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An Analytical Model of Tourist Destination Development and Characteristics of the Development Stages: Example of the Island of Bornholm

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Abstract: This paper presents the basis of the tourism area life cycle (TALC) concept and its extension in the context of the implementation of sustainable development practices in the tourist business model. The author uses the logistic function to determine the level of tourist absorption and capacity. The empirical basis of the methods used was statistics on the development of the tourist industry on Bornholm. The objective of the paper is to determine the stage of development of the tourist area of Bornholm and the consequences of this stage for business models of tourist enterprises functioning there. The results of the analysis indicate that the range of tourist absorption was reached in the 1960s–1970s, and that it is currently getting closer to the upper threshold of that range. Tourism on Bornholm, in line with the TALC concept, is currently in the stabilization stage. Future tourist trends on Bornholm depend on many factors; however, if tourist development goes into the decline stage, the offered products may require transformation, in terms of both transport and the form and availability of tourist attractions. Perhaps this will involve a total transformation of the island into a facility with a specific entertainment, leisure, or business profile. The listed solutions will require entrepreneurs to react within the scope of a transformation of their business models into sustainable models of tourist business.

Keywords: sustainability; business model; logistic function; TALC

1. Introduction

Sustainable tourism, which has been developing rapidly for only a few decades, assumes that it is necessary to responsibly manage and use the natural and cultural resources made available for tourists. It is also a concept referring to the degradation of the natural and cultural environment caused by excessive tourist activity and the infrastructure established in tourist areas (currently defined as overtourism). Starting from the 21st century, this phenomenon has become an important element in running a tourist business, because, as researchers have noted [1] since 2002 in the academic literature, one can observe a specific kind of business model which is a sustainable business model, defined as a set of components in which the components and the stakeholders interact to create, provide, capture, and list sustainable value [2]. It is, therefore, a tool to include sustainable development rules in a company's value logic and the logic of value creation [3].

For many decades, scientists have been thinking about methods of identifying the stages of development of tourist destinations and studying the impact of tourist congestion on the inhabitants of these areas. Despite many proposals, it is still difficult to define a universal tool for identifying the current stage of development of a tourist destination. However, this is often only achieved after the fact. The most frequently confirmed approach by researchers, the concept of the tourism area life cycle (TALC) proposed by Butler [4], assumes the possibility of developing tourist areas in stages, which will

result in exceeding the critical tourist capacity of the area, after which a reversal of the growing trend of increasing numbers of tourists visiting the area and a slow disappearance of the tourist function will occur. In general, it is associated with the degradation of natural and cultural areas that previously encouraged tourists to visit the area and excessively expand the tourist industry.

This paper uses the logistic function to determine the level of absorption and tourist capacity. The empirical basis of the methods used was statistics on tourism development on Bornholm. The objective of the paper is, therefore, to determine the stage of development of the tourist area of Bornholm and determine the consequences of this stage for business models of tourist enterprises functioning there.

2. Theoretical Basis of the TALC Concept and Sustainable Tourism: Literature Review

The concept of the tourism area life cycle (TALC), published in 1980 [4], describes the process of tourist area development, dividing it into stages and describing each stage. According to Butler, the development of a tourist area takes the shape of an asymptotic curve that, when repeated during the course of occurrence, creates a cyclical image of changes, which is especially visible in the number of people visiting the tourist area annually. The diagram of the concept covers six stages of evolution of a tourist town: exploration, involvement, development, consolidation, stagnation, and decline or rejuvenation (defined jointly as a stage of dichotomy divergence) [5].

When distinguishing the evolutionary stages of the area, the symptomatic variable was used in the form of the number of tourists visiting a given town during the year. This is not the only variable representing this phenomenon, as Butler, when characterizing specific stages, also used other features, including spatial and economic ones [6,7].

The first stage is the exploration stage [8]. It is present when individual tourists start to appear in small numbers in a given area, attracted by natural or cultural aspects. These are the tourists who organize their stay independently and do not use common patterns of holidays, and they have a minimal influence on the lives of locals and the local economy. Next is the involvement stage, when tourists visit a given area more often and some locals begin to profit from accommodations, catering, medical services, etc. The engagement of locals takes place by participating in the economic activity envisaged for tourists or by directing services mainly or solely toward visitors. In a tourist town, expectations emerge for organized forms of leisure, and pressure can be felt to improve transportation and facilities for tourists.

The moment when tourism becomes one of the main sources of income in a given area and the number of tourists is equal to or exceeds the number of locals, the development stage begins. This is the stage that signifies that the tourist market is well-defined. Local services are replaced by tourist organizations outside of the tourist area, and as a result, modern and complex services and products appear, the locals lose control over the development of tourist functions, local engagement decreases, and even antagonism on the part of the locals emerges.

The consolidation stage means full development of the tourist function in a given area. This is characterized by a decrease in the growth rate of the number of tourists, and tourism becomes the main area of the local economy. Next, the separation of therapeutic and tourist functions (health resorts, hotels, restaurants) from social functions (for example, households) takes place in the city space. Attempts are made to extend the tourist season and expand the territory in which the services are rendered. Antagonism on the part of locals can intensify, along with an intensification of obstacles to carrying out business.

Next is the stagnation stage, which is characterized by a steady inhibition of the growth dynamics of increased numbers of tourists, achievement of a peak number of tourists in a given area, and then a resulting decrease in visitor numbers. The tourist infrastructure, excessively burdened by too many users based on its technical capacity, starts to malfunction, which leads to economic difficulties as well as social and ecological problems. The area has well-defined but old-fashioned offerings and its image does not match the region. The development has reached the outskirts, and properties change owners.

