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Information Technology Transformation to Support Economic Activities: A Case Study of Bukit Peramun Digital Forest

Dwi Ayu Lestari[1]
[1] Development Economics Study Program, Universitas Terbuka, South Tangerang
***** Correspondence: dwi.ayu.lestari@ecampus.ut.ac.id

Abstract: *Bukit Peramun, located in Air Selumar Village, Belitung Regency, has been managed by the Arsel Community since 2006. In 2017, it was established as the Bukit Peramun Digital Forest ecotourism destination. This research aims to analyze the impact of information technology transformation at Bukit Peramun Digital Forest on economic activities, particularly for the local community. This study employs a qualitative method with a case study approach through observation and interviews with purposively selected informants. In 2017, the implemented information technology was QR Codes on trees. Then, from 2020 to 2022, the technology was enhanced by integrating virtual reality and augmented reality, including features like Tour 360, the Tree Recognition application, and an online reservation system through peramun.com. The results show that the information technology transformation at Bukit Peramun Digital Forest improved management efficiency and tourist experiences. Although there was a decline in revenue, foreign tourist visits showed an increase. The technological transformation also helped control visitor numbers, which positively impacted environmental conservation, with more efficient service quality and management.*

Keywords:. *economic activity. digital forest . technological transformation*

JEL : O1, Q1, O3

1. INTRODUCTION

In 2015, all United Nations (UN) member states established the 2030 Agenda, which produced a series of 17 global goals. These 17 global goals, known as the Sustainable Development Goals (SDGs), are expected to be achieved by 2030 with all objectives progressing in tandem. One of these 17 goals focuses on terrestrial ecosystems or life on land (Nations, 2015). The United Nations Development Programme (UNDP) further emphasizes the importance of this goal in promoting sustainable management of all types of forests globally and significantly increasing financial resources for the conservation and sustainable utilization of biodiversity and ecosystems.

Advances in information technology have driven changes and developments across various aspects of daily life and business sectors (Bharadwaj et al., 2013). The ongoing information technology transformation has the potential to increase productivity and efficiency in economic activities by changing how companies and individuals interact, conduct business, and communicate (Melville et al., 2004). Information technology transformation also has the potential to increase productivity and efficiency in forest-related economic activities, such as natural resource management, tourism, and agroforestry (Chao & Zhang, 2018).

One example of information technology transformation implementation in forest-related economic activities is the Bukit Peramun Digital Forest in Bukit Peramun Tourism Village, Belitung Regency, Bangka Belitung Islands Province. The Bukit Peramun Digital Forest covers 115 hectares and serves as a habitat for rare flora and fauna in the Bangka Belitung Islands Province. The Bukit Peramun Digital Forest has been designated as the First Community-Based Digital Forest according to the Indonesian World Records Museum (MURI).

The Bukit Peramun Digital Forest represents an innovation in the context of Industry 4.0 by offering eco-tourism based on technological advancement through smart guide features that can display flora, fauna and their information through tourists' individual smartphones (Daulay et al., 2022; Hanifa et al., 2023). The uniqueness of the Bukit Peramun Digital Forest makes it an interesting research subject for study. While Aldyanto (2019), Daulay et al., (2022), Hanifa et al., (2023), and Awalia (2024), have examined digital implementation and its changes in the tourism sector, existing research has not addressed questions regarding whether the information technology

transformation at Bukit Peramun Digital Forest has had a positive impact on economic activities in Belitung Regency, particularly for communities around Bukit Peramun, and whether communities around Bukit Peramun have become Society 5.0 participants in utilizing information technology for their economic activities. Based on these two research questions, this study aims to examine the relationship between information technology transformation at the Bukit Peramun Digital Forest and economic activities.

2. LITERATURE REVIEW

2.1. Information Technology

Information Technology (IT) is a field encompassing the use of computers, software, networks, and other digital technologies to manage, process, store, and disseminate information. IT functions to support human activities across various aspects of life, including business, education, government, and entertainment. This technology involves the integration of hardware and software, along with procedures used to manipulate data into useful information (Turban et al., 2018).

The development of information technology (IT) in forest management and business has experienced significant advancement in recent years. This technology has helped improve efficiency, productivity, and sustainability in natural resource management and business operations (Chen et al., 2014).

