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An influencer pathway framework for sustainable tourism in SIDS ecotourism hotspots: A case of Aripo ecosystems, Trinidad

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Introduction: Ecotourism hotspots in small island developing states (SIDS) are affected by unsustainable practices characterized by a lack of coordination, management inadequacies, and poor enforcement of policies and regulations. Consequently, depletion of natural resources and reduction in ecosystem value occur, with the undermining of the contribution of tourism to SIDS economies. An ecotourism system that ensures sustainable ecological integrity, economic viability, and social awareness is therefore critical in SIDS.

Methods: We developed an influencer ecotourism pathway framework (IPF) using the Aripo ecosystem as a case study of an ecotourism hotspot by focusing on influencers within a SIDS system to improve collaboration toward the common goal of ecosystem sustainability. The framework was created to reflect the ecosystem attributes and services found in Aripo, the influencers that both negatively and positively impact the environment, possible solutions specific to addressing these negative impacts, and the ecotourism goals of the area.

Results and discussion: The framework was used to characterize the natural capital of Aripo in relation to the three (3) main ecosystems: forest, savanna, and man-made Aripo village. The influencer ecotourism framework provides a practical model to be applied for sustainable ecotourism management efforts in tropical small island regions as it identifies ecotourism attributes and ecosystem services, linking them to the potential impacts of influencers on the environment. It also provides useful insights to various influencers about their role in sustainable ecotourism that conserves the natural capital of the destination community while improving socioeconomic conditions.

KEYWORDS

sustainable tourism, ecotourism, ecosystem services, ecotourism hotspot, influencers, influencer pathway framework, SIDS

1. Introduction

The sustainability of tourism dependent small island developing states (SIDS), particularly in the Caribbean, depends in large part on the extent to which these islands can effectively diversify and manage their product offerings in an increasingly competitive tourism marketplace. "*SIDS are inherently economically vulnerable due to their remoteness and insularity, susceptibility to natural disasters, fragile ecology, limited institutional capacity, limited ability to diversify, strong dependence on a narrow range of exports, and high*

import content, particularly of strategic goods such as food and fuel, whose prices have exhibited high volatility" (United Nations, 2010, p. 18). Given this context, many SIDS have gravitated toward tourism as an engine of growth to sustain the economies through the generation of foreign exchange, employment creation and an overall diversification of their economic base. The majority of Caribbean islands in particular, have pursued mass tourism development as a panacea for economic development and have collectively earned the Caribbean the reputation of being the most tourism dependent region in the world (Mather and Todd, 1993; World Travel and Tourism Council, 2022). However, the developmental benefits of tourism have been severely constrained over the years owing to the many socio-economic and environmental challenges that have plagued the islands as a result of rapid, unplanned growth. Foreign ownership, high leakage, expatriate domination of management at high levels, overexploitation of limited physical resources are some of the ills of mass tourism development (Lewis-Cameron and Brown, 2022).

The traditional mass tourism development model has come under scrutiny given the vulnerabilities of SIDS, the rapidly evolving global tourism landscape and the continuing negative impacts of tourism (Sharpley, 2021). As the impacts of tourism become more apparent, concern about the quality of the environment and the future of the industry has emerged which has led to a focus on alternative forms of tourism. Concerns for the delivery of sustainable tourism using the mass tourism model of development is a key driver of alternative tourism. The new forms of tourism share in varying degrees a concern for "development" and take account of the environmental, economic, and socio-cultural impacts of tourism which lie at the core of sustainable tourism development. They also share an expressed concern, with varying levels of commitment for participation and control to be assumed by "local people" and the degree to which they engage and benefit the poor. Proponents of alternative tourism,Benur and Bramwell (2015, p. 214) argue that "alternative products" can potentially be more socially and environmentally sustainable for destinations as these products "encourage appreciation of a destination's special character, involve businesses that are locally-owned, and are small-scale in terms of tourist numbers and infrastructure requirements."

Ecotourism has been identified by the United Nations World Tourism Organization (UNWTO) as an alternative form of tourism that can contribute to the attainment of sustainable tourism development. The IUCN (World Conservation Union) defines ecotourism as "*environmentally responsible travel and visitation to relatively undisturbed natural areas, in order to enjoy and appreciate nature (and any accompanying cultural features- both past and present) that promotes conservation, has low visitor negative impact and provides for beneficially active socio-economic involvement of local populations*." According to Klak (2007), sustainable ecotourism takes into consideration ecological integrity, which includes environmental health, protection, restoration, and stewardship. Secondly, it examines economic viability or economic security at the community and national levels. Thirdly, it focuses on social justice, social welfare, inclusion, cultural interaction, and mutual respect. The reinforcing benefits of these three, are contingent on activities, whether natural or human, that pose positive and/or negative effects on the ecosystem that impact sustainable ecotourism. The proponents of these activities are considered ecotourism influencers. Therefore, for ecotourism, it is crucial that influencer activities are economically viable, positive for both host and visitor communities, and contribute to environmental conservation.

