



From Blue Crab to Sustainable Blue Economy: How the Social Innovation Spiral Fosters Coastal Community Enterprise Sustainability in Eastern Thailand

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Abstract

The Sustainable Blue Economy has emerged as a transformative paradigm emphasizing the responsible use of marine resources while maintaining ecological integrity. However, its role in fostering grassroots social innovation within coastal communities remains underexplored. This study examines how community-led social innovation emerges, evolves, and generates socio-economic and environmental impacts through the Social Innovation Spiral, drawing on a case study of a community enterprise on Ko Si Chang in Eastern Thailand. A mixed-method approach was employed, combining in-depth interviews with 25 key informants and survey data from 100 tourist consumers. The findings reveal that the Social Innovation Spiral operates as a dynamic and iterative mechanism enabling continuous learning, adaptive experimentation, and participatory development. The blue crab ice cream initiative demonstrates how seasonal oversupply and low-value marine resources can be transformed into value-added products through local knowledge, fair-trade sourcing, and circular waste management. Results indicate improved livelihood stability, more equitable income distribution, reduced waste, and stronger engagement with community-based tourism. Survey findings confirm high consumer satisfaction, particularly in product uniqueness, engagement, and perceived social impact. This study contributes the Social Innovation Spiral to micro-level coastal contexts and empirically by demonstrating how Sustainable Blue Economy principles can be operationalized through community enterprises. It offers actionable insights for developing scalable, resilient, community-driven innovation models.

Keywords

Social Innovation, Blue Economy, Circular Economy, Zero Waste Management, Sustainability

Introduction

Thailand's Twenty-year National Strategy (2018-2037), promulgated during the administration of Prayut Chan-ocha, envisioned and legally prescribed for subsequent governments economic and social policies with the aim of achieving a national high-income status with an emphasis on the strengthening of local economies and ensuring equitable income distribution. Central to this vision would be efforts to boost community competitiveness, foster self-reliance, and improve living standards. The strategy focused on leveraging local resources, supporting community enterprises, and promoting social equity and economic restructuring through collaboration of government, academia, civil society, and the private sector to drive "sustainable development" (National Strategy Secretariat Office, 2018). These ideals were included in the 13th National Economic and Social Development Plan (2023-2027), which prioritized "innovation", local economies, and environmental sustainability, and were also meant to align with the UN's idealistic 17 Sustainable Development Goals (SDGs), which were first proposed in 2015 (Office of the National Economic and Social Development Council, 2023).

Ko Si Chang is a small island in the Gulf of Thailand, located approximately 12 kilometers off the coast of Si Racha District in Chonburi Province in Thailand's eastern region, as illustrated in Figure 1. Ko Si Chang is a hub for international shipping and a popular tourist destination. Urban expansion has significantly impacted the community's way of life, while environmental degradation linked to regional growth has led to the decline of marine life, which is vital to the local fishing industry. This decline has severely affected the livelihoods of local fishing families who rely on traditional fishing practices.

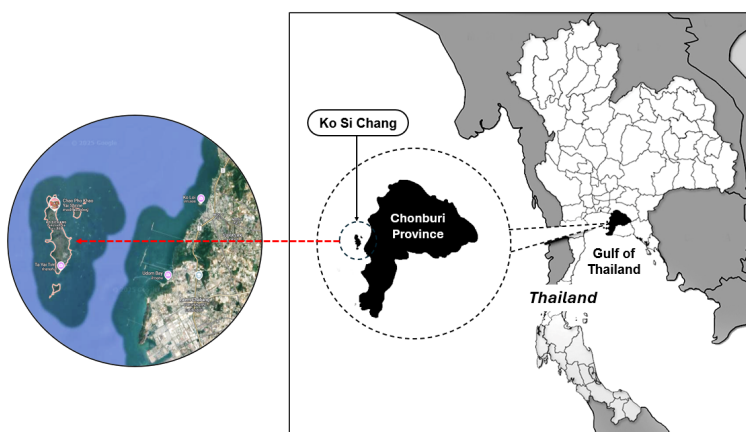


Figure 1 Location of Ko Si Chang in the Gulf of Thailand

Source: By authors

In response to growing concerns about the impact of increased human activity on Thailand's coastal environment, and in line with the spirit of the National Strategy, the Blue Crab Bank Initiative was established in 2018 under the royal patronage of Her Royal Highness Princess Maha Chakri Sirindhorn, through a collaboration between the National Research Council of Thailand (NRCT), Chulalongkorn University, and the Ko Si Chang community. The initiative was designed to restore marine biodiversity and promote sustainable fishing practices by conserving and breeding blue crabs and other marine species for release into the sea. These concerted efforts have revitalized the local marine ecosystem, transforming the waters around Ko Si Chang into a thriving habitat while raising public awareness of the importance of marine conservation. The community has embraced responsible fishing practices, caught only mature blue crabs and protected juveniles to ensure long-term sustainability. However, this ecological success has also brought an unforeseen economic challenge: during certain periods when blue crab populations are seasonally abundant, market oversupply occurs, leading to price fluctuations and difficulties for local fishers in maintaining stable income and consistent buyers. Importantly, smaller or imperfect blue crabs often fetch lower prices, further exacerbating economic pressures on these vulnerable communities (Ko Si Chang Community-Based Tourism Enterprise, 2024).

Against this backdrop, a local community enterprise established in 2021 on Ko Si Chang emerged as a coastal and community-based tourism (CBT) initiative formed by local residents to enhance the value of local marine resources and develop innovative products that generate income within the community. The enterprise was founded with the goal of fostering collaboration among local households to create value-added products, strengthen community networks, and promote equitable income distribution. Recognizing these challenges, the enterprise constituted a form of applied "social innovation" that supports and strengthens local fishing communities by expanding their commercial opportunities. By leveraging the island's unique cultural identity and natural endowments, it developed blue crab ice cream, a distinctive product that creatively combines marine conservation, community identity, and tourism appeal. By purchasing unsold or low-value blue crabs from local fishers at fair prices, the initiative reduces waste, supports sustainable livelihoods, and exemplifies a circular-economy model that extends the shelf life of perishable marine resources. This innovative approach not only enhances income stability for coastal households but also provides a replicable model for inclusive and sustainable community enterprise development.