2.2. Economic Activities

Economic activities refer to all types of actions undertaken by individuals, companies, or nations to produce, distribute, and consume goods and services to meet needs and desires. These activities encompass various aspects, from production and trade of goods to service provision, investment, and consumption (N. Mankiw, 2021). Economic activities are generally categorized into several sectors:

a. Primary Sector: Includes activities related to the extraction and production of raw materials from natural resources, such as agriculture, fisheries, and mining.
b. Secondary Sector: Encompasses the processing of raw materials into finished goods, such as manufacturing and construction.
c. Tertiary Sector: Involves providing services to consumers and businesses, including financial services, education, and healthcare.
d. Quaternary Sector: Relates to activities involving knowledge and innovation, such as research and development, and information technology.
e. Quinary Sector: Focuses on activities related to creativity and innovation, such as arts and entertainment.

The impact of information technology (IT) development on economic activities is extensive and significant, covering various aspects such as efficiency, productivity, innovation, and market structure (Brynjolfsson & McAfee, 2014). Here are several major impacts of IT development on economic activities:

1. Enhanced Efficiency and Productivity
   IT development has increased efficiency and productivity across many sectors by accelerating business processes, reducing costs, and improving accuracy.
2. Improved Access to Information and Markets
   IT has expanded access to information and markets, enabling companies and consumers to interact more broadly and effectively.
3. Promoting Innovation and New Product Development
   IT facilitates innovation by enabling faster research and development and the launch of new products and services.
4. Transforming Market Structure and Competition
   IT has transformed market structures by creating new business models and increasing competition through digital platforms and e-commerce.
5. Accelerating Business Processes and Automation
   IT enables business process automation and accelerates workflows, impacting operational costs and cycle times.

2.3. Digital Forest

Digital forest refers to the concept of forest management and monitoring using digital technology

to enhance efficiency, accuracy, and sustainability. Digital technology in this context includes the use of geographic information systems (GIS), remote sensing, and analytical software to collect, analyze, and manage forest-related data. Digital forests aim to facilitate forest resource management, track environmental changes, optimize conservation, and improve transparency and accountability in forest management (Bespalova et al., 2021).

Bukit Peramun Digital Forest is a project that integrates digital technology with forest management to enhance sustainability and efficiency. Located in Bukit Peramun Tourism Village, Belitung Regency, Bangka Belitung Islands Province, this project aims to manage forest resources more effectively by utilizing digital systems to monitor and analyze forest data. This includes the use of technologies such as Geographic Information Systems (GIS), drones, and sensors to monitor forest conditions, detect environmental changes, and support conservation and tourism activities (Sari & Arief, 2020).

3. METHODOLOGY

This research employs a qualitative method with a case study approach to investigate the impact of information technology transformation at Bukit Peramun Digital Forest on economic activities. This methodological choice was made as it enables a deeper understanding of complex dynamics within specific contexts. Data collection was conducted from October 3rd to 6th, 2024, in Belitung Regency. Primary data collection was carried out through two approaches: observation and interviews. The observational approach was implemented to obtain qualitative data regarding changes in management practices using technology and their influence on economic activities.

The qualitative data observed included interaction patterns, technology utilization, and workflow processes objectively. The interview approach was conducted with informants selected through purposive sampling. The interviews aimed to obtain qualitative data in the form of informants' subjective views regarding technological transformation, perceived benefits, and challenges. The selected informants included the former leader or pioneer of the Arsel community, the current head of the Arsel community, and the IT expert of the Arsel community. These three informants are members of the Arsel community who have been directly involved in the information technology transformation. Additionally, to enrich the analytical perspective, this research also involved government sectors that have contributed to Bukit Peramun's management, including UPTD KPHL Belantu Mendanau, the Environmental Agency of Belitung Regency, the Tourism Office, and the Air Selumar Village Office. The selection of these informants was expected to provide deep and comprehensive insights into the information technology transformation in ecotourism-based economic activities.