It is against this background that this paper proposes the development of a framework that focuses on sustainable ecotourism by concentrating on influencers within a SIDS system that could improve collaboration toward the common goal of ecosystem sustainability. The context for this study is the rural community of Aripo in the island of Trinidad. Aripo has unique ecosystems that support the livelihoods of surrounding communities *via* ecotourism (Atwell et al., 2018). As in other SIDS ecosystems, the competing influences in Aripo have resulted in the depletion of rare, threatened, and endemic species and limit the ecosystem's capacity to provide goods and services. These challenging issues highlight the fact that, for several years, different influencers have been impacting the potential of Aripo as an ecotourism hotspot. With this in mind, the specific objectives of the study are to: (i) use Aripo to bring more awareness to the natural capital of the ecosystems (NCE) in SIDS, (ii) assess potential solutions to current challenges faced in SIDS ecosystems, and (iii) identify critical influencers for sustainable tourism in Aripo and create a sustainable ecotourism framework with influencer pathways that can be applied to other SIDS ecosystems. The proposed framework can be extrapolated to similar ecosystems, as Aripo is a microcosm of the processes that occur within SIDS and on a much larger scale in the mainland continental countries of South America. As a result, this paper has greater global implications and applications. To the best of our knowledge, there has been no study conducted on the development of a sustainable ecotourism framework with influencer pathways.

2. Sustainable ecotourism: Benefits and challenges

Ecotourism is one of the fastest growing segments of the global travel and tourism industry. According to a report by Million Insights (2022), the global ecotourism market size is expected to expand by 10.3% between 2021 and 2028 and to reach USD $385.01 billion by 2028. The report noted that drivers of this expansion include an increase in environmental protection and awareness, affordable prices, demand for more sustainable travel experiences to natural areas that strive to conserve the natural environment, utilization of locally sourced food supplies and services that provide economic benefit to local communities and destinations adopting sustainable best practices and recognized certification programmes. However, the lack of a homogeneous and functional definition of ecotourism activity, makes its impact difficult to assess. While there may be various definitions, there is agreement on the key principles that underpin ecotourism which include:

1. A type of usage that minimizes negative impacts to the environment and to local people;

2. The awareness and understanding of an area's natural and cultural systems and the subsequent involvement of visitors in issues affecting those systems;
3. The conservation and management of legally protected and other natural areas;
4. The early and long-term participation of local people in the decision-making process that determines the kind and amount of tourism that should occur;
5. Directing economic and other benefits to local people that complement rather than overwhelm or replace traditional practices (farming, fishing, social systems etc.);
6. The provision of special opportunities for local people and nature tourism employees to utilize and visit natural areas to learn more about the wonders that other visitors come to see (Wallace and Pierce, 1996).

Notwithstanding the lack of agreement on a definition, the benefits of ecotourism are undisputed. Ecotourism within the broader tourism phenomenon contributes to maintaining the ecosystem as it raises awareness among tourists. Benefits are also obtained by local populations that learn about the significance and worth of their community. By promoting environmental stewardship, ecotourism encourages both tourists and locals to be mindful of wasting resources and polluting the environment (Hampton and Jeyacheya, 2013). Ecotourism creates jobs and generates revenue supporting local economies and further motivating the populace to protect the environment. It is a major contributor to GDP and foreign exchange (Royle, 2001) with the greatest input coming from general sales tax on travel-related services and tourism tax. Ecotourism is a key source of employment for SIDS populations given its direct contribution. It integrates conservation, communities, and sustainable travel and is essential to the survival of SIDS (Guyana Chronicle, n.d.). Ecotourism sets the standard when it comes to the protection of natural and cultural environments, it helps address the issues that isolation and insularity pose for SIDS. By supporting regional development, through careful planning of resource use and development, poverty can be alleviated. Policies that promote diversity, such as buying locally produced goods and services, boosting carrying capacity, and investing in specialized education and training are therefore essential (Fotiou et al., 2002).

When implementing a plan for ecotourism in a community, Sirakaya et al. (1999) signaled a number of potential disruptions that can occur including an alteration of local cultures and the lifestyle of local populations depending on the intensity of visitor-host interactions. Economically, the extent of foreign control of ecotourism operations may limit the local economic impact of ecotourism operations due to high leakage. From an environmental perspective, the nature of the activity can lead to erosion e.g., hiking. Further, ecotourism operations can pollute the environment through improper waste disposal. Deforestation is also a concern as infrastructural development is necessary for expansion of operations. Sustaining ecotourism therefore entails effective management of resources in such a way that the benefits are maximized and challenges minimized.

