). According to Karniati et al. (2021), mangrove forests are the primary habitat for numerous fishery commodities, particularly mud crabs. The mud crab is a crab from *Scylla*, comprising four species: *Scylla serrata* (Forsskål, 1775), *Scylla olivacea* (Herbst, 1796), *Scylla tranquebarica* (Fabricius, 1798), and *Scylla paramamosain* (Estampador, 1949) (Keenan et al. 1998). Mud crabs are commonly found in Indonesian mangrove forests, including Sulawesi (Hamid and Wardiatno 2018), Bali (Ginantra et al. 2021; Swasta et al. 2023), Java (Fitri et al. 2017), and Sumatra (Sari et al. 2021). In Belitong, *S. tranquebarica* was more abundant than other species of mud crabs (Sari et al. 2021). Generally, mud crabs are not extensively cultivated and are primarily traded in their live or fresh states.

The potential of mud crabs to become a leading agritourism in Indonesia has not yet been fully realized. However, the diversity of crabs in mangrove ecosystems holds considerable promise for ecotourism development in this region (Irwansyah et al. 2021). In Kenya, mud crabs have long been used as primary menu items in agro-food tourism at various local tourist attractions (Mirera 2017). Specifically, Tranter et al. (2022) reminded us that stakeholders must manage the development of fishery tourism well to avoid negative impacts on the environment and society.

The ecotourism approach can foster economic, environmental, and social sustainability. Studies have shown that ecotourism has minimal impact on ecology (Arif et al. 2022). However, mud crabs have not yet been widely promoted as a leading tourism attraction in the form of mud crab ecotourism. Adlan and Yusof (2024) have only proposed the establishment of a mud crab ecotourism center in Malaysia, focusing on the design of mud crab ecotourism products and services. The development of innovative products requires business model innovation (Visnjic et al. 2016). In order to achieve success, business actors must align product innovation, particularly in the context of mud crab tourism, which requires urgent business model innovation, including adapting product innovation to process, marketing, and organizational innovation (Tavassoli and Bengtsson 2018). Bagnoli et al. (2021) suggested that businesses should develop their business models after the covid-19 pandemic. Therefore, it is crucial to refine product innovation through the development of a business model. The concept of a business model is applicable to a diverse range of businesses (Hock-Doepgen et al. 2021). Therefore, the

business model approach can serve as a means to facilitate the advancement of Belitong UGGp.

The Belitong UNESCO Global Geoparks (UGGp) region presents a promising opportunity to establish a mud crab ecotourism business model, considering the extensive mangrove forests that are over a century old, such as those found in the granitic mangrove forest of the Kuale geosite. The Gunung Kubing Geosite is another notable mangrove forest in the Belitong UGGp area, which serves as a source of mangrove crabs for local food and commodities markets, as well as for international markets. Given the popularity of the Kuale Geosite as an ecotourism destination for old mangrove forests, it is essential to position the Gunung Kubing geosite as a mangrove crab ecotourism destination through the development of a mud crab ecotourism business model.

The development of a mud crab ecotourism business model in the Belitong UGGp area is a strategy for sustainable mud crabs that preserves the environment, provides added value to geological heritage and local communities, encourages the creative economy to create jobs, and emphasizes the authenticity of products, producers, and restaurants within the geopark area. Liu et al. (2017) noted that agri-food tourism is an eco-innovation strategy that integrates agricultural and food products with tourism services, prioritizing sustainability to meet customer values. This study aims to formulate a mud crab ecotourism business model within the Belitong UGGp mangrove ecosystem by first examining the existing business model and the perspectives of mangrove ecotourism customers.

MATERIALS AND METHODS

Study area

Indonesia ranks among the top five countries with the highest number of geoparks recognized by UNESCO. One of the geoparks is the Belitong Geopark, in Belitung District, Bangka Belitung Islands Province, Indonesia, which has attained the highest score in the history of Indonesian geopark submissions to the UNESCO Global Geopark, specifically 850 of a maximum of 1,000 points. The Belitong Geopark stands out for its exceptional integration of geological, biological, and cultural components. This distinctive landscape features an extensive mangrove forest ecosystem that provides habitat for a wide array of plant and animal species.

Kuale and Gunung Kubing geosite boast substantial mangrove ecosystems in the Belitong UNESCO Global Geopark (Belitong UGGp) area. The Kuale geosite is distinguished by its mangrove forests, which surpass 100 years old. Therefore, the Belitong UGGp management has positioned this geosite as an ancient mangrove ecotourism destination. In contrast, the Gunung Kubing Geosite is comprised of relatively young and muddy mangrove forests. This muddy mangrove forest area serves as the primary habitat for mangrove crab reproduction (Pati et al. 2023).

As a recently incorporated geosite within the Belitong UGGp, the Gunung Kubing geosite has not attained the same level of recognition as the Kuale geosite. Considering these distinct characteristics, it is strategically advantageous to develop Gunung Kubing as a specialized ecotourism site that focuses on mud crab habitat. Therefore, this study was conducted at the Gunung Kubing Geosite, Belitong UGGp (Figure 1).