This research was inspired by the challenges faced by the Ko Si Chang community and specifically focuses on a community enterprise recognized for its best practices in adding value to local resources. The enterprise transformed seasonal surpluses of blue crabs, including smaller

or underdeveloped individuals that fetch lower prices, into a unique and sustainable product: blue crab ice cream. The study examines this initiative as a case of bottom-up development, utilizing the Social Innovation Spiral framework (Murray, Caulier-Grice, & Mulgan, 2010), which emphasizes the iterative and participatory nature of innovation in addressing complex socio-economic and environmental issues.

Despite the expanding body of literature on the Blue Economy, existing scholarship has predominantly emphasized macro-level policy frameworks, industrial strategies, and large-scale marine resource governance. Consequently, limited scholarly attention has been directed toward micro-level social innovation processes within community enterprises, particularly in coastal contexts of Southeast Asia. More critically, there remains a paucity of empirically grounded studies that explain how grassroots innovations emerge, evolve, and generate socio-economic and environmental outcomes through iterative, participatory, and context-dependent mechanisms. Addressing this gap is essential for advancing more inclusive, context-sensitive, and practice-oriented models of sustainable coastal development.

In response, this study investigates how social innovation emerges, evolves, and produces socio-economic and environmental impacts within a coastal community enterprise in Eastern Thailand, employing the Social Innovation Spiral as the primary analytical framework. It specifically examines the iterative processes through which local actors identify challenges, co-develop and refine innovative solutions, and scale these innovations under conditions of resource constraints. By analytically integrating the Social Innovation Spiral with the principles of the Sustainable Blue Economy (Pauli, 2011; Smith-Godfrey, 2016; WWF, 2018; Evans et al., 2023), this study advances a more nuanced understanding of how community-based innovation can simultaneously support sustainable livelihoods, circular resource utilization, and environmental stewardship.

Beyond its empirical contribution, the study offers a context-sensitive application of an analytical framework for understanding grassroots innovation that is transferable to similar coastal settings. The findings also generate actionable insights for community enterprises seeking to develop value-added innovations from local resources, while offering policy-relevant implications for government agencies and innovation-support organizations to strengthen local capacity, economic resilience, and inclusive development pathways.

Literature Review

Community Enterprise and Community-Based Tourism (CBT) in Coastal Contexts

Community enterprises and community-based tourism (CBT) contribute significantly to sustainable coastal livelihoods by supporting community-led management of marine resources and fostering stronger social and economic resilience. McIntosh & Renard (2010) demonstrate that commons-based initiatives such as cooperative fisheries, eco-tours, and coastal conservation create significant social and ecological value. Their findings emphasize that local autonomy, transparent governance, and fair benefit-sharing are essential for effective community enterprises and strong stewardship of shared coastal assets.

Within the sustainable blue economy framework, CBT is a key avenue for communities to translate ecosystem services into inclusive economic opportunities. Phelan et al. (2020) demonstrate that integrating ecosystem-service thinking into coastal CBT supports waste reduction, habitat restoration, and skill development in hospitality, while linking tourism with local fisheries and mangrove conservation. Similarly, Naylor et al. (2021) emphasize that community resilience in coastal tourism depends on participatory decision-making and the recognition of local knowledge. This participatory dimension not only enhances adaptive capacity but also cultivates environmental consciousness among residents and visitors alike.

Recent research also underscores the potential of coastal CBT to stimulate eco-entrepreneurship and innovation. Setyanti & Sudarsih (2023) argue that empowering local entrepreneurs to integrate green innovation into marine ecotourism strengthens sustainability and competitiveness. Complementarily, Syafitri et al. (2023) demonstrate that participatory tourism initiatives, such as mangrove restoration and community-led coastal cleanups, enhance environmental awareness and generate blue carbon benefits. Collectively, these studies suggest that when coastal CBT and community enterprises are integrated into circular and inclusive local economies, they can generate social, economic, and environmental co-benefits aligning directly with the goals of SDG 11 (“Make cities inclusive, safe, resilient and sustainable”) and SDG 14 (“Conserve and sustainably use the oceans, seas and marine resources for sustainable development”) while reinforcing community resilience to climate and market pressures.

Building on these principles, this study applies the integrated framework of community enterprise and CBT to examine how the community enterprise in this case study develops and implements social innovations that enhance local livelihoods, preserve marine resources, and foster sustainable place-based development.

Sustainable Blue Economy

The Blue Economy has emerged as a transformative paradigm for sustainable development, emphasizing the responsible use and conservation of marine resources. First proposed by Pauli (2010) as a sustainable economic model, it seeks to reduce environmental degradation through innovation, technology, and efficient resource use. Grounded in biomimicry and self-reliance, the approach aspires to a Zero Waste system that supports coastal ecosystems while enhancing community livelihoods. As a paradigm shift concept, the Blue Economy contributes to addressing climate change and resource scarcity, aligning with the United Nations Sustainable Development Goals, particularly SDG 14 on marine conservation (Pauli, 2011; Smith-Godfrey, 2016; Rees et al., 2018).

Most conceptualizations highlight three interdependent pillars: environment, economy, and society (Louey, 2022). The framework balances economic growth, environmental stewardship, and social well-being through sustainable use of marine and coastal resources. It encompasses direct and indirect maritime activities, including fisheries, tourism, shipping, renewable marine energy, and the extraction of seafood, natural gas, and water, demonstrating the potential to generate economic value while preserving ecological integrity and supporting long-term prosperity for coastal communities (Smith-Godfrey, 2016; Bari, 2017).

Expanding on this framework, Lee et al. (2021) and Sarwat (2022) identify six key dimensions of the Blue Economy: economic growth through local value creation, equitable benefit distribution, environmental protection via biodiversity conservation and pollution reduction, technological innovation including AI and renewable energy, preservation of cultural heritage, and effective governance for sustainable ocean management. This perspective aligns with Abhinav et al. (2020), who advocate for an interdisciplinary approach integrating natural and social sciences with economics to address the complex interconnections between human activities and marine ecosystems. Sustainable resource management, therefore, requires innovation, technological advancement, and financial mechanisms that align with policy frameworks and stakeholder priorities.

Youssef's (2023) review underscores the positive business implications of adopting Blue Economy principles, particularly in unlocking new market opportunities in marine renewable energy, biotechnology, and marine tourism, which in turn stimulate employment and revenue growth (Hussain et al., 2017). Through the integration of innovation and advanced technologies, businesses can sustainably create new products and services (Spalding, 2016), expand their access to both local and global markets (Kull & Andriamahefazafy, 2019), and strengthen their brand reputation, leading to greater customer loyalty and market share (Bocken et al., 2014).