3. Materials and methods

3.1. The case of Aripo Trinidad

Aripo is located at (10°30'35" N, 61°12'0" W) in the Northern Range of Trinidad and can be broken into three distinct ecosystems (forest, savanna, and man-made; Figure 1). The services provided by these ecosystems support human wellbeing through the provision of fresh water, food, timber forest products, carbon storage and sequestration, erosion control, runoff regulation and retention, soil conservation, recreation, cultural services, and biodiversity support (Table 1). The forest ecosystem comprises El Cerro del Aripo, Trinidad and Tobago's highest peak at 940 m above sea level, as well as upper and lower montane and seasonal evergreen forests. Generally, these mountainous portions of Aripo are characterized by high rainfall (3,500 mm per year) and humidity (as fog and cloud), lower average daily temperatures, and high winds as compared to the flat, low-lying Aripo savanna. These climatic conditions are ideal for the development of unique forests such as the cloud forest at the summit, which contains an elfin woodland.

The Aripo Savanna is generally flat, lying ∼30–45 m above sea level. There is a gradual rise to the north which fans out of the foothills of the Northern Range where the forest and man-made ecosystems are located (Figure 1). The climate is humid-tropical, with annual rainfall ranging from 2,400 to 2,600 mm on average. The monthly temperatures range from 22.7 to 31.3°C with relative humidities of 60 and 75% in the dry and wet seasons, respectively (Environmental Management Authority, 2007). Evapotranspiration is high, accounting for about 60% of the total rainfall (Water Resource Agency, 2001). These climatic conditions give rise to the heterogeneous vegetation distribution of the Aripo Savannas and surrounding areas. The Heights of Aripo village is located at the base of El Cerro del Aripo. Therefore, it is a man-made ecological system, nestled within the forest ecosystem. The village is surrounded by secondary forests, agricultural lands, and cultural heritage sites.

3.2. Ecotourism framework with influencer pathways

Disruptive influencer activity has degraded the natural capital of ecosystems (Robinson et al., 2013; Massingham et al., 2019). This has caused a major extinction crisis (Grandcolas and Roseli, 2016), particularly in rare ecosystems such as the Aripo ecosystem in the small island state of Trinidad (Atwell et al., 2018). For ecosystem sustainability, human activities that arrest and reverse ecosystem degradation are crucial to sustained nature experiences. Therefore, ecosystem sustainability is pivotal to sustainable ecotourism.

Ecotourism occurs as a part of an interdependent system (Hvenegaard and Dearden, 1998). The sustainability of an ecosystem, therefore, could be achieved by looking holistically at the key players (herein referred to as "influencers"), whether environmental or human, that positively or negatively influence the ecosystem's health and attractiveness to patrons. To achieve this,

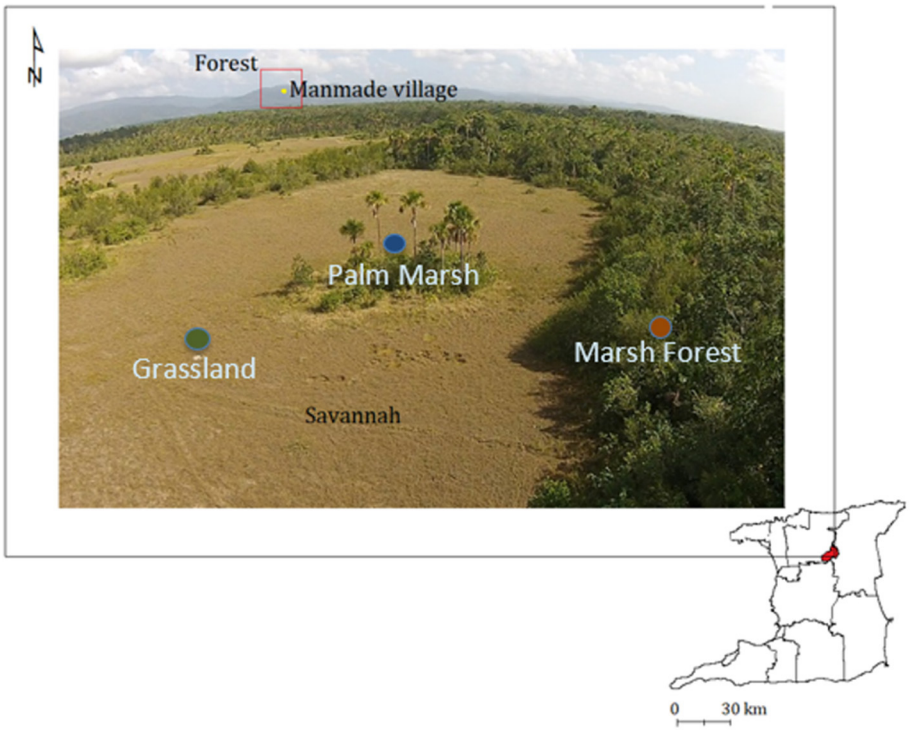

FIGURE 1
Map of Trinidad with the location and extent of Aripo highlighted in red. The insert is an aerial photograph showing the Aripo savanna ecosystem in the foreground and the approximate locations and extents of the forest (red box) and manmade (yellow dot) ecosystems in the background. The three sub-ecosystems in Aripo Savannas: marsh forest (brown oval), grassland (green oval), and palm marsh (blue oval).