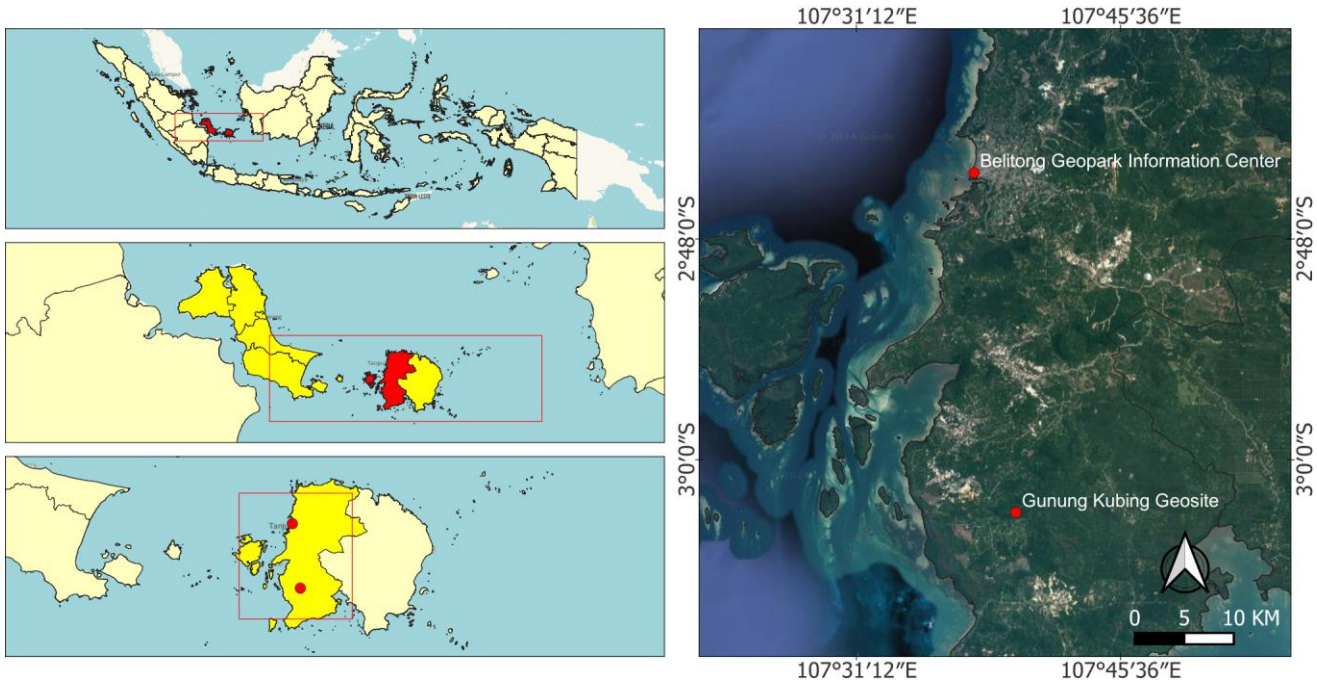

Figure 1. Location of Gunung Kubing Geosite, the Belitong UNESCO Global Geopark UGGp) in Belitung District, Bangka Belitung Islands Province, Indonesia

Data collection

This study employed a qualitative design utilizing a phenomenological approach. This study involved 65 participants, comprising 30 mud crab catchers (coded M1 to M30), 30 tourists (coded T1 to T30), and five key stakeholders: two representatives from Belitong UGGp Management (coded B1 and B2), two from the Indonesian Tourism Association (coded A1 and A2), and one from the Belitong Government's Tourism and Creative Economy Office (coded G1). The study participants were selected based on specific criteria, such as mud crab catchers living around the mangrove forest and being members of forest village community institutions, tourists visiting Gunung Kubing at least twice, the Indonesian Tourism Association regularly taking tourists to this area, and the head of the government.

The questions for participants referred to the elements of the Business Model Canvas (BMC), empathy map, and value innovation framework. The BMC comprises nine elements: value proposition, key activities, key resources, key partners, customer relationships, customer segments, channels, cost structure, and revenue streams. BMC assists in understanding how an entrepreneur generates revenue. The empathy map contained six elements of customer insight: see, hear, think and feel, say and do, gain, and pain. This map serves as a tool during the interview process to describe customer insights and is subsequently used to formulate a business model. Value innovation comprises one page with four blocks: eliminating value propositions that customers do not require, reducing value propositions that customers do not need, increasing value propositions that customers need, and creating value propositions that customers really need.