Moreover, the Blue Economy fosters cross-sectoral collaboration, facilitating knowledge exchange and resource sharing to advance sustainable development (Bennett, 2018).

Recent discourse has increasingly emphasized social justice as a critical dimension within the Blue Economy framework (UNDP, 2019; Bradford et al., 2020; Phelan et al., 2020). This community-centered adaptation prioritizes inclusive development, advocating for community-based fisheries that mitigate unsustainable practices, protect marine ecosystems, and enhance local well-being (Ertor & Hadjimichael, 2020). Within coastal contexts, applying Blue Economy principles enables communities to add value to local resources, encourage participatory governance, and create livelihood opportunities, thereby supporting local enterprises and improving the overall quality of life (Evans et al., 2023).

The Sustainable Blue Economy, defined by WWF (2018), promotes the restoration and protection of marine ecosystems while enhancing resilience, innovation, and abundance across economic, social, and environmental dimensions. Operating within a circular economy framework, it generates positive socio-economic and environmental outcomes for present and future generations. Adoption of circular principles such as recyclable product design, clean energy, sustainable tourism, and innovative financial instruments is increasingly recognized as a pathway to a resilient marine economy (Youssef, 2023). Ultimately, it harmonizes social, economic, and environmental development by leveraging innovation, technology, and sustainable practices, enabling community enterprises to create value-added marine products, generate income, and support long-term ocean and coastal conservation.

Social Innovation Spiral

Social innovation has gained growing global scholarly attention, with peer-reviewed publications rising from 2,153 (1990-1999) to 25,014 (2010-2020) (Satalkina & Steiner, 2022). The European Commission defines social innovation as the generation of new ideas that lead to products, services, or processes addressing societal needs (European Commission, 2013). Portales (2019) identifies four core components: addressing unmet social needs, providing innovative solutions, transforming social structures and relationships, and empowering collective action through cross-sector collaboration for sustainable change. Satalkina & Steiner (2022) add six characteristics: tackling social issues, meeting societal needs, creating sustainable value, fostering collaboration, challenging conventional approaches, and generating social impact. Social innovation can be product- or process-based, while TEPSIE (2014) outlines four forms: creating new products or services for local needs; developing practices that redefine societal roles or relationships; implementing new production processes; and establishing rules or regulations that promote social justice.

Murray et al. (2010) conceptualize the evolution of social innovation through the Social Innovation Spiral, a dynamic framework illustrating the iterative process of idea generation, experimentation, and diffusion. The model comprises six interrelated stages. The first stage, *Prompts*, involves recognizing societal problems and the motivations driving innovation. The second, *Proposals*, focuses on idea generation through creativity and interdisciplinary collaboration. The third, *Prototyping*, entails developing and testing solutions iteratively until they are refined and validated. The fourth stage, *Sustaining*, ensures the long-term viability of innovations through financial and institutional support. The fifth, *Scaling and Diffusion*, expands successful innovations across wider contexts with support from both public and private sectors. Finally, *Systemic Change* represents the ultimate goal, embedding innovation into social systems and influencing movements, business models, policies, and infrastructure to produce transformative and lasting impact.

In summary, the Social Innovation Spiral provides a comprehensive and systematic framework for understanding how social innovations emerge, evolve, and create impact. It begins with identifying societal needs and progresses through solution design, prototyping, and scaling, culminating in systemic transformation. Through this process, social innovation serves as a catalyst for advancing economic, social, and environmental sustainability, fostering inclusive and long-term societal progress.

Methodology

Theoretical Framework

This study is grounded in two complementary theoretical frameworks: the Social Innovation Spiral and the Sustainable Blue Economy. The Social Innovation Spiral provides a process-oriented analytical structure for examining the generation, testing, and scaling of community-led innovation. The Sustainable Blue Economy framework adds an ecological-economic dimension by emphasizing sustainable marine resource management, community resilience, and long-term ecosystem preservation. Together, these frameworks allow for a systematic investigation of how grassroots innovations emerge, evolve, and generate environmental and socioeconomic impacts within coastal community contexts.

Case Study Selection

A single-case study design was employed to enable an intensive, contextually embedded examination of social innovation processes. Ko Si Chang in Chonburi Province was purposively selected due to its national recognition for exemplary practices in community-led social innovation and sustainable coastal resource governance. The focal community enterprise's Blue Crab Ice

Cream initiative, funded in 2024 by the Social Innovation Driving Unit of Central Thailand, Thammasat University (SID-TU) under the National Innovation Agency (NIA), serves as an analytically rich case that represents successful grassroots social innovation that enhances community livelihoods while supporting marine sustainability.

Key Informants and Participants

Employing a qualitative-led research design, complemented by quantitative data for analytical support, key informants were purposively selected based on three criteria: (1) substantial involvement in the development of the blue crab ice cream innovation, (2) direct beneficiary experience, and (3) the capacity to provide detailed and context-rich insights. A total of 25 individuals met these criteria, as summarized in Table 1.

Table 1 Details of Key Informants

Key informants	Role	Code	Total
Community enterprise leader	Responsible for planning and overseeing the development of blue crab ice cream	C01	1
Community enterprise members	Participate in production and benefit from the enterprise	C02-C08	7
Local fishers	Supply blue crab raw materials	C09-C13	5
Innovation funding supporters	Provide financial and knowledge-based support for community social innovation	C14-C15	2
Tourist consumers	Experience and provide feedback on the product	C16-C25	10
			Total 25

Source: Authors

Additionally, 100 tourist consumers who had purchased or tasted the product were selected as quantitative participants using convenience sampling consistent with exploratory mixed-method designs.

Data Collection

A mixed-methods approach was employed to capture both the processes and outcomes of social innovation.

Qualitative data were collected through in-depth interviews with 25 key informants using a semi-structured interview guide. The guide was validated by three social science experts to

ensure content accuracy and relevance. Interview questions addressed all stages of the social innovation process, including: 1) identification of community needs, 2) innovation design, 3) partner engagement and resource mobilization, 4) prototype development and testing, 5) scaling and diffusion, and 6) generation of social and sustainability impacts. Secondary data from the 2024 SID-TU report were integrated to strengthen contextual triangulation.