an influencer pathway framework (IPF) for sustainable ecotourism was developed. The IPF considers sustainable ecotourism (SE) as a function of the natural capital of the ecosystem (NCE), the activities of the service providers (ASP), the activities of the tourists (AOT), the ecosystem extraction activities (EEA, which are essentially intended to mine the natural capital for other economic purposes), and the environmental-climatic factors (ECF; Equation 1).

$$SE = f(NCE, ASP, AOT, EEA, ECF) \quad (1)$$

For sustainable ecotourism, the combined effects of conservational influencer activities (CIA) must be greater than the combined disruptive influencer activities (DIA) on the NCE (Equation 2).

$$SE = \sum_{i=1}^{n} CIA_i > \sum_{i=1}^{n} DIA_i \quad (2)$$

where n is the number of activities that comprise CIA or DIA, and i is the ith activity. Ecotourism becomes unsustainable when DIA exceeds CIA.

A participatory approach to management (Roopnarine et al., 2021) is required for the IPF. The development of ecotourism typically involves a wide range of influencers who may have different motivations. The IPF provides an umbrella under which these influencers can operate toward a common goal of environmental and natural resource sustainability, which are crucial in ecotourism. Effective management also links ecological preservation to financial gains, this not only empowers local communities but motivates local populations to preserve their resources. It is necessary to involve local influencers at every stage of the ecotourism management process. Allowing stakeholders to shape the process and its major outcomes ensures long-term commitment. The importance of local participation cannot be stressed enough, especially when it comes to monitoring and evaluation of ecotourism management practices (Li and Han, 2001; Roopnarine et al., 2021).

The need for the tourism industry's sustainable development in the Caribbean has long been acknowledged, allowing for the achievement of the ideal balance between maximizing the sector's capacity to support national economic development goals and preventing damage to the very resources that initially drew tourists.

4. Results and discussion

4.1. Natural capital of the ecosystem (NCE) for ecotourism

Ecotourism has emerged as one of the most popular strategies for community development and conservation. Its appeal stems from its promise to boost the local economy while also preserving the integrity of ecological resources through minimally disruptive, non-consumptive usage of local resources (Stem et al., 2003). Ideal destinations for ecotourism are places where wildlife, vegetation,

and cultural landmarks are prevalent (Ezebilo, 2014), making Caribbean island states prime destinations. Thus, Trinidad, one of the most biodiverse (Table 2) and culturally rich islands on the planet, has enormous untapped ecotourism potential. The ensuing subsections discuss the unique natural capital of ecosystems for ecotourism found in Aripo.

4.1.1. Forest

Cloud forests are rare, fragile ecosystems that develop on tropical and subtropical mountains where clouds almost continuously cover the landscape (LaBastille and Pool, 1978). Cloud forests uniquely contribute to the hydrology and biodiversity of watersheds. In Trinidad, the cloud and tropical montane forests in El Cerro del Aripo support inland freshwater systemsincluding rivers, streams, and waterfalls that are important for ecotourism (Environmental Management Authority, 2012).

Cloud forests support high levels of endemic and threatened species. *Epiphytic* plants such as mosses, ferns, and bromeliads are a crucial component of cloud forests hydrology and biodiversity. These plants trap water from the fog and provide a variety of microhabitats for endemic and threatened species. Trinidad has recorded 59 endemic vascular plants, 32 of which have been collected within the Northern Range and restricted to the island's peaks such as El Cerro Del Aripo and El Tucuche (Van den Eynden et al., 2008). The summit of El Cerro Del Aripo's cloud forest is home to an elfin woodland that is characterized by gnarly stunted trees densely covered in epiphytes. The El Cerro Del Aripo cloud forest is extremely humid with temperatures ranging between 14.4 and 24°C (Beard, 1946). These environmental factors are ideal for the nocturnal endemic luminous lizard (*Riama shrevei*; Hitlal, 2016) and bromeliad species such as the enormous epiphytic bromeliad (*Glomeropitcairnia erectiflora*; Brozio et al., 2017). The bromeliad plants in Trinidad and Tobago's cloud forests are slightly acidic with high water contents which creates a microhabitat for the *Phytotriades auratus* also known as the golden tree frog (Brozio et al., 2017). This rare frog species is only found in Trinidad and Tobago's highest summits (Jowers et al., 2008) and in the Paria Peninsula of Venezuela (Rivas and De Freitas, 2015). Other endemic species found in El Cerro Del Aripo are *Eleutherodactylus urichi* and *Mannophryne trinitatis* frogs and the *Leptophis stimsoni* snake.