The last stage of the cycle can be twofold: the decline stage, which results in a total collapse of health resorts, or the rejuvenation stage, starting with stabilization during the stagnation stage, which leads to re-expansion of tourist functions. In the literature on the subject, the last stage is defined in various ways. Butler calls it a stage of decline and rejuvenation. Agarwal [5] uses the term "post-stagnation", as it takes place after the stagnation stage. At the same time, it is a stage of dichotomy divergence, as it is characterized by the divergence of two stages (decline and rejuvenation). Even though they can occur in the same cycle, they cannot occur at the same time.

If, however, the decline stage takes place, it is characterized by a decrease in the number of tourists and closure of unprofitable hotels and spas, transforming them to other entities (for example, nursing homes, private apartments). The area cannot compete for tourists with other, more attractive towns. The service offerings decrease, and the town becomes less attractive and attracts fewer tourists. If the town has a sufficiently large infrastructure, then weekend or one-day tourists start to arrive. Engagement of the locals emerges, this time often generating demand by purchasing services that are now available at more affordable prices. The decline stage can end with total or partial disappearance of the tourist function in a given area.

The town may, however, enter the rejuvenation stage, but this is not possible without sensible and complex activities that aim to expose features that determine the attractiveness of the area. Oppermann [9] cites (and confirms) Defert's [10] opinion, dating back five decades, that a tourist area, despite the decline stage, can begin a new life cycle. This is possible, thanks to the town's ability to adjust its advantages to the needs of tourists and improve the attractiveness of services (through product modification). Butler proposed two solutions: the first is based on introducing artificial attractiveness (for example, by transforming entities into casinos), and the second is based on using previously unused natural resources [11].

The concept also assumes a critical point of tourist absorption and capacity, which, once reached, results in development of the area in a steady direction toward decline. It is, therefore, a symbolic point of overcrowding of the tourist area that, once achieved, degrades the tourist area and its attractiveness and, as a result, its popularity.

The analysis of Butler's [4] concept is consistent with two economic concepts, with sources in the model of cyclical economy development by Keynes: the concept of economic growth by Rostow [12] and the product life cycle by Kotler and Turner [13]. The TALC concept, from the moment it was published, was often criticized by researchers, but more often its development scheme was discovered in many parts of the world. Butler, participating in the process of supplementing his own concept two decades after it was published, added additional features characterizing this model [14]. In 2000, Butler added the characteristics of eight elements, on which the concept is based, and six years later he expanded the concept, collecting the experiences of other researchers working with his model [14,15]. The key supplementation was the reference to weak points and advantages that the literature identified in the course of two decades and the proposal of terms explaining the reasons for development, changes, limitations, and interference in the tourist area (Figure 1). Butler named eight issues [16]: (1) dynamism: change over time, one of the most characteristic features of tourist activity; (2) process: understood as a feature that characterizes the changes taking place in a tourist area, enabling a model-based view of development; (3) tourist absorption and capacity or development limitations: the model is based on the claim that if the number of visitors exceeds the tourist absorption and capacity, the quality of their experience will decline; (4) initiative factors: factors that cause change in a tourist area, e.g., innovation; (5) management: it is crucial to emphasize the management of a tourist area as a whole (comprehensively), because many components in this area lack management, even though they have separate resources and properties; (6) long-term perspective: this perspective needs to be considered when observing an area in the initial development phase; it is an indicator of both the effectiveness of actions that delay the onset of the decline phase and intervention actions that initiate rejuvenation immediately after stabilization, typical for stagnation; (7) spatial components: if the development in an area slows down, a locational shift of the tourist area is proposed to sites where development is

starting from the beginning or is continuing; and (8) universal application: the model was designed for all tourist areas, including specialized areas such as spa resorts.
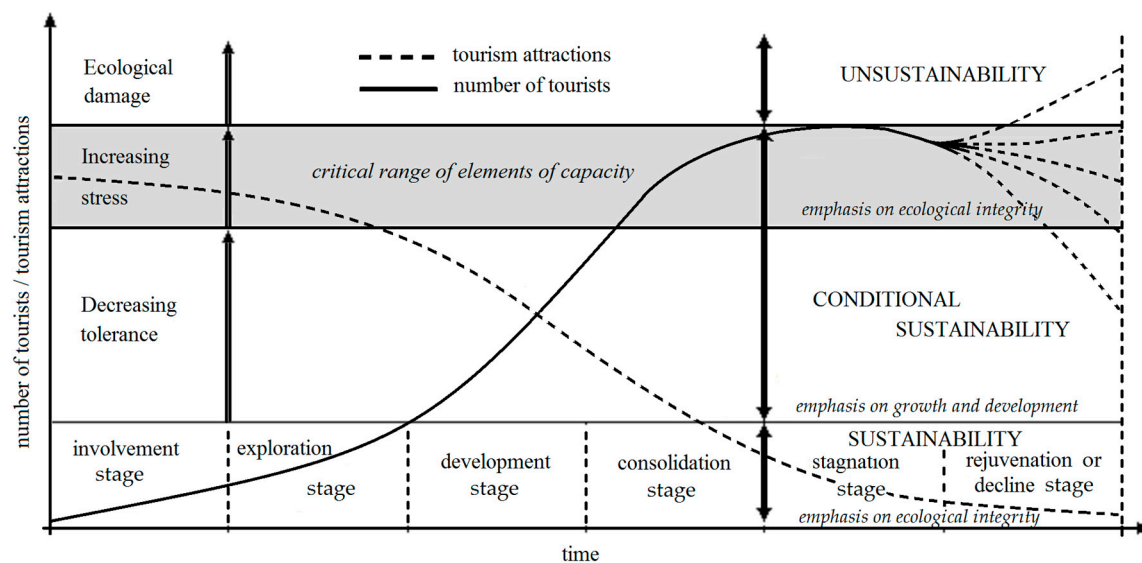

Figure 1. Sustainable development and the tourism area life cycle (TALC). Source: own work based on [4,17,18].