Quantitative data were collected using an online structured questionnaire administered to 100 tourist consumers. The instrument comprised six sections based on the 4E marketing framework (Chowdhury, 2024), designed to capture tourist consumers' perceptions of the social innovation product. The questionnaire consisted of: (1) demographic information (gender, age, occupation, and income), (2) Experience (4 items), (3) Exclusivity (4 items), (4) Engagement (4 items), (5) Evangelism (4 items), and (6) Impact (4 items).

All items were measured using a five-point Likert scale. Content validity was established through expert review by three experts, along with the Index of Item-Objective Congruence (IOC). The reliability of the instrument was assessed using Cronbach's alpha coefficient, yielding an overall value of 0.88, which indicates a high level of internal consistency (Cronbach, 1970). These results confirm that the instrument is reliable and suitable for quantitative data collection.

Data Analysis

Qualitative data were analyzed to capture both individual perspectives and shared patterns, forming the basis for thematic development (Marshall & Rossman, 2015). The analysis was guided by a descriptive phenomenological approach and complemented by systematic content analysis to identify and categorize emergent themes. To enhance methodological rigor, triangulation was applied across participants, data sources, and time periods. Interview data were cross-validated with testimonies, documented reports, and historical records, ensuring the credibility, dependability, and trustworthiness of the findings.

Quantitative data were analyzed using descriptive statistics, including mean and standard deviation. Interpretation of mean scores followed Best's (1981) criteria. Data quality checks, including analyses of missing data and distribution assessments, were conducted prior to analysis.

Methodological Limitations

The study acknowledges the limitations inherent in a single-case design, which may constrain statistical generalizability. Nevertheless, the integration of mixed methods, the use of multiple data sources, and rigorous triangulation strengthen the robustness, depth, and credibility of the findings, consistent with methodological expectations for high-impact empirical case study research.

Results and Discussion

The findings demonstrate that the blue crab ice cream initiative represents a distinctive form of social innovation that integrates product and process innovation within the context of local cultural tourism. Grounded in Sustainable Blue Economy principles, the enterprise enhances the value of marine resources while embedding circular practices that minimize waste and support ecological balance. Through collaboration with the community's Blue Crab Bank, processing waste is transformed into value-added outputs, reinforcing a closed-loop resource system.

The analysis further reveals a strong alignment with the Social Innovation Spiral, as the innovation evolves through interconnected and iterative stages (Figure 2). This process reflects the community's capacity for collective learning, adaptation, and cross-sector collaboration, enabling local challenges to be transformed into innovation opportunities. Overall, the case illustrates how community enterprises, supported by external networks, can generate integrated economic, social, and environmental value through sustainable and participatory innovation processes.

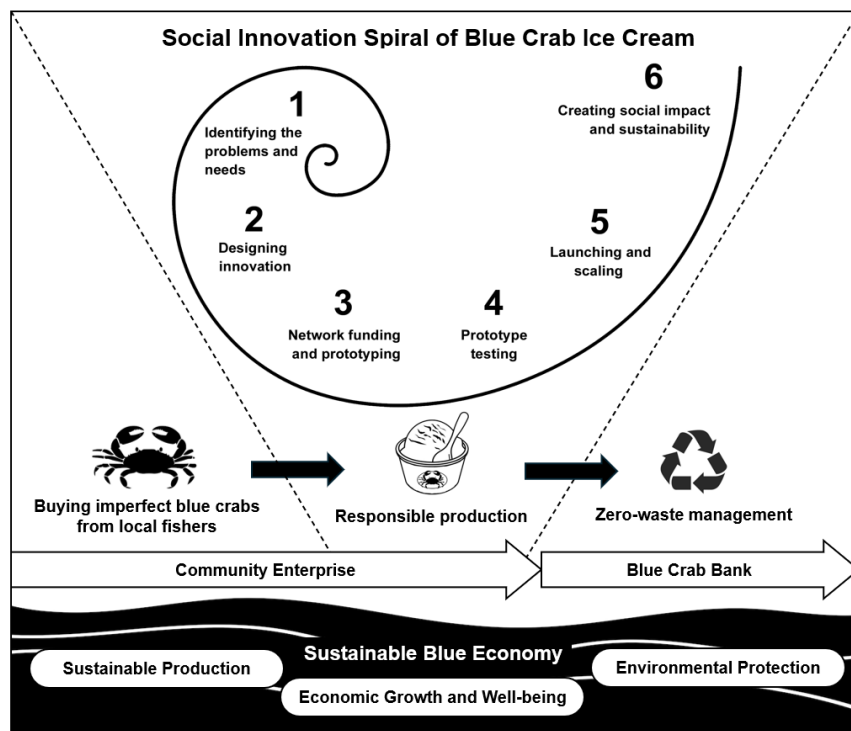


Figure 2 Social Innovation Spiral of the Blue Crab Ice Cream

Source: By authors

1. Identifying the Problems and Needs

The findings from the Ko Si Chang community study indicate that approximately 70 percent of the local population depends on small-scale fishing as their primary source of livelihood. This reliance is supported by the island's rich marine resources, particularly blue crabs, fish, squid, and shrimp, which underpin both household income and local economic activity. In line with national policies promoting a resilient, self-sufficient local economy, the community established a formal community enterprise in 2021. The initiative was designed to enhance the value of local marine products through innovation, create equitable income distribution networks, and ultimately improve the socio-economic well-being of residents.

To systematically assess the community's development potential, a SWOT analysis was conducted in collaboration with local stakeholders. The analysis identified internal strengths and weaknesses, as well as external opportunities and threats influencing the enterprise's performance. Following the analytical sequence recommended by Watkins (2007), the process began by identifying potential threats and opportunities to sharpen strategic awareness, followed by evaluating internal capabilities and limitations. This framework provided a structured basis for developing strategies to strengthen community resilience and sustainable innovation capacity.

The synthesized results of the SWOT analysis are summarized in Figure 3, highlighting how the Ko Si Chang community leverages marine resource abundance and local collaboration to drive social innovation while addressing environmental vulnerabilities and market challenges.

The SWOT analysis identified three critical challenges confronting the Ko Si Chang community. Most local fishers rely on traditional fishing methods and sell their blue crab catch to intermediaries, making them vulnerable to price suppression and market oversupply during peak seasons, which significantly reduces their income. Additionally, the community lacks alternative income sources during off-season periods, leading to economic instability. Small-sized or imperfect blue crabs are also sold at low prices, limiting their potential for value creation. Nevertheless, several internal strengths were recognized, including abundant marine resources, a vibrant cultural tourism sector, and a strong community enterprise that promotes collective action. The presence of the Blue Crab Bank, established through partnerships with academic institutions and government agencies, further enhances the community's capacity to utilize external support and expand its development potential.