Data collected from observations and interviews were analyzed thematically. Thematic analysis is a method used to analyze qualitative data, including data obtained from in-depth interviews, as in this study. This approach is particularly suitable when the research aims to explore and understand information in depth. Specifically, thematic analysis is utilized to identify patterns that emerge within the information that constitutes the focus of the study (Heriyanto, 2018).

4. RESULTS AND DISCUSSION

Bukit Peramun nature tourism is located in Air Selumar Village, Sijuk District, Belitung Regency, Bangka Belitung Islands Province. The site has been managed by the Air Selumar village community group since 2006, known as the Arsel Community. The formation of the Arsel community was driven by public concern for natural resources, forest conservation, and environmental services from Bukit Peramun. The area possesses natural wealth including twelve springs, granite rocks, and both endemic and non-endemic flora and fauna. According to research by Rianti et al., (2023), the fauna biodiversity in Bukit Peramun includes 12 fish species, 6 amphibian species, 8 reptile species, 18 bird species, and 7 mammal species. Furthermore, (Darmawan et al., 2021) documented flora and fauna comprising 147 tree species, 9 forest mushroom species, 30 moss species, 15 mammal species, 2 primate species, 8 snake species, 24 bird species, 17 freshwater fish species, and 11 insect species. Additionally, 8 orchid species were identified by Destri et al., (2015).

Bukit Peramun is part of the Batu Itam-Air Gelagak Production Forest area. In 2013, a

Community Forest Utilization Permit (IUP-HKm) was granted to the Arsel Community based on Belitung Regent Decree No. 552/866/KEP/DKP/2013 and Ministry of Forestry Decree No. 627/Menhut-II/2013. The area was subsequently expanded to 115 hectares under the Ministry of Environment and Forestry Decree No. SK.7593/MENLHK-PSKL/PKPS/PSL.0/11/2021. The Digital Forest of Bukit Peramun directly borders the Belitung Biodiversity Park (Kehati) spanning 16.25 hectares, established under Belitung Regent Decree No. 620/032/KEP/I/2013, which was later expanded to 34 hectares under Belitung Regent Decree No. 188.45/279/KEP/BPKAD/2021, with management assistance from the Arsel Community.

Following the issuance of IUP-HKm and Kehati management permits in 2013, the Arsel Community began planning ecotourism-based utilization of Bukit Peramun to achieve their initial objectives of forest conservation and environmental services preservation. Additionally, this ecotourism-based utilization aimed to improve community welfare and transform local mindsets to prevent environmental degradation in their livelihood activities (Bhinekawati et al., 2020). Manahampi et al., (2015) added that ecotourism activities contribute to community welfare improvement, both directly and indirectly. Subsequently, Bukit Peramun was officially designated as an ecotourism area in Belitung Regency in 2017 through Belitung Regent Decree No. 188.45/050/KEP/DLH/2017.

4.1. Information Technology Transformation

Since its official opening as an ecotourism destination in 2017, Bukit Peramun has been recognized for its innovative use of information technology and digitalization. Known as the Digital Forest, it initially implemented QR Code technology placed on tree trunks. These QR codes allowed visitors to access information about the trees, including local and Latin names, family classification, and additional details (Figure 1). The QR Code system remained in use until 2019.

Figure 1. QR Code for Accessing Tree Information
Source:https://photo.sindonews.com/gallery/38785/menjelajah-hutan-masa-kini-di-bukit-peramun

During the COVID-19 period from 2020 to 2022, the Arsel Community closed tourist visits to the Bukit Peramun Digital Forest. During this period, the Arsel Community conducted an evaluation regarding the management of Bukit Peramun Digital Forest ecotourism. The Arsel Community implemented changes in the form of effectiveness and efficiency mitigation for managers and environmental sustainability. The information technology transformation utilized integrated Virtual Reality and Augmented Reality. Virtual reality is technology that creates a fully artificial simulation environment or world. Users will be fully immersed in this virtual world, as if they were actually there (Neelakantam & Pant, 2017). An example of implementation at Bukit Peramun Digital Forest is the 360 Tour on peramun.com website. Meanwhile, Augmented reality is technology that combines real-world elements with digital elements. Users can view digital elements overlaid with the real world through devices such as smartphones (Aini et al., 2021; Kostaras & Xenos, 2012). An example of implementation at Bukit Peramun Digital Forest is Tree Recognition in the virtual tour guide application (Figure 2).