The literature also cites other developments of this concept, but due to the subject of this work, further discussions will focus on sustainable development issues. Within the basis of the TALC concept, one can distinguish the work by Boyd [18], who divided the cycle into several spheres. The first sphere overlaps with the first two stages in Butler's model and is named the balance sphere, where the emphasis is placed on ecological integration as a state where ecological and biological processes of ecosystem communities achieve self-maintaining balance. The second is the sphere of conditional balance, divided into two subspheres. The first one concerns the development stage, where economic balance is desired (meaning improvement of the quality of life and the environment take place at the same time), but focuses on economic growth and development, and then (in the second subsphere) on a return to the maintenance of ecological integration. In the development stage, a decrease in environmental tolerance can be observed, and in the consolidation stage (the first stage of the critical range of tourist capacity of the area), the increased factors resulting in ecological tensions can be observed. The third sphere, located above the critical area, is the sphere of unbalance, where ecological destruction takes place.

Weaver and Lawton [19] found a gap in Butler's [4] concept and Boyd's proposal [18]. They assumed that the critical tourist capacity area does not change during the life cycle of a tourist area. Yet, along with the development of the area, its capacity increases when it comes to tourist absorption. This means that this sphere of tolerance, tension, and ecological damage, just like balance or its lack, does not have to be constant in the entire cycle. Weaver and Lawton [19] proposed two possible solutions for reaching a balance of supply and demand while maintaining critical capacity. The first one is about adjusting the supply to demand; along with increased visitors, the capacity to accommodate new tourists increases. It does not mean, however, that reaching a critical capacity is excluded, as it is possible that the rate of facilities' capacity growth will not match the development pace, and that the area capacity limits will be reached. An alternative is to limit the demand to a defined supply size. Then, the critical capacity will remain unchanged, and when it is reached, balance will not be achieved, unless the gray market, which bypasses those restrictions, expands.

Weaver and Lawton [19] proposed the use of one or several of the following limitations:

- Introducing restrictions on the place or standards concerning the acceptable number of visitors

- Enforcing development standards
- Introducing limitations on the number of places and conditions for accommodation
- Introducing spheres that set limits on tourist activity development
- Introducing bans on infrastructure expansion, for example, airports, or increasing entrance fees to a tourist region (for example, visa charges), the amount of which depends on the desired demand reduction

It must be noted that in recent years, researchers and practitioners have more often developed complex solutions indicated by Weaver and Lawton. An example is the Global Sustainable Tourism Council (GSTC) [20], which developed criteria for sustainable tourism that focuses on four thematic areas: sustainable management, socioeconomic impact, cultural impact, and environmental impact (including resource consumption, pollution reduction, and biodiversity and landscape conservation). The GSTC criteria take into account guidelines and standards on environmental, social, cultural, economic, quality, human rights, health, safety, risk, and crisis management issues, as well as boost constant development. They were developed to ensure a common global understanding of "sustainable tourism" and represent a minimum that every tourist enterprise and tourist reception area should strive to achieve. Those criteria indicate what needs to be done in terms of implementation of sustainable tourism, but not how to implement it. The performance indicators are a complement to the criteria that allow determination of the level of the implementation of set goals.

Buhalis [21] noticed that destinations experience various environmental and sociocultural impacts during their development stages. He developed a set of features that characterize individual stages of development of a tourist area (according to Bull's concept). Table 1 lists several groups of such features, and among them are:

- Destination characteristics
- Marketing response
- Economic impact
- Social impact
- Environmental impact

A decade later, Szromek [22] supplemented Buhalis' table [21], indicating the compatibility of assigned properties of destinations with the concept of Plog [23,24], through the use of selected elements of both concepts and their reconstruction to make them useful in spa areas and extend their theoretical value, making them more utilitarian. Butler's concept (TALC), which describes the phase development of tourist areas, uses a complex set of changes (in time) and economic characteristics that describe each phase of the tourist area for preliminary identification of the current phase of development. The second concept (Plog's) explains the phase development of a tourist area by typological changes in the dominant group of tourists, taking into account the original typology of visitors (allocentrics, near-allocentrics, midcentrics, near-psychocentrics, and psychocentrics). Combining the scientific frameworks of these two concepts allowed an evaluation of the theoretical possibility of verifying both concepts, which would give them more importance because of not only the descriptive abilities post factum, but also the prospective feature by being able to identify the current phase of development. Ultimately, a set of features was obtained, and thus, symptoms that could help determine the various stages of development were specified. The results are presented in Table 1.

Table 1. Destination life cycle and tourism impacts according to the concept of Buhalis, supplemented by Szromek.