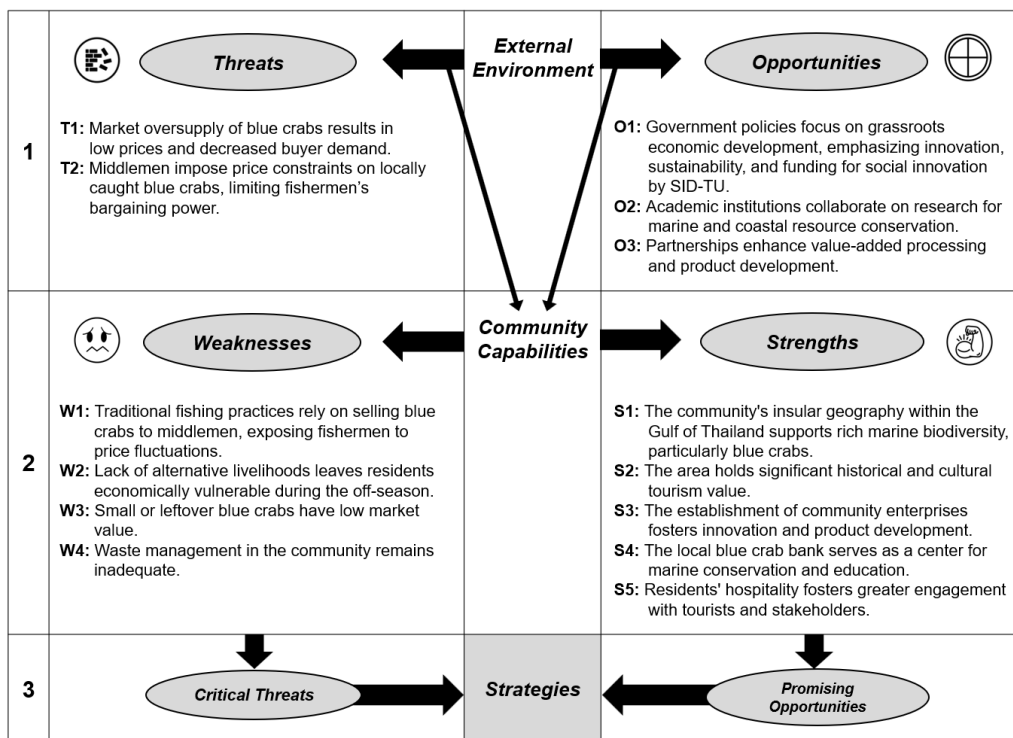


Figure 3 SWOT Analysis of the Ko Si Chang Community

Source: By authors; Ko Si Chang Community-Based Tourism Enterprise, 2024.

Drawing on these insights, the community applied the TOWS Matrix to devise three integrated strategic responses. The proactive SO strategy (S1+S2+S3+S4+O1+O2) leverages social and natural capital, along with external networks, to develop new, value-added products from blue crabs and strengthen market competitiveness. The corrective WO strategy (W1+W2+W3+O1+O2) addresses internal weaknesses by engaging external resources to improve the efficiency and quality of local blue crab production. The defensive ST strategy (S1+S3+S4+T1+T2) mitigates market oversupply and reliance on intermediaries by driving product innovation and diversification.

Together, these strategies offer a systematic pathway for turning local challenges into opportunities for sustainable development. They enabled the Ko Si Chang community to leverage its strengths and collaborate with partners to create value-added blue crab products, generating fairer income and strengthening the local economy. These efforts are reinforced through academic, governmental, and private sector partnerships that enhance resilience and promote social innovation rooted in sustainable marine resource use.

2. Designing Innovation

The SWOT and TOWS analyses sparked the development of value-added blue crab products tailored to market demand and community strengths. Based on the community's needs, they brainstormed creative uses for blue crab and chose ice cream for its uniqueness, production feasibility, longer shelf life, and strong market potential. Drawing inspiration from crab-flavored soft serve in Osaka, the community enterprise launched Thailand's first blue crab ice cream, a pioneering national innovation. Partnering with a network of community enterprises in the Eastern Region, they developed a specialized recipe and adopted the 4E marketing strategy to align with modern consumer behaviors and expectations. It focuses on creating experiences, offering value exchanges, ensuring brand presence, and turning customers into brand evangelists (Chowdhury, 2024). This approach aligns well with the community's unique innovation, which delivers distinctive value while generating positive social and environmental impact. Guided by the 4E marketing framework, the strategy enhances the product's market appeal through:

Experience: creating a memorable consumer experience through unique flavors and refined sensory qualities, supported by sustainable packaging;

Exclusivity: delivering a one-of-a-kind value proposition rooted in local heritage and community innovation, while ensuring affordability and a distinct consumer experience, and generating meaningful social value and positive community impact.

Engagement: fostering meaningful consumer interaction through immersive storytelling, hands-on tasting activities, product showcases, and continuous feedback for improvement; and

Evangelism: strengthening long-term customer–brand relationships by embedding the product within community tourism, conservation values, and shared experiences.

Together, these elements position the product as a distinctive local innovation that resonates with customer expectations while amplifying the community's identity and market differentiation.

In addition, the community enterprise adopts process innovation guided by an impact-oriented approach to develop sustainable blue crab ice cream. The production system is intentionally designed not only to enhance operational efficiency but also to generate positive economic, social, and environmental outcomes for the local community. At the supply chain level, the process begins with the fair-trade sourcing of imperfect or undervalued blue crabs, enabling more efficient resource utilization while reducing waste.