The results of the information technology transformation, which was self-taught by IT experts and Arsel Community pioneers with assistance from other team members, include a virtual assistant application currently only supported on Android devices to provide various information in an engaging way and the peramun.com website for tourists to learn about Bukit Peramun Digital Forest. The resulting information technology transformation is a virtual tour guide application comprising Peramun Hill Virtual Guide, Virtual Zoo, Tree Recognition, Virtual Photo Spots, and Online Maps Navigation.

Figure 2. Application for Accessing Tree Information

Before visiting Bukit Peramun Digital Forest directly, tourists can first learn about the actual conditions of the destination through the 360° virtual tour guide available on the Bukit Peramun website, peramun.com. This technology allows tourists to conduct interactive virtual exploration, providing a more realistic and clear picture of Bukit Peramun's natural conditions and beauty without having to be physically present. Additionally, to ensure smooth visits, tourists are required to make reservations or purchase tour packages along with payment gateway through the website before visiting. Payment through the payment gateway in collaboration with Bank Central Asia (BCA) is integrated, allowing visitors to plan their trips more efficiently. The Arsel Community's IT expert adds that this technology not only provides convenience for tourists but is also an important effort in supporting the operational sustainability of tourist destinations in the post-pandemic period, when many tourist attractions reopened with strict health protocols. The development of this technology is expected to attract more tourists and provide added value to the local tourism sector. According to Jaelani & Hanim, (2021), the application of digital technology in tourist villages enables integration of various management components, business process automation, service quality improvement, and more effective tourism promotion, while supporting environmental conservation efforts.

4.2. Economic Activities

The author conducted interviews with the Chairman and IT Expert of the Arsel Community, which revealed that information technology transformation has influenced revenue, management, and environmental sustainability at the Bukit Peramun Digital Forest. According to Sambuardi, (2024), the use of information technology can help maintain environmental sustainability and economic growth. Norliani et al., (2024) added that information technology transformation has a significant influence on management efficiency and organizational productivity.

Figure 3 below shows the visitor numbers before the information technology transformation (QR Code implementation). The graph indicates fluctuating visitor numbers with peak visitation in June. In 2018, visitor numbers reached 4,604, increasing to 5,362 in 2019. Research by Darma et al., (2020) showed that June 2017-2019 was the peak tourist season in Indonesia, correlating with school holiday periods. May and December show zero visitors, which according to the Arsel Community Chairman, was due to temporary closures for maintenance and natural regeneration of Bukit Peramun.

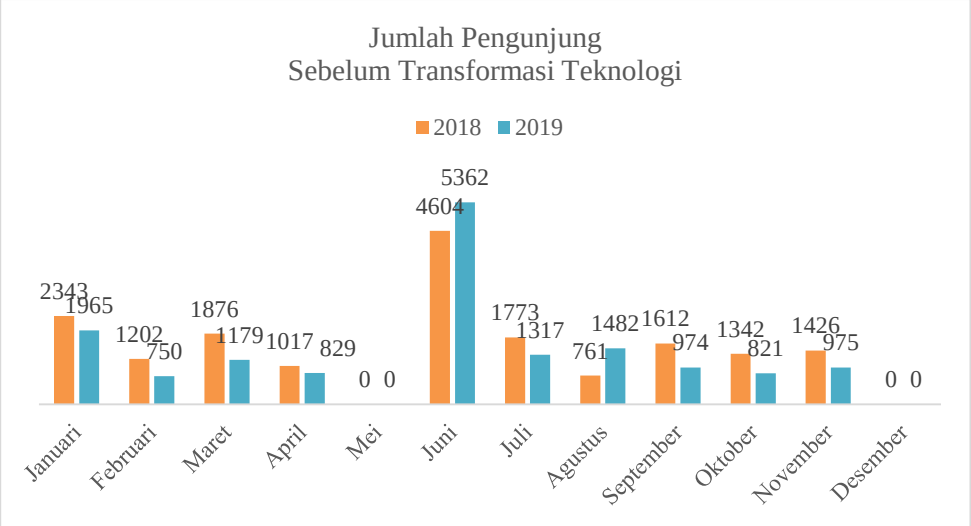

Figure 3. Graph of Visitor Numbers After Information Technology Transformation in Bukit Peramun Digital Forest.