As you descend the Aripo massif Upper Montane Rain Forests, Lower Montane Rain Forests, and Seasonal Evergreen Forests can be observed. Rooks and Barclay (2012) characterized Trinidad's Upper Montane Rain Forests as very moist and chilly and found at elevations below 900 m.Trinidad's Lower Montane Rain Forests are the most populous and fertile and may be found between 750 and 150 m above sea level. Seasonal Evergreen Forests are predominant in lower elevations and resemble Lower Montane Rain Forests, however, due to seasonal influences, trees in Seasonal Evergreen Forests are taller and deciduous. The Trinidad and Tobago national flower, the chaconne (*Warsewiczia coccinea*), is one of many species commonly found in the Lower Montane Rain Forests and Seasonal Evergreen Forests. Lianas and epiphytes are also common, in part because the canopy is not dense, allowing enough light to pass through to support their growth. The predominant epiphytes in both types of forest are bromeliads, but aroids, orchids, and ferns are also widespread. The peach palm (*Bactris gasipaes*), also known as Pewa in Trinidad and Tobago is one of the many edible fruit producers in Aripo's forest ecosystems.

FIGURE 2
Rare terrestrial orchids found in the Aripo Savannas.

4.1.2. Savanna

Nestled at the foothills of the Northern Range of Trinidad lies the Aripo Savannas, the last natural ecosystem of its type in Trinidad and Tobago. The Aripo Savanna is a delicate habitat with many rare species of flora and fauna. Scientists have identified 457 species of plants in this relatively small area, including two endemic plant species, *Rhynchospora aripoensis* and *Xyris grisebachii*. As such, the Aripo Savanna has been designated as an environmentally sensitive area with a special designation as a scientific nature reserve. The Aripo Savannas are made up of grasslands, marsh forests, and palm marshes (Figure 1). This vegetation segregation thrives upon a unique White Sand Ecosystem (WSE) which may have developed due to weathering and aeolian deposition.

The grasslands are comprised mainly of sedges and grasses. However, interspersed in the open areas of the savanna are sphagnum moss and a variety of small shrubs. Clumps of spiny palm (*Bactris savannarum Britton*) and *Byrsonima crassifolia* are occasionally seen within the savanna. The savannas are beautified by the presence of several rare terrestrial orchids that are unique to South America and Trinidad, such as *Otostylis brachystalix Reichb.f. Schltre* and *Epistephium parviflorum Lindl.* (Figure 2). In addition to its natural beauty, the grassland biodiversity supports microflora and nematode diversity. Additionally, Loreau et al. (2002) noted that native grassland ecosystems increase the stability of soil ecosystem patterns and processes.

Palm marsh areas are found within the savannas, forming belts ~20 m wide that form scattered palm islands (Figure 1). Moriche palms (*Mauritia flexuosa*) are only found in Brazil, Colombia, Ecuador, and Peru, and the Aripo Savanna. This palm tree grows in and near swamps and other wet areas. The palm islands also contain a thick understory of sedges and grasses, similar to those found in the open savanna.

The Aripo grasslands and palm marshes merge into the marsh forest. These forests are inundated during the wet season due to this sub-ecosystem's lower elevations. The forest plant community

can be separated into an upper and lower stratum. The upper stratum consists of trees such as bois bandé (*Parinari campestris),* which is reputed to have aphrodisiac properties and is only found in Trinidad, and a few South American countries. The upper stratum has a variety of tropical fruit trees such as Cajuca (*Annona glabra L.*), and wild kaimit (*Pouteria sp*), as well as medical and ornamental plants, for example, the yellow mangue (*Symphonia globulifera L. f*). The lower stratum consists of biscuit wood (*Ilex arimensis*) and agalie-type (*Ficus spp.*) trees. The palm and marsh forests in the Aripo Savanna can increase biodiversity and are home to many varieties of medicinal plants (Ehrlich and Wilson, 1991). These sub-ecosystems can also increase carbon fixation, and suppress soil-borne diseases and pests.

The Aripo Savannas are also classified as White Sand Ecosystems (WSE). In addition to the Aripo Savannas, WSE only occurs in the humid tropical Amazonian Basin and the Guiana Shield (Anderson, 1981; Adeney et al., 2016; Capurucho et al., 2020). WSE are rare since tropical environments are dominated by red sesquioxide soils (Richards, 1941). The soil properties in WSE are characterized by low pH, aluminum toxicity, low fertility, and groundwater fluctuation. These edaphic factors drive the natural occurrence of WSE (Adeney et al., 2016; Capurucho et al., 2020). These ecosystems provide homes for many endemic species (Adeney et al., 2016; Capurucho et al., 2020), which adds to the already high biodiversity of humid tropical ecosystems by opening up the otherwise completely closed canopy and forming natural savannas (Fine and Baraloto, 2016). Due to the uniqueness of WSE, there is an increased chance of the proliferation of varieties of specialized bacteria important for various biogeochemical processes, such as nitrifiers, nitrogen fixers, and fungi (Brussaard, 1997).