A key feature of this model lies in its circular waste management system. In collaboration with the community's Blue Crab Bank, processing waste is systematically redirected and repurposed. Organic waste is used to cultivate black soldier fly larvae, which are subsequently

processed into marine animal feed, while discarded crab shells are converted into chitosan, a binding agent used in producing crushed oyster shells for carbon dioxide absorption in aquaculture systems. This integrated approach reduces reliance on cement-based materials and contributes to a lower carbon footprint. The resulting waste-free production cycle, illustrated in Figure 4, demonstrates how circular economy principles are embedded within the innovation process as a core operational mechanism rather than a peripheral practice. As reflected by a key informant:

“We developed the blue crab ice cream by designing the product, process, and waste management as an end-to-end system, prioritizing zero waste across the supply chain.” (C01)

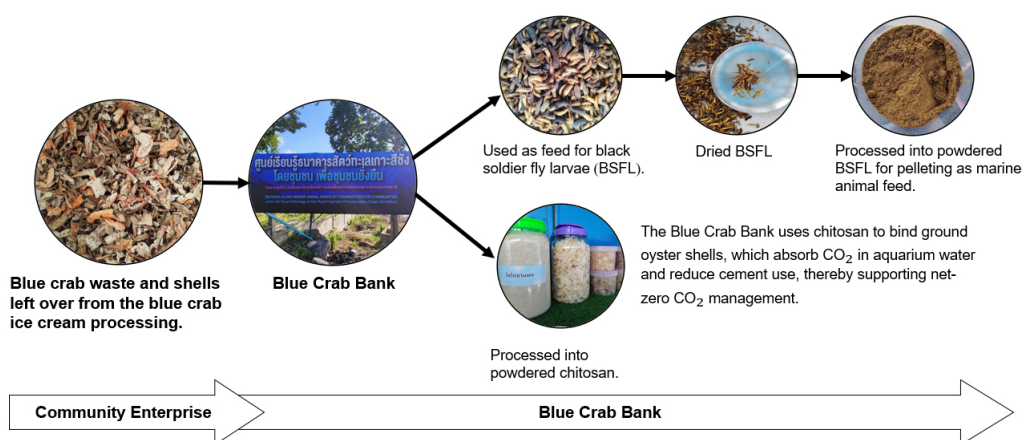


Figure 4 Zero-Waste Management in Blue Crab Ice Cream Production

Source: By authors

3. Network Funding and Prototyping

The blue crab ice cream innovation was collaboratively designed, including its recipe and sustainable supply chain, resulting in a product prototype. The community enterprise secured funding and partnerships for *prototype testing*, with research and development support from academic experts and SID-TU, funded by NIA. SID-TU provided a comprehensive incubation mechanism, including capacity-building, financial support, and close monitoring of implementation. This mechanism strengthened the enterprise's capability to access funding opportunities for local-level innovation development. With SID-TU's support, the community enterprise acquired standard ice cream production equipment, reducing production time and increasing output. They developed a 4-ounce blue crab ice cream in paper packaging to ensure environmental

sustainability. This prototype enhances product value, creates jobs, strengthens the local economy, and minimizes waste, aligning with the future vision of low-carbon tourism. The product represents a nationally unique innovation, as no other community has produced anything similar, (Figure 5).



Figure 5 Blue Crab Ice Cream Prototype

Source: By authors

4. Prototype Testing

After developing the blue crab ice cream prototype, the community enterprise conducted tasting sessions and in-depth interviews with 10 tourist consumers to refine the product and assess scalability. The feedback indicated general satisfaction with the flavor, texture, color, and packaging. The flavor was praised for its balanced taste and pleasant blue crab aroma reflecting the product's main ingredient, while the packaging was viewed as appropriately sized and biodegradable. The ice cream was widely perceived as a representation of local identity with potential community benefits (Figure 6).

Some participants suggested adding a sour note to enhance refreshment. In response, the community enterprise experimented by incorporating sour fruit into the recipe; however, the results showed that this option disrupted the distinctive blue crab flavor. Consequently, the community enterprise decided to retain a single standardized flavor to maintain product identity and differentiation. To enhance consumer experience, a QR code was added to the packaging to communicate the product story and promote Ko Si Chang's tourism narrative.

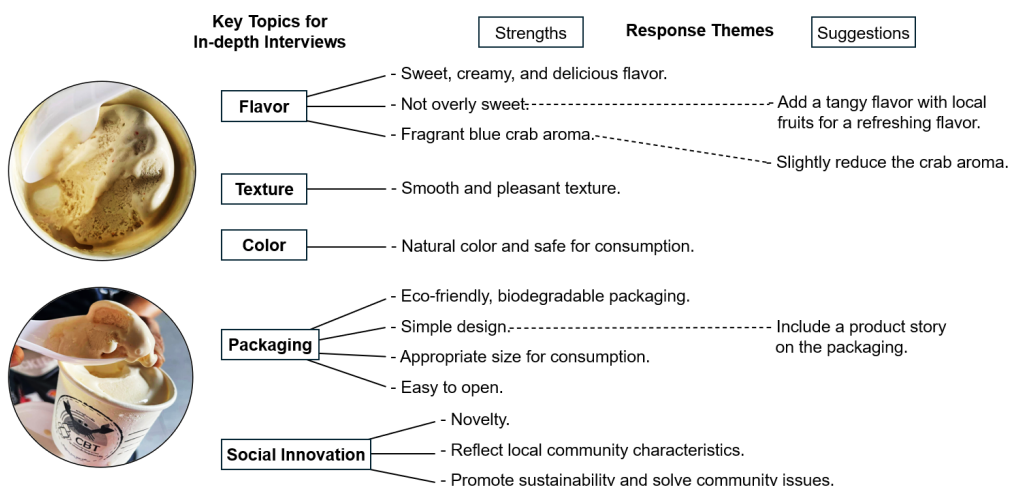


Figure 6 Prototype Testing Feedback

Source: By authors

5. Launching and Scaling

The blue crab ice cream was launched through online promotion via the community enterprise's Facebook page and multilingual (five-language) product signage and is primarily sold at the Flower Blue Cafe on Ko Si Chang, the community enterprise's storefront. The product is offered at 50 THB per cup and presented alongside a newly designed blue crab menu, including blue crab gyoza, blue crab bingsu, blue crab chiffon cake, blue crab cream soup, and blue crab sushi rolls, providing alternative choices for visiting tourists. In addition, the ice cream is served as a snack during study visits and CSR activities, allowing participants to learn about the development process and the community's Sustainable Blue Economy approach. A permanent booth at the Blue Crab Bank was also established to sell ice cream to both Thai and international study groups, complemented by booths at local festivals on Ko Si Chang, helping raise awareness and highlight the innovation's uniqueness (Figure 7).