This study collected data in two phases. The first phase explores the existing mud crab business model. This involved conducting in-depth interviews with mud crab catchers and directly observing their commercial activities at the Gunung Kubing Geosite, Belitong UGGp. Observational data were captured using digital photography and detailed field notes, encompassing both descriptive and reflective elements. In addition, a focus group discussion was organized with key stakeholders. These discussions centered on the current business model and the potential for ecotourism at the Gunung Kubing Geosite, Belitong UGGp. The second phase investigated customer insights at the Gunung Kubing Geosite, Belitong UGGp. This phase entailed conducting interviews with tourists who had visited the location. Relevant documents were collected in both phases, including journals, newspapers, proceedings, and visual materials owned by informants.

Data analysis

The data analysis adopted Miles and Huberman's practical framework. The qualitative analysis procedure covered the phases of data condensation, presentation, and conclusion or verification.

Condensing the data

This phase consists of various procedures: selecting, simplifying, abstracting, and transforming the data that appear in the entire body of written field notes, interviews, transcripts, and documents. Data selection involves highlighting pertinent data pertaining to each aspect of the business model canvas. We also assigned numerical codes to each dataset, comprising interview transcripts, videos, and images. Also, data selection was actually conducted up to the focusing stage, particularly regarding the quality and sufficiency of the data pertaining to the nine components of the business model and consumer empathy map, which were both deemed satisfactory. This information was used to address the research objective. To guarantee that there were no missing or incorrect data, we repeated this abstraction process three times and carefully examined the attributes of the nine elements of the business model and empathy map. We moved on to the next stage only after confirming that this process had been completed and that there were no missing or mixed-color marks. Following the abstraction stage, the data were streamlined and refined through extensive selection, data classification, and concise descriptions.

Presenting the data

This action facilitates the comprehension of the business model canvas's nine elements, the empathy map, and value innovation, either as a whole or in specific segments.

Concluding or verification

Data verification in qualitative research was conducted continuously throughout the study. From the beginning of entering the field and during the data collection process, we tried to analyze and search for the meaning of the words collected, namely, looking for patterns, themes of relationships, things that arise, hypotheses, or so be outlined in tentative conclusions. With the addition of data through a continuous verification process, conclusions can be drawn from the figures and narratives.

Triangulation and kappa statistical tests were performed to assess the validity and reliability. The kappa coefficient obtained was 0.81, which is an excellent agreement, surpassing the threshold of 0.75. Qualitative data analysis also utilizes NVIVO software, a tool that facilitates the capture, transcription, coding, and examination of textual and graphical data.

RESULTS AND DISCUSSION

The existing mud crab business model in the mangrove ecosystems of Belitong UNESCO Global Geopark

The Belitong UGGp mangrove forest serves as a breeding ground for mud crabs to provide alternative subsistence for local communities. Torres et al. (2022) categorized mud crabs as coastal trap fisheries. During the COVID-19 pandemic, when tourists were restricted due to lockdown measures, these crabs became the main source of income for the community living in the Belitong UGGp area. Mud crab catchers found more *S. tranquebarica* (Fabricius, 1798) than other mud crab species in the Belitong UGGp mangrove forest. Figure 2 illustrates the existing mud crab business model.

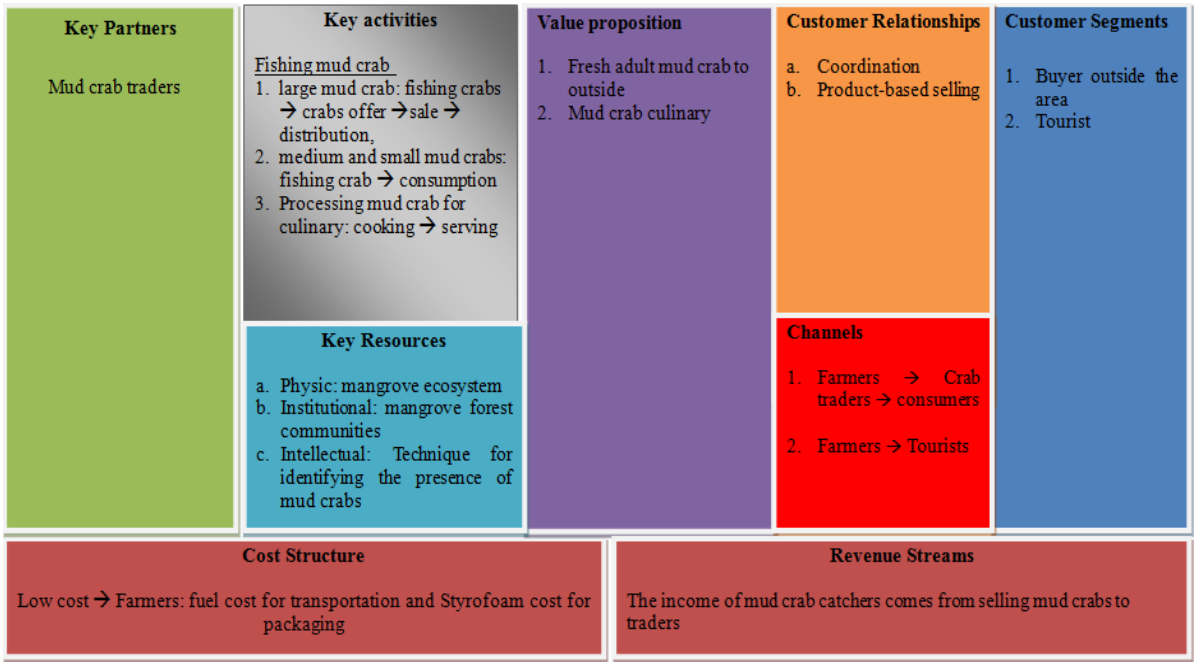

Figure 2. Existing mud crab business model in the mangrove ecosystems of Belitong UGGp, Belitung District, Indonesia