The Aripo Savannas and surrounding areas are home to many species of fauna, in addition to earthworms and termites, there are many species of damselflies, butterflies and fish, four species of terrestrial turtles, 13 species of snakes, 128 species of birds, and 26 species of mammals. The complex ecological relationships between the flora and fauna increase the ecotourism potential of this unique ecosystem (Table 2).

4.1.3. The Height of Aripo village

In the twentieth century, the work offered by Cocoa Estates was a significant magnet for labor and settlers. One of the cultural landmarks of the village is the old cocoa houses, some of which are still in use. The Aripo Cocoa Estate also known as the Charamal Estate (Figure 3a), is listed as a historical site on the Heritage Asset Inventory, a list of Trinidad and Tobago's heritage sites. Although most of the villagers no longer engage in cocoa production, agriculture continues to play a significant role in the community as The Heights of Aripo is the island's second-largest watercress producer (Figure 3b).

The village is a theming ecotourist destination, offering hikers a non-technical, challenging climb to El Cero del Aripo's cloud forest and the Aripo caves. The Blue Basin waterfall, located in lower Aripo, is the perfect resting spot for weary travelers. On the way to the summit, hikers are treated to scenic views of the beautiful watercress fields and the Datta Ganga Temple (Figure 4), a popular Hindu pilgrimage site located on the Aripo river. The temple blends beautifully with the surrounding vegetation, creating the ideal fusion of a natural and spiritual atmosphere. The river's clear and pure water creates a picturesque setting, which is an ideal place where people can go to meditate, practice yoga, and practice spirituality, as well as enjoy what many purports to be a healing bath in the river.

Hikers witness a variety of wildlife, flora, and fauna. However, bird watchers can visit the Heights of Aripo Hummingbird Sanctuary, a 1-min walk from the Aripo caves, as it is one of the last places accessible by the Aripo road. Both the sanctuary and caves are popular destinations for ecotourists as they are brimming with wildlife such as the white hawk, common black hawk, violaceous and white-tailed trogons, purple honeycreepers, turquoise, and speckled tanagers, blue-headed parrot, gray-headed kite and the squirrel cuckoo, and rare visiting warblers such as the bay-breasted, black-throated blue, and blackpoll warblers, oilbirds, bats, the "luminous" lizard, and devil birds.

The abandoned US military army bunkers still present in Aripo are leftover relics from World War II. During this time, several sections of the Aripo forests were used not only for the storage of artillery but also for conducting drills all while being a major terminus for the shuttling of troops to war in the pacific. Today the infrastructure left behind in the form of roads and train tracks is used as the main access points into the forest, while the abandoned bunkers draw the curiosity of many tourists that visit Aripo.

4.2. Ecotourism framework with influencer pathways

Tourism or non-tourism influencer activities are undertaken despite the ecological and social limits of living in a finite ecological setting (Higgins-Desbiolles, 2018). The relevant influencers, environmental attitude, subjective norms, perceived behavioral control, and ecotourism behavioral intention was identified and used to create critical insights into and accurately grasp the factors that ultimately influence ecotourism behavior Lee and Jan (2018). The influence that influencers exude can be related to the situation at hand and their ability to either positively or negatively affect the environment (Maxwell, 2013). Having an understanding of the influencer's role, stake, and perspective indicates the interest the influencer has in ecotourism. This level of interest would also impact their environmental actions through the types of behaviors, attitudes, and contributions they make toward sustainability.

An IPF for the best use of natural resources while conserving the environment and cultural heritage in Aripo was developed (Figure 5). The framework was created to reflect the possible pathways influencers (ASP, AOT, EEA, and ECF) may take that both negatively (disruptive, DIA) and positively (conservational, CIA) impact the NCE of Aripo for sustainable ecotourism.

The IPF, therefore, consists of three main interconnected components: (1) the NCE, comprising ecotourism attributes, ecosystems, and ecosystem services; (2) influencers, comprising ASP, AOT, EEA, and ECF; and (3) pathways, whether sustainable