To strengthen market positioning, the community enterprise adopted a *niche strategy*, limiting product availability to Ko Si Chang and leveraging its uniqueness to attract tourists and stimulate local income generation. As one interviewee explained, exemplified by the following key informant's statements:

*"If you want to eat blue crab ice cream, you must come to Ko Si Chang.
It is a strategy to attract tourists to the island and stimulate income distribution within the community."* (C01)



Figure 7 Advertisements and Sales Booth for Blue Crab Ice Cream

Source: By authors; Ko Si Chang Community-Based Tourism Enterprise, 2024.

To further evaluate the impact of these initiatives, systematic feedback was collected during the launch to assess overall satisfaction and guide further refinement. Insights from tasting activities and consumer interactions were reinforced by quantitative survey data from 100 tourist consumers, focusing on product experience, product uniqueness, customer engagement, brand evangelism, and social impact (Table 2).

Table 2 Tourist Consumers' Satisfaction Levels with Blue Crab Ice Cream

Questions	Satisfaction Levels (n=100)		
	Mean	S.D.	Meaning
Experience: Consumers' product experience	4.43	0.85	High Satisfaction
1) The taste of the product	3.86	0.97	High Satisfaction
2) The product's texture or mouthfeel	4.47	0.80	High Satisfaction
3) The appearance or color of the product	4.66	0.68	Highest satisfaction
4) The product's eco-friendly packaging	4.71	0.62	Highest satisfaction
Exclusivity: The unique characteristics of the product	4.69	0.61	Highest satisfaction
1) The product is innovative, as no other community in Thailand has ever created it before.	4.77	0.55	Highest satisfaction
2) The product reflects the community's identity.	4.68	0.65	Highest satisfaction
3) The product is reasonably priced and reflects its value.	4.57	0.67	Highest satisfaction
4) The product offers a unique experience.	4.74	0.56	Highest satisfaction

Table 2 Tourist Consumers' Satisfaction Levels with Blue Crab Ice Cream (continued)

Questions	Satisfaction Levels (n=100)		
	Mean	S.D.	Meaning
Engagement: Customer involvement and connection	4.66	0.70	Highest satisfaction
1) Setting up booths to promote the product and collect feedback.	4.51	0.87	Highest satisfaction
2) Using storytelling to communicate the narrative of the community product.	4.63	0.72	Highest satisfaction
3) Offering free samples before purchase.	4.77	0.55	Highest satisfaction
4) Surveying feedback for improvement.	4.73	0.62	Highest satisfaction
Evangelism: Strengthening customer–brand relationships.	4.78	0.49	Highest satisfaction
1) Selling the product primarily through cafés within the Ko Si Chang community network to create a unique identity.	4.79	0.52	Highest satisfaction
2) Linking the product's story and marine conservation with community-based tourism.	4.78	0.50	Highest satisfaction
3) Integrating the product as part of the learning station in CSR activities.	4.81	0.44	Highest satisfaction
4) Collaborating with public and private partners to promote the product as a check-in landmark.	4.75	0.50	Highest satisfaction
Impact: Supports community income, fair trade, zero-waste, and sustainable marine use	4.76	0.51	Highest satisfaction
1) The product provides additional income for the community.	4.78	0.46	Highest satisfaction
2) The product allows local fishers to sell blue crabs at fair prices.	4.76	0.57	Highest satisfaction
3) The product supports the circular economy with a zero-waste process.	4.78	0.44	Highest satisfaction
4) The product promotes sustainable use of marine resources.	4.73	0.57	Highest satisfaction
Total from all factors	4.66	0.66	Highest satisfaction

Source: Authors

The results indicate very high consumer satisfaction across all dimensions, with an overall mean score of 4.66 (S.D. = 0.66). Among the five constructs, Evangelism received the highest rating (Mean = 4.78, S.D. = 0.49), underscoring the effectiveness of community-based promotion and network-driven branding strategies. The highest scoring item in this dimension was the integration of the product into CSR learning activities, highlighting its strong potential for experiential and educational engagement. The Impact dimension also recorded very high satisfaction (Mean = 4.76, S.D. = 0.51), particularly regarding income generation and circular economy practices. Within the product experience dimension, tourist consumers expressed the strongest satisfaction with the eco-friendly packaging (Mean = 4.71, S.D. = 0.62), while taste received the lowest rating (Mean = 3.86, S.D. = 0.97), suggesting an area for improvement.

Overall, the results indicate that tourist consumer satisfaction is driven not only by product attributes but also by the social, cultural, and environmental values the product provides. In particular, the community's efforts to build brand and product recognition through niche markets, CSR activities, and community-based tourism (CBT) were highly valued, providing tourists with unique and memorable experiential engagement.

6. Creating Social Impact and Sustainability

The development of blue crab ice cream exemplifies a sustainable supply chain model, generating social value across three key dimensions aligned with Sustainable Blue Economy principles. Details are provided below.

Sustainable Production

The community enterprise sources imperfect blue crabs from local fishers at fair prices, purchasing up to 50 kilograms per production cycle. This helps address issues related to price manipulation by middlemen and the market oversupply of blue crabs during certain seasons. Regarding the production process, the community enterprise demonstrates responsible social and environmental practices by employing local workers, particularly the elderly, who are skilled in extracting blue crab meat, ensuring 100% utilization of the blue crabs with no waste. Blue crab waste, including shells, is collected and processed for waste management, in line with circular-economy principles (Herrero-Luna et al., 2022).

Environmental Protection

The development of blue crab ice cream promotes sustainable use of marine resources in line with the Sustainable Blue Economy (Pauli, 2010, 2011; Smith-Godfrey, 2016; Rees et al., 2018). Blue crab waste is efficiently managed, with 7 kilograms processed per production cycle. The waste is donated to the community's Blue Crab Bank, where 6.5 kilograms are used to cultivate black soldier fly larvae, and 500 grams of shells are converted into 46 grams of chitosan,

which binds crushed oyster shells to absorb CO₂ in marine breeding tanks. This process reduces cement use, supporting a zero-carbon footprint and aligning with circular economy principles (Herrero-Luna et al., 2022). It transforms the linear supply chain into a circular one, reducing environmental impacts (Dey et al., 2020), as reflected in the following key informants' statements:

"We follow circular economy and zero-waste principles, addressing waste at its source by donating leftover blue crab scraps to the Blue Crab Bank, adding value to the waste by using it to cultivate black soldier fly larvae for aquaculture feed and to produce chitosan." (C01)

Economic Growth and Well-being

The community enterprises ensure fair income distribution across the supply chain. Imperfect blue crabs, typically unsellable to restaurants, are bought at 250 THB per kilogram, providing additional revenue for local fishers. Additionally, 12 community members involved in ice cream production earn an extra 300 THB daily, with some earning up to 6,000 THB monthly, thereby sustaining their livelihoods during the off-season when fishing is not available. Moreover, through branding, market expansion, and a niche market strategy that limits sales exclusively to Ko Si Chang, the community enterprise linked the distribution of blue crab ice cream to CSR activities and community-based tourism initiatives. This approach attracts tourists to the island, generating income that is subsequently distributed throughout the community. Beyond economic benefits, the blue crab ice cream has also become a distinctive local product that strengthens community identity and promotes sustainable community-based tourism, as reflected in the following statements from key informants.