In comparison, Figure 4 below, showing visitor numbers after the technology transformation, demonstrates more stable fluctuation patterns. Peak visitation at Bukit Peramun Digital Forest occurred mid-year, from April to September. In 2023, the peak occurred in April with 535 visitors. In 2024, based on research until October, the peak occurred in September with 515 visitors. These findings contradict Wiratama et al., (2023), who predicted peak tourism would occur in August 2024. The more stable peak visitor numbers after the technology transformation can be attributed to a more exclusive ticketing system.

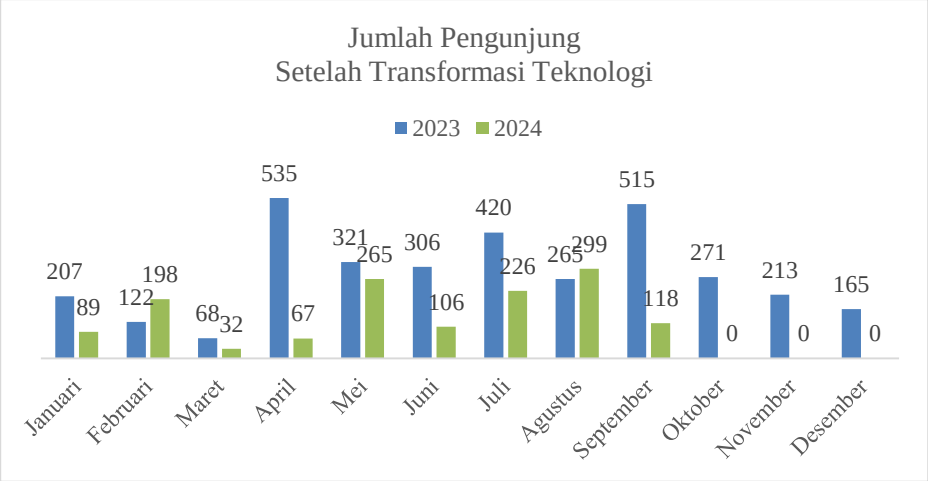

Figure 4. Graph of Visitor Numbers Following the Information Technology Transformation in Bukit Peramun Digital Forest.

Before the information technology transformation, entrance tickets cost Rp 20,000 and included access to natural attractions such as trekking to the hilltop to enjoy Belitung's landscape from 129 meters above sea level, along with contemporary photo spots including a flying car, red bridge, hobbit house, and twin rocks (natural features that remain today). Visitors did not need prior reservations, allowing them to visit anytime during operational hours. This contributed to higher total visitor numbers before the technology transformation. This aligns with research by Anggraini et al., (2019), indicating that while tourists have varying price perceptions depending on their goals and needs, they generally prefer lower prices.

After the technology transformation, the ticketing system shifted to package-based arrangements requiring advance reservations through the Bukit Peramun website (peramun.com). According to Eddyono, (2021), online reservation mechanisms are effective for tourism

development, facilitating tourist activity planning. The website uses English to achieve effective communication and increase attraction for both domestic and international tourists (Adhanisa & Fatchiya, 2017; Solihah et al., 2018; Wirajaya, 2013).

The Arsel Community offers five types of packages: trekking, afternoon tour, specta sunset, cross-country, and meeting events. The trekking package is the most affordable at IDR 50,000, while the afternoon tour is the most expensive at IDR 225,000. According to Fahri, the head of the Arsel Community, the trekking package is the most popular among tourists. This information aligns with the data available on the website peramun.com, which highlights trekking and afternoon tours as the most popular packages. Research using multiple linear regression by Intan & Eviana, (2018) and Saputra, (2021)shows that price variables are related to tourist attraction. However, Kalalo et al., (2022) argue otherwise, suggesting that price perception does not influence tourist attraction at Camp James Remboken. Apart from price, service quality is another variable that significantly affects tourist attraction and satisfaction (Wibiksana et al., 2022).