	Development Stages of the Tourist Area						
	Plog/Butler	**Exploration**	**Involvement**	**Development**	**Consolidation**	**Stagnation**	**Post-Stagnation**
Dominant Tourists	Allocentrics		Allocentrics				
	Near-allocentrics			Near-allocentrics			
	Midcentrics				Midcentrics		
	Near-psychocentrics					Near-psychocentrics	
	Psychocentrics						Psychocentrics
	Features characterizing individual stages of tourist area development						
Destination Characteristics	Number of visitors		Few	Many	Too many	Many	Many
	Growth rate	–	Low	Fast growth	Fast growth	Slow growth	Declining
	Capacity of beds	–	Very low	Low	High	Very high	Very high
	Occupancy rate	–	Low	Very high	Very high	High	Low
	Service prices	–	High	Very high	High	Low	Very low
	Expenses per person	–	High	Very high	Very high	Low	Very low
	Visitor type		Drifters	Innovators	Innovators	Followers	Cheap mass market
	Brand and attractiveness	–	Low	Very high	High	Low	Very low
	Tourists are seen as:		Guests	Guests	Customers	Customers	Foreigners
Marketing Response	Marketing purpose	–	Awareness	Inform	Persuade	Persuade	Loyalty/new market
	Strategic focus	–	Expansion	Penetration	Defense	Defense	Reintroduce
	Marketing expenses	–	Growing	High	High	Falling	Consolidating
	Product	–	Basic	Improved	Good	Deteriorating	Decaying
	Promotion	–	Introduction	Advertising	Travel trade	Travel trade	Travel trade
	Price	–	High	High	Lower	Low	Below cost
	Distribution	–	Independent	Independent	Travel trade	Travel trade	Travel trade

Table 1. *Cont.*

		Development Stages of the Tourist Area					
	Plog/Butler	**Exploration**	**Involvement**	**Development**	**Consolidation**	**Stagnation**	**Post-Stagnation**
Economic Impacts	Employment	–	Low	High	Very high	High	Low
	Currency exchange	–	Low	Very high	Very high	High	Low
	Profitability of private sector	–	Negative	Growing	Very high	High	Declining
	Residents' income	–	Low	Very high	Very high	Low	Very low
	Investments	–	Low	Very high	Very high	Low	Very low
	National income and taxes	–	Low	Very high	Very high	Low	Very low
	Economic structure	–	Balanced	Tourism oriented	Tourism dominant	Tourism dependent	Unbalanced and not set sufficient
	Dependence on intermediaries	–	Negligible	Low	High	Overdependent	Overdependent
	Import	–	Low	Very high	Very high	Very high	High
	Inflation	–	Low	Very high	Very high	High	Low
Social Impacts	Tourist type	Allocentric	Allocentric	Midcentric	Midcentric	Psychocentric	Psychocentric
	Tourists' origin	Nearby cities	Nearby cities	Region	Whole country	Country and abroad	Country and abroad
	Relations between tourists and locals	–	Euphoria	Apathy	Irritation	Antagonism	Final
	Tourist area demographics	–	Immigrants and existing residents	Young settlers working in tourism; relative sustainability	Balanced	Balanced	Immigration due to no jobs Available and older residents
	Migrations in tourist area	–	Low	High	Very high	High	Low
	Crime in tourist area	–	Low	High	High	Very high	Very high
	Family structure	–	Traditional	Affected	Modern	Modern	Modern
Environmental Impacts	Environment and views	Unspoiled	Unspoiled	Improved	No respect	Polluted	Damaged
	Conservation and heritage	Unspoiled	Unspoiled	Improved	No respect	Decayed	Damaged
	Ecological disturbance	Unspoiled	Unspoiled	Improved	No respect	Decayed	Damaged
	Air pollution	Negligible	Negligible	Low	High	Very high	Very high
	Water pollution	Negligible	Negligible	Low	High	Very high	Very high
	Congestion and traffic jams	Low	Low	Low	Very high	Very high	Low
	Erosion	Low	Low	High	Very high	Very high	Very high

Source: own work based on [21–24].

It must be noted that the measurement and identification of development stages of destinations are based on observations and experience. In the case of an island, it is also possible to refer to examples from other destinations, especially coastal tourist destinations. Therefore, previous experiences from various tourist destinations described in the literature, for example, Venice, Barcelona, Krakow, or even the Arctic [25], might provide interesting insights.

Trancoso González [26] looked at the problem of overtourism when analyzing congestion in Venice, a city that receives 30 million tourists per year and where tourists do not stop coming, also motivated by cruises (in 2017, 2.5 million people landed) [27]. However, the causes of the problem are noticed in tourism democratization, which has led to disproportionate use, not in excess but with bad management, even if increasing consumption was foreseen. In the case of the island's tourist traffic, it was proposed to shift tourists' attention to cruises.

Similar approaches were applied in other destinations. Examples include Barcelona and Palma de Mallorca. Huete and Mantecón presented an interesting analysis of these and other destinations, analyzing the phenomenon of "tourismophobia" in the scientific literature [28].

In the literature, there are many examples of the implementation of rescue or preventive solutions for excessive tourist traffic. Examples include the Biosphere Reserve in Rügen [29] and Wolin National Park in Poland [30] and many others, even global ones such as the World Network of Biosphere Reserves (669 biosphere reserves in 120 countries) [31]. Therefore, this problem is noticed in a context that goes beyond tourism, although it is very related to this human activity. Stoll-Kleemann and O'Riordan [32] described this issue in the context of biosphere reserves. They noticed that in the new era of the Anthropocene, characterized by planetary boundaries being exceeded, with negative consequences not only for "the environment" in an abstract sense, but also for humans themselves, there is an urgent need for innovative ways to showcase sustainable living practices in the light of dominant unsustainable patterns of growth and human consumption.