Value proposition

Mud crab catchers trade fresh adult mud crabs outside of the Belitong UGGp area. The weight of adult mud crabs sold must meet the Indonesian standard set by the Ministry of Marine Affairs and Fisheries Regulation number 7 of 2024. According to these regulations, mud crabs that can be transported must not lay eggs, have a carapace width of > 12 cm, and weigh > 150 g. The largest mud crab (1890 g) was found on the island of Sumatra, Indonesia, by Cahyadinata et al. (2021). Mud crabs are rarely traded in the Belitong UGGp tourist area, indicating that they are not widely processed into local food served by tourists, even though mangrove forests are the main destination of choice for tourists in the Belitong UGGp. As stated by Rukisah et al. (2021), this commodity is considered a delicious and healthy food.

"*I consistently sell adult mud crabs weighing in excess of 500 g per specimen to collectors, and we rarely provide mud crab culinary offerings*." (Interview with M1, M4, M6, M7, M10, M11, M15, M19, M24, M27, M28, M29, and M30).

"*Tourists must place orders in advance if they desire a mud crab specialty menu when visiting*." (FGD with A1, A2, B1, B2, and G1).

Customer segments

Mud crab customers are primarily inter-regional traders. This finding aligns with the research conducted by Yolandika et al. (2023), in which the consumer segment for fishery commodities is typically traders. This suggests that crab catchers typically sell fresh crabs to traders rather than end or household consumers. The Belitong UGGp area has the potential to process mud crabs into locally branded food that can be sold directly to visitors.

"*The primary consumers of these products are mud crab collectors from regions outside the Gunung Kubing area. Direct purchases by tourists are infrequent*." (Interviews with M2, M3, M5, M8, M9, M12, M13, and M14 as well as FGD with A1, A2, B1, B2, and G1)

Customer relationships

Griesemer and Shavit (2023) categorized interactions between groups into three types: coordination, cooperation, and collaboration. Based on this classification, the interaction between mud crab farmers and their customers is limited to coordination. Frow and Payne (2009) identified four types of customer relationship management: product-based selling, customer-based marketing, managed services and support, and individualized customer relationship management. Mud crab catchers establish relationships with customers that fall within the product-based selling category.

"*I coordinate with the crab collectors when there are quite a lot available*." (Interviews with M4, M7, M8, M12, M15, M18, M22, M23, M26, M28, and M29)

Channels

The marketing channel for mud crabs involves catchers selling to collectors, who then sell to traders in Jakarta for exportation via importers in the destination country. Ultimately, this channel provides end consumers with mud crab cuisine at various international restaurants. This channel is similar to the supply chain of mud crabs from Bangladesh to the global market, as reported by Bhuiyan et al. (2021).

"*I got information from a mud crab collector that the mud crabs were exported to ASEAN countries to become part of the favorite menu in restaurants in the destination*

countries." (Interviews with M1, M2, M3, M5, M7, M16, and M17).

Key activities

The mud crab catchers catch adult crabs weighing more than 500 g, then tie the mud crabs and put them into a Styrofoam container, offering and selling the mangrove crabs to collectors. This weight was categorized as large based on the classification by Paran et al. (2022). They classified mud crabs above 500 g as large, 400-500 g as medium, and sizes below 400 g as small. Crab catchers consume mud crabs caught in small-to-medium sizes between 200-500 g. Small mud crabs have the potential to be raised or released to maintain the sustainability of mud crabs in the Belitong UGGp area.

"*I get mud crabs by fishing in the mangrove forest area of the Gunung Kubing geosite. There are many crabs in a location based on traces or nests of mangrove crabs. We returned young crabs caught for the sustainability of mangrove crabs. we tie and pack mangrove crabs in styrofoam*." (Interviews with M2, M5, M6, M8, M10, and M11)

Key resources

The Belitong UGGp boasts extensive mangrove forests, particularly at the Gunung Kubing geosite. Water in these mangrove forests serves as the primary habitat for mud crabs (Indarjo et al. 2020). Another important resource is the Village Forest Management Institution, which includes mangrove forests members of which are also mangrove crab catchers. This institution aims to manage forest resources, including mangrove forests, sustainably, based on principles of sustainable development (Dewi et al. 2021). In addition, its members can identify the presence of mud crabs at a specific location. Overall, the local mangrove ecosystem community plays a role in maintaining and improving the ecosystem health (Elwin et al. 2024).