In addition to information about the packages offered by the Arsel Community, tourists can explore another exciting feature before visiting Bukit Peramun Digital Forest—Tour 360. Tour 360 is a virtual reality technology that provides a realistic preview of Bukit Peramun's environment, offering an immersive experience that enhances consumer trust and reduces uncertainty during the decision-making process for purchasing travel packages. Studies by Basuki et al., (2023), Istita & Suroyo, (2021) dan Riyadi et al., (2023) confirm that Tour 360 effectively increases prospective tourists' interest.

The Arsel Community has also benefited significantly from the ticketing system transformation in terms of management and environmental conservation. Before the information technology transformation, the management could not predict visitor arrival times, requiring them to stay on standby at the Bukit Peramun Digital Forest entrance. This situation disrupted their daily activities. However, the introduction of a reservation system has allowed them to manage their time effectively and efficiently. The system has also improved service quality, as it enables the management to prepare optimally before visitors arrive. According to Ilhamuddin, (2019), reservation systems act as comprehensive management tools for handling various aspects of visitation, from booking to evaluation.

Environmental sustainability is the primary goal of this ecotourism initiative. Rhama, (2019) defines ecotourism as a form of sustainable tourism focusing on biodiversity conservation, environmental protection, and enhancing the quality of life for local communities near tourist areas. The reservation system introduced after the information technology transformation has proven to better support environmental sustainability compared to the previous system. Before the transformation, high visitor numbers significantly contributed to environmental burdens, particularly waste production. Studies by (Nadjih et al., 2020; Titah et al., 2024; Tuahatu et al., 2023; Yusari & Purwohandoyo, 2020) highlight that increased tourist activity directly correlates with rising plastic waste volumes in tourist destinations. Improper waste disposal practices have severe negative impacts, playing a significant role in environmental degradation (Alabi et al., 2019; Utami et al., 2023).

Beyond environmental conservation, the Arsel Community aims to improve the welfare of local residents, especially community members involved in managing Bukit Peramun Digital Forest. Unlike the positive impacts on management and environmental sustainability, the income generated after the information technology transformation has decreased compared to the period before the transformation (Figure 5). The data shows that before the transformation, in 2018 and 2019, revenues were IDR 350,765,000 and IDR 298,290,000, respectively. However, post-transformation in 2023 and 2024 (provisional), revenues dropped to IDR 179,649,000 and IDR 127,880,000, with a decline of approximately IDR 150,000,000.

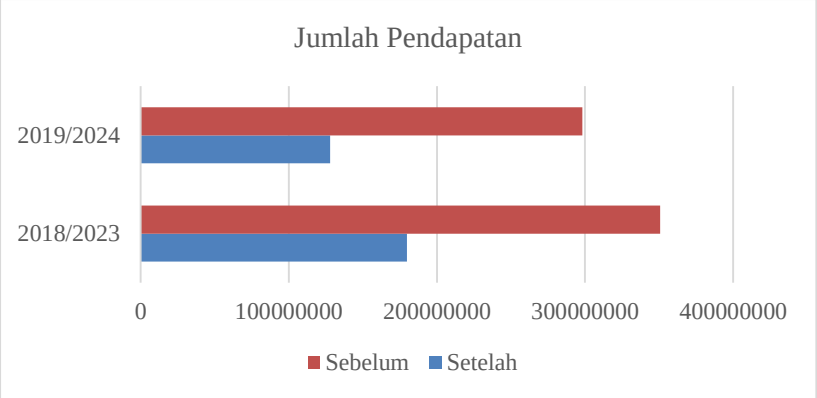

Figure 5. Graph of Revenue at Bukit Peramun Digital Forest (red: before information technology transformation & blue: after information technology transformation).

However, in 2023 and 2024, international tourist visits reportedly exceeded those of 2018 and 2019, according to the Head of the Arsel Community. In 2023, the number of international tourists, ranked from highest to lowest, originated from France, Germany, USA, North Korea, Japan, Netherlands, Italy, United Kingdom, Australia, Russia, and other countries (India, Singapore, etc). According to Handayani & Sari, (2021), East Asian tourists characteristically prefer private tour concepts for nature tourism.