Even though the listed solutions for protecting the natural environment and local culture should be subjected to tourist impact analysis at every stage of tourist area development, there are tourist destination development stages where such activities should be more intense. Therefore, the TALC concept and its extensions can be useful tools for forecasting or diagnosing the situation.

A successful implementation of the proposed solutions to remedy the disappearance of the tourist function requires their constant use, to ensure that they are rooted in enterprise or community strategic goals. It is best to place them among elements creating a formal model of running a business.

Therefore, a business model is characteristic of the described business [33] or a description of relations between components in an organization that result in the creation of value for the organization [34]. In the majority of cases, it has the form of a tool used to run a business [35] or a story that explains how the enterprise works [33]. The business model is also defined as a theoretical construct that describes the activity of the business based on selected indicators [36]. One of the most accurate definitions of the business model is the one by Wit [37]. Wit states that the essence of a business model is a visual depiction of organizational functioning logic, its elements or ventures in the form of appropriately named interlinked elements of a template that, once populated with content, ensures logical understanding of the functioning, survival, and development of an organization. Visualization of this organization functioning logic requires the use of a specified concept of modeling. Among the most popular concepts is the template by Osterwalder and Pigneur [38]. This model takes into account nine interconnected and interacting elements: customer segments, value proposals, distribution channels, customer relations, revenue streams, key resources, key activities, key partners, and cost structure.

Each of these elements can have assumptions that will implement the sustainable development concept and delay the decline stage (the disappearance of the tourist function) or will make it possible to skip it by entering a new cycle. Examples of such solutions drawing from the Global Sustainable Tourism Council [20] are practices of limiting energy use, pollution, water use, and waste production. An important example of introducing sustainable tourism rules is encouraging contractors, especially

tourist enterprise suppliers, to use similar practices that support and protect the local culture and natural environment.

However, if the tourist area is in the stagnation or decline stage, pro-ecological practices are not enough, as entropy of the current local tourist industry system takes place. Then the enterprise is forced to introduce more radical actions and plans. These can be about changes in the scope of tourism product promotion or even transformation of the business activity.

3. Materials and Methods

The analysis of the intensity of tourist movement identified in a specific area is associated with several difficulties, enforcing the adoption of some assumptions. They aim to simplify the present conditions to develop a model that can explain a specific phenomenon or development mechanism. Therefore, one of the first difficulties is to quantify the tourist movement. Current attempts to describe tourist activity are limited mostly to the adoption of a specific symptomatic variable by which the size of tourist movement can be estimated, and thus approximately defined, taking into account deviation from the actual size of the movement. In the case of tourist reception areas, deviation concerning tourist movement intensity is associated with the inability to precisely measure the values that describe this phenomenon, meaning the number of visitors (including tourists), the length of their stay, etc. These values, even though they can be found in statistical reports, present movement that is registered by entrepreneurs and entities providing tourist services or by border patrols. They do not cover the total size of tourist movement, as tourists can make use of many alternatives (family or second-home stays, unregistered stays, gray market or one-day stays, etc.)

The special tourist area is, in this context, an island, where communication takes place only with the use of defined transportation channels, namely, maritime navigation and air transport. If the island does not have an airport, then visitors can only make use of water transport (ferries, ships, etc.). Due to the fact that there are specific and controllable transport channels, it is also possible to accurately capture tourist movement. It needs to be emphasized, however, that this is still an approximate number, as quite often the statistics do not differentiate tourists' from island residents' travel. Nevertheless, the observations made in such conditions allow for better approximation of the actual scale of the situation, therefore, the probability of error distorting the results is lower.

An example of such a specific tourist area is the Danish island Bornholm, which relies on passenger sea transport (with the use of several ferries) and, since 1982, air transport. The dominant means of transport is still the ferry that, for a decade, has handled more than 90% of total tourist movement [39]. This means that air traffic (with a capacity of 200,000 passengers per year) in this area will be considered marginal.

The Danish Statistics Office (Denmarks Statistik) [39] has registered passenger traffic associated with the island since 1912, and in some periods this research was extended with an additional category, passenger type (resident/visitor). This observation allowed them to notice the stability of these proportions in the years 1991–2009, when residents amounted to 30 ± 1% of passengers. Taking into account the fact that the resident population of Bornholm in the last century underwent slight fluctuations (increasing steadily until 1965 and then decreasing, on average, by 305 persons a year), the influence of this phenomenon on the proportion of residents and nonresidents was insignificant.