"*During the COVID-19 lockdown, tourist visitation to the Gunung Kubing geosite ceased. However, our residence in a mangrove forest area, which serves as a habitat for mud crabs, has proven to be advantageous. As a member of a forest community institution, I utilized this ecosystem as an alternative source of livelihood. I refined our understanding of mud crab behavior through field-based observations*." (Interviews with M1, M2, M7, M9, M12, M18, and M20)

Key partners

Individuals engaged in mud crab harvesting within the Gunung Kubing Belitong UGGp geosite region concentrated on collaborating with collector traders. They are yet to engage in discussions and consultations regarding the potential and application of mud crabs for ecotourism within the Belitong UGGp. Clarke and MacDonald (2019) posited that the establishment of sustainable local development requires cooperation among various stakeholders.

"*My main partners are mud crab traders. I have not discussed seriously with the Belitong UGGp management regarding the development of mud crab ecotourism. No party from the campus has explored the potential of mud crabs in this area*." (Interview with M3, M5, M7, M9, M11, 16, M18, M20, M22, M24, M25, M27, M29, and M30).

Cost structure

According to Goyal et al. (2018), a business model's cost structure encompasses operational expenses, transportation, and logistics. Typically, the cost structure of mud crab catching is characterized by low cost. The costs associated with this business model are primarily comprised of fuel costs for the vehicles used to travel between home and the mangrove forest waters for catching mud crabs, as well as the expense of purchasing styrofoam for packaging the crabs.

"*I catch the mud using minimal expenditure, primarily incurring costs for fuel used in transportation from residential areas to mangrove forest waters and for the purchase of styrofoam packaging materials for the mud crabs*." (Interview with M8, M10, M12, M17, M18, M20, M22, M24, M26, M27, and M28)

Revenue streams

Revenue streams refer to how business actors make money (Müller 2019). The income of mud crab catchers comes from selling mud crabs to crab traders. The income of mangrove crab catchers is contingent on the quantity and weight of the crabs they are able to catch. The greater the quantity and weight of the mangrove crabs caught, the higher the income.

"*The income generated is contingent upon the quantity and mass of crustaceans obtained through fishing activities. The market price remains relatively constant*." (Interview with M3, M5, M7, M9, M11, M12, M14, M16, M19, M21, M23, M25, M28, and M30 as well as FGD with A1, A2, B1, B2, and G1)

Customer insight of mangrove tourism of Belitong UNESCO Global Geopark

The success of business model innovation is contingent upon customer evaluation, which is based on their experience (Keiningham et al. 2019). Business model innovation requires a comprehensive understanding of the environment, routines, concerns, and aspirations of customers (Osterwalder and Pigneur 2010). They underscored the importance of viewing a business model from the customer's perspective. In addition, they recommended utilizing the empathy map created by XPLANE to delve into customer preferences. Fishing tourism managers must consider various concepts and expectations of tourists (Lankia et al. 2022), including fishery products that must meet customer desires (Zander et al. 2022). This section explores the insights of tourists who visited the mangrove ecosystem, Belitong UGGp, using the elements of the empathy map to design a mud crab ecotourism business model (Figure 3).