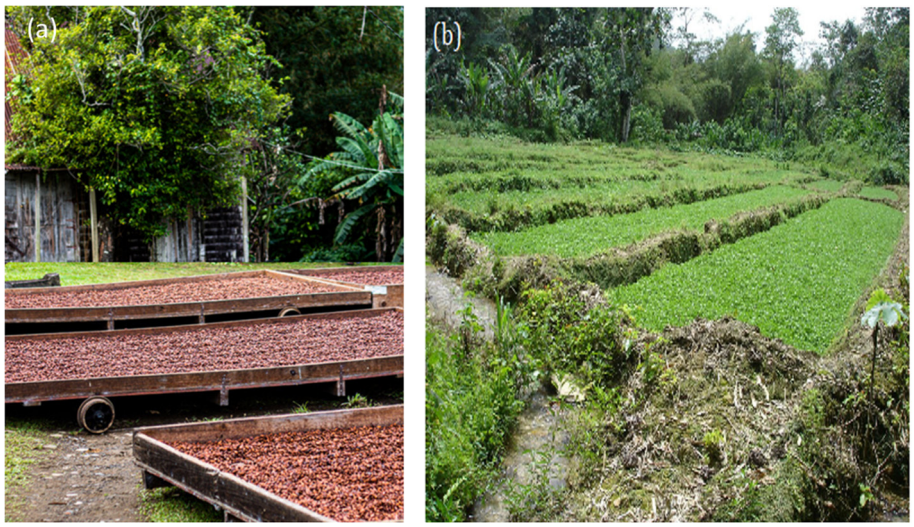

FIGURE 3
Agriculture in the Height of Aripo village **(a)** cocoa drying on tables **(b)** a watercress estate.

FIGURE 4
Photo collage of the Datta Gatta Temple as well as the Aripo river and two of its waterfalls.

(CSA) or unsustainable (DRA) based on the activities of the influencers.

The ecotourism attributes of Aripo include its unique flora and fauna, its rare white sand ecosystem, the cloud forest, and the elfin woodland, the cultural heritage sites of Aripo, and its water catchment areas. These attributes are of high importance as they allow for the gaining of strong benefits once used optimally. The major ecosystems in Aripo are highlighted in the framework. These include the natural ecosystems of forests and savanna and the man-made ecosystem found in the Aripo village. The anthropogenic practices that occur in the village modify the natural ecosystem for the provision of food, energy, raw materials, and spirituality. The natural ecosystem services found in the forest and savanna include regulating, filtering, recycling, cycling of nutrients, supporting biodiversity, and detoxification (Table 1).

4.2.1. Disruptive influencer activities (DSA) and conservation influencer activities (CSA)

Human intervention in the natural environment is done to produce goods and services. Generally, these interventions exposed the environment to different threats that led to its degradation (Wuddivira et al., 2010). This exposure is exacerbated in Caribbean SIDS with fragile ecosystems and where tourism is the mainstay for