Therefore, taking into account the stability of the proportions of passenger groups in the studied period (1912–2018) and the probable (thanks to passenger movement control) high precision of tourist movement quantification in ferry transportation, it can be assumed that the image of the way this phenomenon was shaped (Figure 2) reflects its true status.
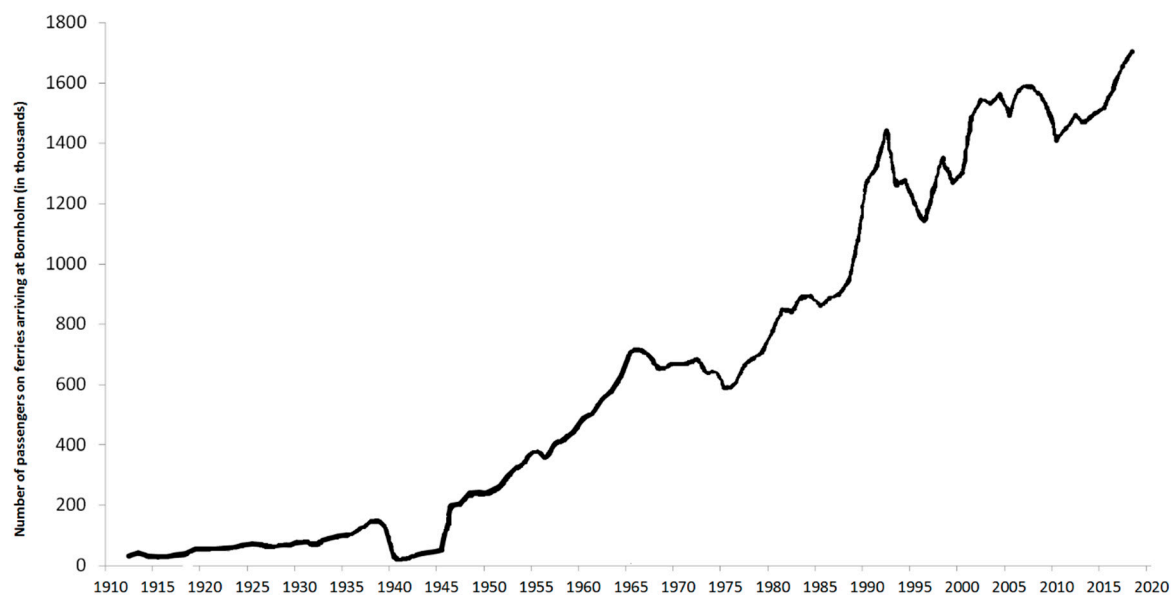
Figure 2. Amount of passenger traffic on Bornholm island, 1912–2018. Source: own study based on data from Denmarks Statistik [39].

Among important historical events that could have influenced the intensity of tourist movement on the island in the analyzed period, the following facts should be considered:

- World War II (1940–1945) significantly decreased transport movement to the island.
- There was a trend among Danish people to spend family vacations by the sea (1948–1972).
- The narrow-gauge railway that was functioning since 1900 closed in 1968; afterwards, reconstruction of internal transport took place.
- Denmark joined the EU in 1973.
- An airport was established on the island in 1982, which made it possible to offer air transport for passengers (in 1940–1968, the airport was used for other transport purposes).
- In 1999, in the whole EU, a new law was introduced that liquidated duty-free shops.
- A bridge opened in 2000 that shortened the journey from Sweden to Denmark and new, fast ferry connections decreased the travel time to Bornholm from 7 to 3 h.
- Denmark joined the Schengen Area in 2001.

Taking into account the development of tourism on Bornholm and the historical events of the area, it can be seen that this phenomenon takes the form of a logistic function (1):

$$y_t = \frac{k}{1 + be^{-at}}. \tag{1}$$

where y_t is a variable determining the development of the analyzed phenomenon (explained variable); t is the time variable; a, b, k are parameters of the logistic function; and e is the base of the natural logarithm (mathematical constant; $e \approx 2.7182$).

The parameters for this logistic function were estimated by Hotelling [40,41]. According to this method, parametric estimation has two stages. First, the least squares method determines parameters a and k (transformed form of a linear function), then parameter b is estimated by performing the least squares estimation again.

The comparative analysis also uses the Pearson linear correlation coefficient r_{xy} and the determination coefficient R^2 to determine the quality of the quantitative model.

4. Results of Own Research: Logistics Analysis of Tourist Area Development

The analysis of the tourist movement development on Bornholm (possible thanks to long-term statistical reporting carried out on the island) shows that Bornholm is often used as a base to test Butler's concept of the tourist area life cycle [4]. Even though the world literature on the subject notes several cases when the concept was confirmed, it is very rare that one can analyze hundred-year-long periods that still have not reached the last stage.

Among the works that tested Butler's concept are works by Lundtorp and Wanhill [42], who, in 2001, estimated the logistic function as a mathematical reflection of the course of the development of Bornholm [42]. While a logistic function is a good model that can explain the development of many economic phenomena, its interpretation is not an easy task. Yet, Lundtorp and Wanhill undertook an estimation of the function and described its properties in the context of stages described by Butler, using data from the period 1912–1999. The result of their work was a logistic function developed for the period 1912–1967, as follows (2):

$$FB_{LW} = 35 + \frac{985}{1 + e^{-0.11(t-1960)}}. \tag{2}$$

The experiment was about verifying the function estimation correctness (LWF) of the described phenomenon based on a limited number of observations. Even though Lundtorp and Wanhill emphasized the exceptional usefulness of development modeling with the use of a logistic function, they also proved that it is useless if the first stages of the cycle are not fully formed. This thesis was confirmed in their paper from 2006 [43,44].

The logistic function (*SFw*) developed by the author with the use of data from the period 1912–2009 is slightly different (3):

$$SFw = \frac{1402.18}{1 + 635e^{0.12t}} \tag{3}$$

The above functions reveal a significant inconsistency when it comes to function maximum, and thus allow the error size *B* that results from the difference $SFw_{ma} - WLF_{max}$ to be shown. Thus, it was empirically confirmed that the model has prediction features only if the majority of stages are formed; moreover, it does not allow prediction of the last stage of the cycle (decline). Therefore, it acts as a function describing the phenomenon ex post.