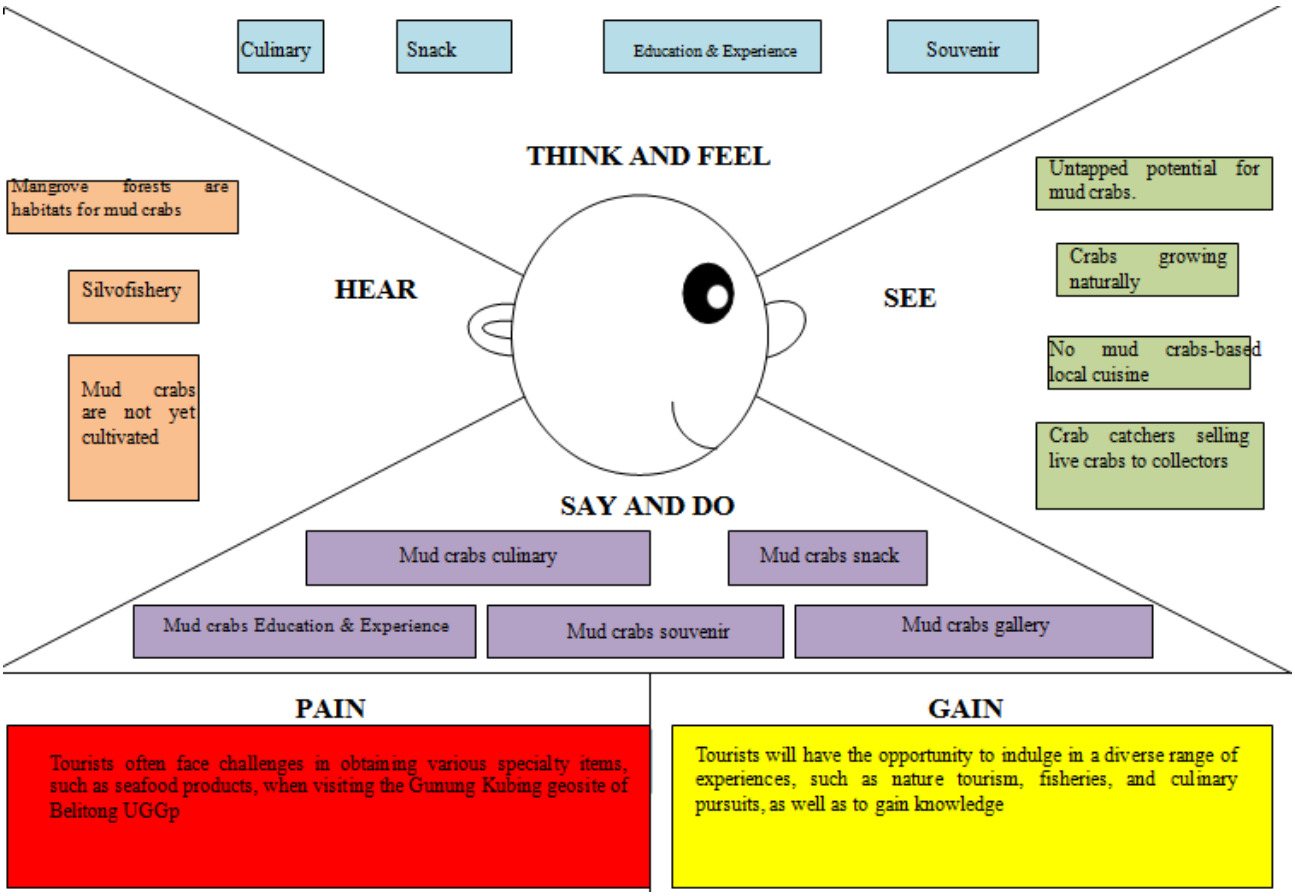

Figure 3. Customer insight into mangrove tourism of Belitong UNESCO Global Geopark, Belitung District, Indonesia

Tourists to the Gunung Kubing Geosite mangrove area in the Belitong UGGp discovered an untapped potential for mud crabs. They observed crabs growing naturally in the area as well as crab catchers selling live crabs to collectors, but none had processed them into local cuisine for visitors to consume. According to Nanda et al. (2021), crabs are highly regarded because of their delicious taste, significance as a nutritional source, and the versatility of crab waste, which can be used to produce various products, such as souvenirs. For instance, mothers in South Sulawesi successfully produced processed spicy and sour crabs (Rusydi et al. 2022).

"*I found many crabs in the mangrove forest area at the Gunung Kubing Geosite, Belitong UGGp. I met mud crab catchers who sell crabs to collectors, and I have never encountered local culinary made from local crabs consumed by tourists*." (Interview with T10, T15, T18, T21, T24, T27, T28, T29, and T30)

Tourists have heard that mangrove forests are habitats for mud crabs that can be cultivated using the silvofishery system. According to Wamnebo (2018), silvofishery is the cultivation of fishery commodities with the aim of obtaining fishery products and preserving mangrove plants. They received information that the mangrove crabs had not been cultivated in the Belitong UGGp.

"*I have heard from various mass media that mangrove forests are habitats for mud crabs. I also heard from mud crab catchers that they did not cultivate mud crabs. In fact, I have heard of silvofishery, an integrated fish farming system in the mangrove forest area*." (Interview with T2, T3, T4, T5, T7, T9, T11, T13, T16, T17, T19, T20, and T22)

Tourists perceive that the Belitong UGGp, especially the Gunung Kubing geosite area, has the potential to develop a variety of culinary items, snacks, and souvenirs using mud crabs. They also believed that this region had the potential to establish educational programs and explore mud crabs, including a mangrove crab gallery. This perspective represents future aspirations. Muñoz-Vilches et al. (2020) stated that consumer imagination can provide a new perspective on consumer insight.

"*The Gunung Kubing Geosite - Belitong UGGP exhibits potential for the development of mangrove crabs as a specialty culinary offering, source of accessories, and the subject of a dedicated gallery. Furthermore, this area demonstrates considerable merit in presenting various mangrove crab-based attractions*." (Interviews with T6, T8, T12, T14, and T25)

The visitors suggested creating culinary items, snacks, and mementos made from mud crabs, educational programs, crab exploration, and the construction of a mud crab museum. This proposal aligns with Adlan and Yusof (2024) proposal to advance crab tourism. However, their

recommendations were limited to the architectural design of a mud crab ecotourism building in Perak, Malaysia.