Regarding the positive economic impact, residents of Air Selumar Village who are also village office employees stated that the benefits were primarily experienced by active managing members of the Arsel Community. They identified several potential contributing factors, including Air Selumar village's geographical location, the relatively low human resource requirements for managing Bukit Peramun Digital Forest, and the comparatively low wages for Bukit Peramun management staff. Similarly, research by Safri et al., (2023) on tourism development in TNKS showed contributions to local economic growth, though employment opportunities and business prospects for local communities remained suboptimal.

Air Selumar Village's geographical location, situated beyond the entrance to Bukit Peramun Digital Forest, prevents tourists from passing through the village for transactions. The community considers the current 15 active Arsel Community members sufficient for managing Bukit Peramun Digital Forest's ecotourism activities. However, the Arsel Community maintains that human resources are still insufficient, particularly among younger generations, with youth comprising only 20% of active members. This aligns with the SWOT analysis by Triwardani & Rochayanti, (2014), which identified youth engagement as a key challenge in managing Banjarharjo Cultural Village.

The relatively low income remains a challenge in attracting Air Selumar Village residents to participate in Bukit Peramun Digital Forest management. This parallels the declining youth interest in agriculture, primarily due to economic uncertainty (Oktaviani & Rozci, 2023). This challenge continues to be a primary focus for both the Arsel Community and the government. The Arsel Community head mentioned plans for new tourism facility development in 2025, including a medicinal plant building/greenhouse and an arts/performance venue. These developments aim to enhance Bukit Peramun Digital Forest's ecotourism appeal to potential tourists. The long-term goal is to increase visitor numbers, ultimately benefiting more local residents of Air Selumar Village. Investment in tourism facilities and infrastructure enhances both supply quantity and service quality, potentially improving destination competitiveness and attracting more tourists, thereby positively impacting regional economic growth (Yakup, 2019).

Beyond the self-taught information technology transformation by Bukit Peramun Digital Forest management, infrastructure development has also occurred. Various stakeholders, including banking institutions (BCA and Bank Indonesia) and government agencies (DLH Belitung Regency, DLH Bangka Belitung Province, Belitung Regency Tourism Office, Ministry of Tourism and Creative Economy, and KLHK), have contributed to facility development. Since 2014, facilities including electricity, paved roads, digital information center, public and VIP toilets, waiting areas, prayer rooms, halls, treehouses, pavilions, photo stages, stargazing stations, trekking paths, and suspension bridges have been constructed. This multi-stakeholder collaboration demonstrates strong synergy in

developing Bukit Peramun Digital Forest as a sustainable tourist destination. Developing necessary facilities to support tourism village activities is crucial for visitor safety and comfort (Sianipar et al., 2023). Stakeholders also support promotion through official YouTube channels of BCA, Ministry of Tourism and Creative Economy, and KLHK. Creative promotion through stakeholder collaboration is considered vital for enhancing tourism village appeal (Tjilen et al., 2023).

5. CONCLUSIONS AND RECOMMENDATIONS

CONCLUSIONS

The information technology transformation at Bukit Peramun Digital Forest has significantly influenced ecotourism management and economic activities in the region. The technological implementation, from QR Codes to the integration of virtual and augmented reality, has not only enhanced visitor experiences but also facilitated management in regulating visits and preserving environmental sustainability. The online reservation system implemented following the information technology transformation has helped control visitor numbers and reduce negative environmental impacts, such as increased waste volume. Although there was a significant revenue decline post-transformation, this technology-based development has proven to help management mitigate time and resource allocation more efficiently while providing convenience and ease for tourists. Furthermore, despite decreased revenue, there has been an increase in international tourist visits to Bukit Peramun Digital Forest. This indicates potential for expanding the tourism market more broadly, which is expected to increase local community income.

RECOMMENDATIONS

To support economic activities of communities surrounding Bukit Peramun Digital Forest, it is recommended that collaboration with various stakeholders continues and intensifies. Such collaboration should encompass new tourism facility development, destination promotion, and skills training for management and local communities in tourism and technology sectors. Additionally, synergy with relevant institutions can help expand both domestic and international tourism markets, potentially increasing community income and creating more employment opportunities, particularly for younger generations.

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