However, it is worth analyzing one more possibility. Among the factors that can distort the course of tourist area development are military events and catastrophes. Undoubtedly, World War II significantly limited travel opportunities, which is evident from the statistics from that period. However, if we analyze the same time range while filling in probable sizes of tourist movement on the island (estimated with the use of linear interpolation), the function (*SF*) takes a completely different shape (4):

$$SF = \frac{1718.95}{1 + 71.92e^{-0.07t}}. \tag{4}$$

The logistic function *SF*, where the influence of World War II on the development of tourist movement on the island is limited, indicates a new maximum that is greater than the maximum of the previous functions *SFw* and *LWF*. At the same time, both functions (*SF* and *SFw*) indicate an equally good fit to the empirical data ($R^2 = 0.84$). However, the data obtained from the last decade significantly deviate from the *SFw* function, which indicates that the *SF* function is more reliable (Figure 3).
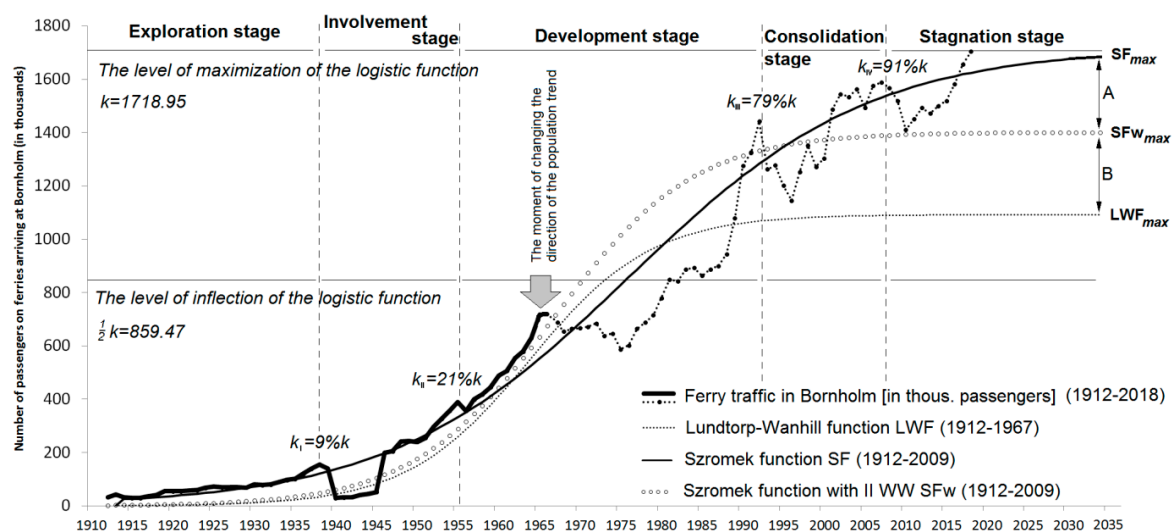
Figure 3. Logistic functions for passenger traffic of Bornholm island, 1912–2018. Source: own study based on data from Denmarks Statistik [39].

What Lundtorp and Wanhill also achieved is knowledge on the subject of the stage-division of a cycle that exceeds the so-called inflection point. Analyzing the function, and especially its characteristic points (calculating zero places with the use of subsequent derivatives), they established that a natural division resulting from the logistic function is in five stages: the first one covers the area from 0% to 9% of the maximum function value and the subsequent ones from 9% to 21%, 21% to 79%, and 79% to 91% of maximum (100%). Thus, proper estimation of the logistic function allows calculation of both the inflection point and the function maximum, which, in turn, makes it possible to determine particular stages of the model.

Lundtorp and Wanhill assumed that the stages resulting from logistics function properties and the mathematical division of the logistics function overlapped with the stages defined by Butler [4]. When analyzing the history of Bornholm and the events that could have influenced the changes in tourist movement on the island in the context of feature characteristics for subsequent TALC stages, it seems probable.

In line with this analysis, the exploration stage took place before 1940, therefore it can be assumed that the period 1912–1940 was when the island was visited only for the purpose of getting to know a new area, without any evident signs of tourist function in that area. It must be noted that because Denmark was neutral, the influence of the Great War on passenger movement in Bornholm ports cannot be observed.

The second stage of the island's tourist development (involvement stage) consists of the years 1940–1955. It can be divided into two important periods in the island's history. In 1940–1945, Denmark was occupied by Nazi troops. At that time, passenger movement was minimal. The postwar era was about further development of railway transport on the island and greater intensity of tourist movement, due to a trend among the Danish to spend family holidays on the seaside.

The growth stage shown in Diagram 3 in 1955–1994 was the time when the number of visitors increased. This growth was not regular but varied in specific moments of the island's history. An example is a breakdown in the growth trend in 1966–1976, when the means of internal transport underwent transformation. The growth trend continued along with the accession of Denmark to the EU, which probably increased the share of foreign tourists in the region (verifying this assumption is not possible).

After 1994, a consolidation of tourist areas took place: the growth trend of the number of tourists collapsed and took on a new shape, a result of inhibition of the increased number of visitors. It is therefore a signal that the area entered the stagnation stage.

The technical analysis indicates that the maximum number of visitors will be reached in the stagnation stage, and thus in the whole cycle (at the level of 1.7 million passengers), in the third decade of the 21st century. It does not mean, however, that carriers will not notice such numbers of passengers until that time, but this number may not be constant and stabilization at this level may take place after 2025.