"*I emphasize the development of crab-based products integrated into product package offerings*." (Interview with T1, T2, T8, T9, T14, T15, T17, T18, T19, T22, T23, and T26)

Furthermore, travelers often face challenges in obtaining various specialty items, such as seafood products, when visiting the Gunung Kubing geosite of Belitong UGGp. Generally, they find traditional food options with limited variety and availability in certain locations. Local cuisine is a crucial factor that tourists consider when selecting a destination to visit (Cankül et al. 2024).

"*I have difficulty getting food, snacks, and souvenirs that are typical of the Gunung Kubing Geosite, and are not easily obtained because they are not available at public stalls around the location*." (Interview with T3, T7, T11, T12, T13, T17, T18, T21, T24, T27, T29, and T30)

Finally, tourists have the opportunity to indulge in a diverse range of experiences, such as nature tourism, fisheries, and culinary pursuits, as well as to gain knowledge. The site offers a unique opportunity to observe sustainable practices surrounding mangrove crabs and forests, which will undoubtedly prove to be an attractive feature for visitors. A study conducted by Goffi et al. (2019) revealed that tourists place a high premium on the sustainability aspects of a destination because it significantly contributes to their overall satisfaction, particularly among Large-Scale Coastal Package Tourists (LCPTs), assuring a fulfilling experience for all.

"*I will have the opportunity to enjoy mud crab-based tourism if these products are available*." (Interview with T1, T4, T8, T12, T16, T18, T19, T20, T21, T24, T25, T27, T29, and T30)

Mud crab ecotourism: the future mud crab business model in the Belitong UNESCO Global Geopark, Indonesia

Based on customer insights from previous discussions, the existing mud crab business model is evaluated using the value innovation framework (ERRC–Eliminating, Reducing, Raising, and Creating) developed by Kim and Mauborgne (2005). The design of the mud crab ecotourism business model is illustrated in Figure 4. According to Foss and Saebi (2017), there are four types of business model innovation: modular, architectural, radical, and incremental. A mud crab ecotourism business model can be classified as an architectural business model innovation that involves exploring new ways, activities, and relationships among business model components. This shift in profession from mud crab catchers to mud crab farmers has altered the business model design from a traditional mud crab trading model to a mud crab ecotourism model. In the context of customer relationships, the shift also moves from product sales-based customer relationships to customer-based marketing and managed services and support (Frow and Payne 2009).

Figure 4. Mud crab tourism: the future mud crab business model in the mangrove ecosystems of Belitong UGGp, Belitung District, Indonesia. Note: Text highlights = pink was eliminated, yellow was reduced, green was raised, and blue was created

Value proposition

The challenge for the fresh fish business is to provide quality fish throughout the year (Bertheussen et al. 2020), potentially leading to over-exploitation by fishermen. Crab farmers should take steps to limit the sale of fresh adult mud crabs outside the Belitong UGGp. In addition, these farmers process crabs into culinary and processed foods served by tourists visiting the Belitong UGGp geosite. Doucek and Zelenka (2018) revealed that farmers produce geofood in the form of local specialties that can be used as souvenirs after returning from geopark tourism. Farmers can also create mud crab souvenirs from crab shells, which would otherwise be wasted. Zilia et al. (2021) classified this effort as the implementation of a sea product circular economy. Farmers can also offer mud crab education and experience programs in the form of mud crab fishing and tracking. Liontakis and Vassilopoulou (2022) reported that fishing tourism positively affects the incomes of individual fishermen.

Customer segments

The structure of the mud crab ecotourism business model reconfigures customer segments by diminishing the sale of mangrove crabs to the trader-collector group and increasing the sale of fresh crab products to the tourist customer group, which encompasses general mangrove tourists, mud crab aficionados, and academicians. This change in the consumer segment encourages manufacturers and consumers to support the sustainability of mud crabs. In addition, consumers play a role in preserving crabs' sustainability; White et al. (2019) classified this action as sustainable consumer behavior.

Customer relationships

As indicated by Greisemer and Shavit (2023) concept of customer relationship patterns, the mud crab ecotourism business model changes its relationship pattern from coordination to collaboration. Dash and Balamurugan (2024) called for stakeholders to collaborate with local communities in an adaptive governance framework for fishery tourism development that does not harm aquatic species. Castañer and Oliveira (2020) defined collaboration as voluntarily assisting partners in achieving their goals, as exemplified by Lakshminarasimha (2017), through sharing of information and joint performance measures. Furthermore, the mud crab ecotourism business model shifts the relationship pattern from product-based selling to customer-based marketing, as identified by Frow and Payne (2009) customer relationship category. This approach focuses on customers who provide various products to meet the diverse needs of tourists, as seen in the Belitong UGGp mangrove forest area, where the mud crab ecotourism business model offers a range of processed products such as culinary items, snacks, and souvenirs.

Channels

The proposed business model advocates a distribution network that connects farmers to souvenir stores and then to tourists while also establishing a streamlined marketing channel for mud crabs that allows farmers to sell directly to tourists. Various distribution channels can enhance customer access to products (Kennedy et al. 2022). In addition, implementing an omnichannel strategy that integrates both offline and online channels is essential to provide a seamless and unified customer experience.