"Making blue crab ice cream gives me extra income, helps local fishers sell lower-grade crabs at fair prices, and boosts the local economy. Tourists love it, a win-win for all. It is not just ice cream; it is part of our identity and a way to promote sustainable tourism." (C11)

These findings align with Thetlek et al. (2024), affirming that innovation management enhances productivity, profitability, job creation, and community participation, ultimately strengthening local economies and improving quality of life. Furthermore, as Comini et al. (2022) argue, effective innovation governance not only drives economic performance but also nurtures a more inclusive, resilient, and socially responsive development pathway, where communities play an active role in shaping their future rather than remaining passive beneficiaries.

Critical Reflection and Conclusion

This study highlights the Social Innovation Spiral as a flexible and adaptive framework for understanding community-driven innovation. Such a dynamic, iterative, and context-sensitive model allows communities to tailor approaches to local capacities, socio-cultural dynamics, and resource constraints, a perspective aligned with recent thinking around innovation in sustainable blue economies (Abid & Abid, 2025). The Ko Si Chang blue crab ice cream initiative illustrates how socio-environmental challenges, like seasonal crab surpluses and low-grade catches, can be reframed as opportunities through the creative mobilization of traditional knowledge, cultural heritage, and underutilized marine resources. This resonates with research emphasizing the importance of local knowledge systems and community economic practices in blue economy transformations (Hoareau, 2025). Anchored in Sustainable Blue Economy principles, the initiative combines environmental stewardship, circular resource utilization, and inclusive livelihood creation into a coherent local development model (Elston et al., 2024; Abid & Abid, 2025).

The linkage between food innovation and community-based tourism in this case demonstrates how local identity can serve as a marketable asset, reinforce destination uniqueness, and support ecological conservation and resilience. This aligns with the role of marine tourism in driving sustainable blue-growth development. Strategic niche marketing, CSR engagement, and participatory tourism initiatives enhance product visibility, attract visitors, and foster equitable income distribution, supporting the idea that tourism can function as a transformative mechanism in the Blue Economy (Pisarović et al., 2025). Furthermore, multi-sector collaboration across households, government, academic institutions, and private actors is critical for technical support, knowledge transfer, and market integration, underscoring the importance of co-creation and participatory innovation as identified in blue-economy governance studies (Elston et al., 2024; Das et al., 2024).

Despite these achievements, several limitations must be acknowledged. The development process remains non-linear and highly context-dependent, influenced by variable financial flows, seasonal fluctuations in marine resource availability, and production capacity constraints. While the zero-waste supply chain demonstrated here is effective locally, it depends heavily on external funding, institutional backing, and technical expertise, raising concerns about scalability and replicability in less supported contexts. These risks mirror findings from recent reviews of blue economy policy, which show that risk factors such as livelihood vulnerability, resource overexploitation, and governance gaps persist in many coastal communities (Ansah & Oduro, 2025). Moreover, the socio-economic gains observed may depend strongly on tourism demand and niche market dynamics, highlighting the importance of longitudinal assessment to understand long-term sustainability.

Overall, the findings suggest that sustainable community innovation requires an end-to-end approach centered on value retention, iterative learning, and continuous improvement. Establishing robust feedback mechanisms, monitoring both environmental and market variability, and periodically refining products, processes, and partnerships are critical for long-term resilience. While the blue crab ice cream model shows potential for transferability, its success hinges on context-specific adaptation, multi-sector collaboration, and strengthening internal capacities to reduce dependency on external interventions. These insights contribute to a growing body of literature arguing for participatory, inclusive, and innovation-driven governance in the Blue Economy.

These reflections also point to essential directions for future research, including: (1) longitudinal socio-economic and environmental impact assessments; (2) exploration of scaling pathways beyond niche markets; and (3) deeper investigation into enabling institutional ecosystems for social innovation in coastal settings. Advancing these research agendas will be crucial for improving the robustness, transferability, and systemic sustainability of marine-based social innovation models.

Suggestions and Policy Implications

The findings demonstrate that community-driven social innovation can generate integrated economic, social, and environmental value through circular and participatory approaches. Advancing such innovation requires a shift from isolated product-based support toward institutionally supported, end-to-end systems that integrate product development, process innovation, and circular supply chains. Key agencies, including the National Innovation Agency (NIA), the Office of the National Economic and Social Development Council (NESDC), and academic institutions, should play a central role in designing incubation, monitoring, and long-term support mechanisms.

Policy interventions should prioritize capacity building over short-term subsidies, strengthening local capabilities in production, branding, experiential marketing, and circular resource management. Organizations such as the Department of Industrial Promotion (DIPROM), the Community Development Department (CDD), and universities are critical in delivering training and knowledge transfer.

The findings also highlight the importance of circular economy practices and zero-waste systems, which should be supported through waste valorization technologies and sustainability standards, led by the Ministry of Natural Resources and Environment and local governments. In parallel, integrating food innovation with community-based tourism (CBT) can enhance market

differentiation and local value creation, with the Tourism Authority of Thailand (TAT) and related agencies playing a key enabling role.

Sustainable outcomes further depend on multi-level governance and cross-sector collaboration, requiring coordinated action among public, private, academic, and community actors. Given the context-dependent and non-linear nature of innovation, longitudinal monitoring and adaptive policy frameworks are essential to track impacts and inform continuous improvement.

Finally, scaling such models requires context-sensitive adaptation and knowledge transfer mechanisms, including cross-site piloting and collaborative learning platforms. Overall, sustainable community innovation in the Blue Economy depends on system-based, participatory, and innovation-driven governance that emphasizes value retention, continuous learning, and institutional collaboration.

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