It is worth noticing another characteristic of the change of the tourist area in the context of overtourism. The expansion of tourism and its intensification consequently led to the disappearance of local culture and displacement of locals residing in tourist areas. This can be proven by observing many cities that are intensely visited by tourists. This influence is particularly visible in the case of tourism on islands.

The analysis of the number of residents of Bornholm indicates that in the middle of the development stage and at the time of breaking the logistic function, a qualitative change in the population number trend took place. Whereas until 1966, the population of Bornholm was positively correlated with the number of visiting tourists ($r_{xy} = 0.787$), after that period, the correlation between these variables was negative and much higher ($r_{xy} = -0.885$). The conclusion, based on the above observation, indicates that the level of critical capacity and absorption of tourism of Bornholm started at the end of the 1960s (Figure 4).
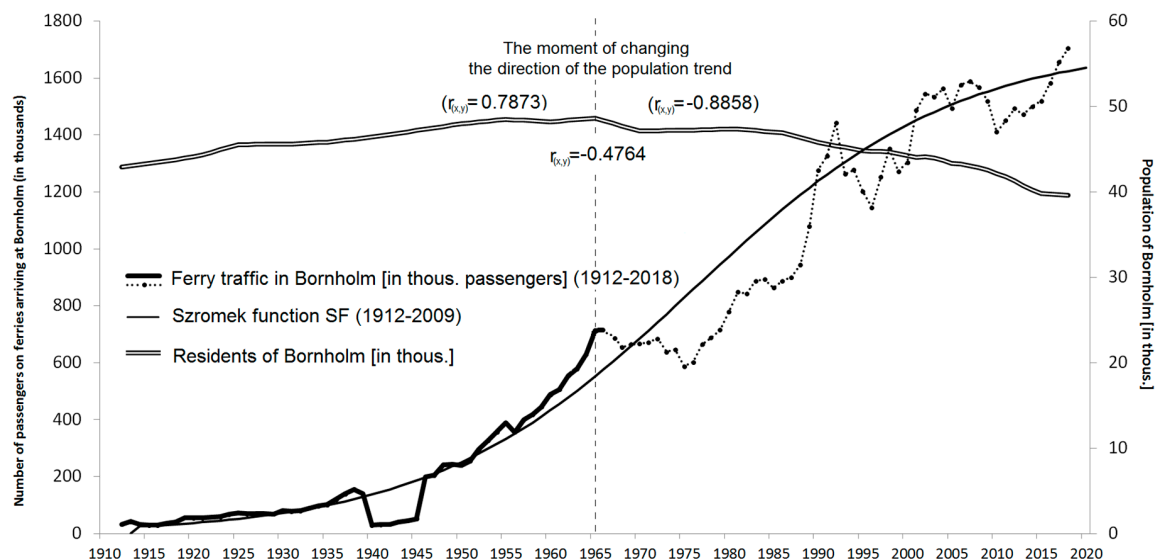

Figure 4. Comparison between the number of tourists on Bornholm and the population living on the island, 1912–2018. Source: own study.

The decline in the island's population is not surprising. The migration of tourist destinations caused by tourist congestion is found in many popular cities. It is possible to stop this trend. The solution may be to reduce congestion either by limiting tourist traffic (but also limiting income) or by expanding the tourist area, which can dissipate the excess tourists. An interesting solution to the problem of tourist congestion on the island of Bornholm is to introduce changes in transport (sea and air) and develop tourist offerings, limiting tourist traffic on land and increasing it in the form of cruises around the island.

5. Conclusions

The scientific value of this paper lies in the correction of previous research in this area, but also in providing a better tool for analyzing the stages of tourism development on Bornholm. The obtained analytical model, combined with the cited concepts of tourist destination development, make it possible to see the current phase of tourism development on the island and changes in the population of inhabitants.

The consequences of the observed changes concern not only the resident population but also enterprises operating on the island. The business model of a tourist enterprise, located in a tourist area that is in the involvement or exploration stage, will differ from the business model of an enterprise functioning in an area in the consolidation or stagnation stage. Due to the conditions faced by enterprises carrying out tourist activities at a time of excessive tourism movement, such a business model should also take defined elements into account.

In the case of Bornholm, the range of tourist absorption was reached in the 1960s–1970s, and currently it is getting closer to the upper threshold of that range. This means that if tourist enterprises functioning on Bornholm have not yet introduced remedial solutions to their business models, they should do so as quickly as possible. Referring to the concepts by Boyd [18], Butler [4], and Plog [24], the tourist area on Bornholm is entering the stage of unbalance, along with the consequences.

The future tourist trends on Bornholm depend on many factors; however, if tourist development goes into the decline stage, the offered products may require transformation, in terms of both transportation and the form and availability of tourist attractions. Perhaps it will become necessary to expand the airport near Ronne and increase tourist movement by plane. Another option is to transfer tourist movement from land to sea. Perhaps it will be total transformation of the island into a facility with a specific entertainment, leisure, or business profile. The listed solutions will require entrepreneurs to react regarding the scope of transformation of their business models into sustainable models of tourist business. This means that the solution to the described problem of island congestion may be to develop a proper approach to tourism management on the island that is focused on sustainable tourism. However, while sustainable tourism generally concerns protection of the natural environment, this time its basic task will be to protect the indigenous culture of the island.

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