Key activities

The proposed business model for mud crab ecotourism recommends curtailing the trade of mud crabs beyond the Belitong UGGp area and discontinuing the consumption of small mud crabs for farming. Mud crab farming tourism avoids trampling by tourists. Park et al. (2024) stated that recreational trampling poses a serious threat to the extinction of the white-clawed fiddler crab in South Korea. The emergence of various new value propositions is expected to generate new activities, such as mud crab cultivation through silvofishery systems. The sustainability of mud crab cultivation requires capital availability, training capacity, and feed affordability (Apine et al. 2023). Financial capital is the most limited capital for mud crab farmers (Apine et al. 2019). In addition, other new activities include cooking, serving, wrapping, offering program packages, and receiving program package orders. Sjödin et al. (2020) revealed that the success of creating new value propositions hinges on the alignment of value-creation activities.

Key resources

Farmers, who are valuable human resources in mud crab ecotourism, must enhance their knowledge and skills to build positive relationships with customers and silvofishery systems. According to Khan et al. (2022), good relationships are a crucial element in attracting customers. Moreover, Herman et al. (2020) stated that Customer Relationship Management (CRM) is a useful tool for managing long-term relationships between companies and customers, resulting in customer loyalty and satisfaction. It is also important to note that Destination Management Units (DMOs) should be established to assist in the governance of ecotourism. These units will play a vital role in maintaining environmental sustainability, ensuring fair business practices, improving access to information, and enhancing tourist satisfaction (Trang et al. 2023). Arfan et al. (2021) stated that the implementation of silvofisheries supports the sustainability of mangrove forest ecosystems. Finally, the role of the mud crab gallery as a mud crab ecotourism infrastructure should not be ignored because it also contributes to these efforts.

Key partners

According to Budhi et al. (2022), collaboration with various stakeholders is essential for achieving shared innovation objectives and ensuring the long-term sustainability of a tourist destination. Local communities must be aware of this ecotourism business model development program. Azad et al. (2021) reported that the majority of local communities around the Sundarban mangrove ecosystem did not obtain information about the development program in their area. In addition, local communities need to be asked for their consent and

involvement as mud crab farmers, not catchers. Afifah et al. (2023) reported that local communities usually agree with the development of ecotourism in mangrove forests. Local community participation can help conserve mangrove forest resources (Dutta and Hossain 2020). Therefore, mud crab farmers and managers must partner with a range of institutions, including the government, particularly fisheries services, to receive assistance by implementing the silvofishery system. Tourism actors, the media, educational institutions, and the global community must be engaged in joint promotion, education, and research, as well as the certification of mud crab-based food products.

Cost structure

The cost structure of producing valuable products depends on various activities. These activities are known as cost drivers, and their magnitude depends on the time required to complete each activity. For example, there are several preparation, spread, and maintenance activities during the mud crab cultivation stage. According to Rahman et al. (2020), the spread of crab seeds is the largest source of the total cultivation costs. Another example is the stage of making food from mangrove crabs, during which there is a cooking and wrapping process. As Elshaer (2022) found, production activities that take the longest time are the largest source of cost for providing one of the food menus in a restaurant.

Revenue streams

According to Remeňová et al. (2020), revenue stream in a business model refers to the value proposition offered to customers. It is not limited to the sale of mud crabs to traders but also includes various processed crab products sold to tourists in the Belitong UGGp area, such as culinary products, snacks, and souvenirs. In addition, the income of mud crab farmers is augmented by mud crab edu tours and experience programs.

In conclusion, the mud crab trading business model in the Belitong UGGp mangrove ecosystem should evolve into a mud crab ecotourism business model that represents a significant transformation in the development of the mud crab industry. Value innovation in this business model is achieved through the creation of various products and mud crab ecotourism programs, such as culinary, snacks, souvenirs, and educational tours. New activities, including mud crab processing and new resources such as mud crab galleries, support these value propositions. The business model also benefits from new partnerships, such as collaborations with the geofood global community. Additionally, value innovation in the business model involves improving customer relations from coordination to collaboration and from product-based selling to customer-based marketing, which includes adding tourist consumer segments and channels and increasing cooperation with various stakeholders. However, there are additional costs associated with creating added value for farmers and managers of Belitong UGGp. In addition, value innovation in the business model includes reducing the trade of fresh mud crabs with collectors for consumers outside the region and eliminating the activity of harvesting small mud crabs. For future studies, we propose to explore the value chain of mud crab ecotourism, encompassing cost evaluation through activity-based costing and value-added distribution assessments. Future research is needed to design a mud crab gallery in the Belitong UGGp mangrove forest. Investigating the opportunities and challenges at each stage of the transition process from the traditional business model to the new one could provide valuable insights. Market research is also essential. Specifically capturing consumer preferences and clustering consumer segments.

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