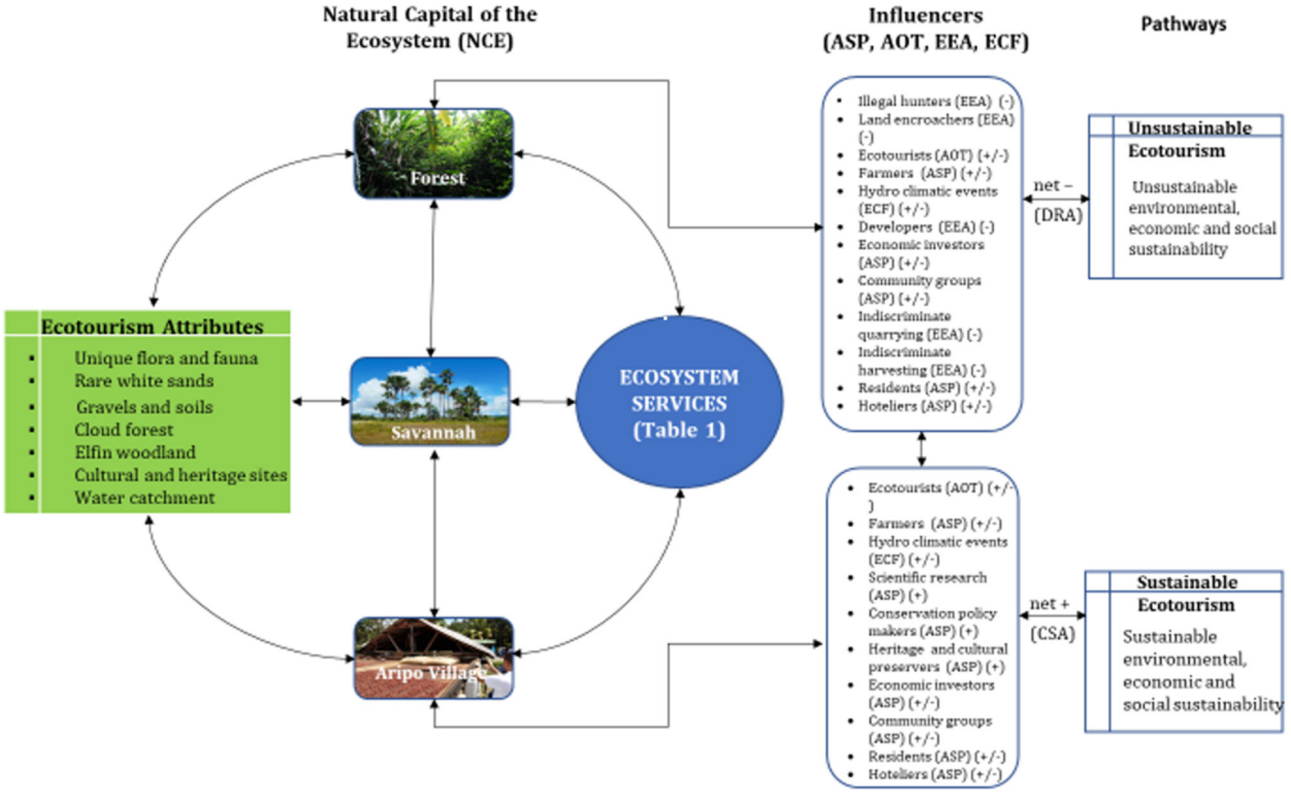

FIGURE 5
Influencer pathway framework for sustainable tourism in SIDS.

economic development (Lewis-Cameron, 2021). In Aripo, some of the unregulated influencer activities that degrade natural resources include illegal hunting, land grabbing by squatters, pollution, land developers, miners, industrial activities, agricultural conversion, fire, and encroachers. These activities result in the clearing of forests, the loss of native vegetation, habitat losses, and the extinction of fauna, as well as having the implication of limiting the carbon abatement capacity of the ecosystem and increasing its vulnerability to disasters and extreme weather events.

For sustainable ecotourism in this and similar hotspots, influencer activities should be understood and managed with sustainability in mind. Hence, conservation actions must become the guiding principle. The mindset of influencer service providers must be conservational so that the NCE is maintained in such a way as to ensure the sustainable future of the ecosystem. We, therefore, opined in the IPF, that the path to sustainable ecotourism is when conservation actions are an integral part of influencer activities and their net effect exceeds the disruptive influencer activities.

For the enforcement of conservation actions, government support and policy intervention are crucial. Therefore, appropriate regulations, land policies that deter land grabbing and squatting, reforestation measures, the creation of fines and other deterrents, approvals/permissions to conduct research, education and awareness campaigns, waste control measures, a controlled hunting season, improved collaboration amongst stakeholders, and disaster preparedness can facilitate the sustainable achievement of environmental, social, and economic goals. The IPF is therefore a practical tool in the sustainable management of tropical small island regions as it identifies ecotourism attributes and ecosystem services, linking them to the potential impacts of influencers on the natural environment. Using the case of Aripo, in the proceeding subsections the relevant influencer activities are discussed.

4.2.1.1. Activities of service providers (ASP)

ASP are individuals or entities that provide services. Given that tourism frequently serves as the foundation of SIDS economies, sustainable development is essential. Generally, the activities of service providers can have both negative and positive effects on the community, however, the negative effects can be minimized by adopting the concepts of environmental, economic, and social sustainability. One of the major service providers in Aripo is hoteliers. Although there are no published reports on tourism in Aripo, Prayag et al. (2010) reported that Mauritius hoteliers agreed that hotels should have favorable effects on the economy, society, and culture, as well as contribute to environmental sustainability. This finding is significant as hotels often spearhead tourist activities by providing useful information such as the history of the community, a list of activities, and brochures from other ASP. Additionally, in the popular ecotourist turtle-watching village of Grande Riviere, Trinidad and Tobago, Waylen et al. (2009) reported that villagers, particularly ASP households were knowledgeable of the NCE of Grande Riviere. These studies indicate that ASP in Aripo may already be very knowledgeable about some, if not all, of the NCE within Aripo. However,

TABLE 1 Ecosystem services provided in the main Aripo ecosystems.

Main ecosystem types/biomes	Provisioning services	Regulating services	Supporting services	Cultural services
Forests	• Timber • Non-timber forest products (including wildlife, handicraft, and medicinal plants) • Tropical forest biota i.e., game species and species used in the pet trade • Freshwater sources • (including inland fisheries, species for the pet trade; aquaculture, and aquatic species used in the pet trade	• Runoff regulation and retention • Biodiversity Services (population regulation, habitat, and species diversity) • Soil Conservation • Soil formation and fertility • Climate and microclimate regulation • Atmospheric composition regulation • Waste disposal, assimilation, and treatment (for the provision of freshwater) • Flood regulation, water storage • Biodiversity *services* (population regulation, habitat, and species diversity)	• Water cycling and replenishment of surface and groundwater resources • Biodiversity support (pollination, germination, dispersal, food webs, productivity, and terrestrial/aquatic ecosystem interface) • Nutrient cycling and transport • Biodiversity support (food webs, productivity, and terrestrial/aquatic ecosystem interface) • Nutrient cycling and transport	• Amenity value (recreation; ecotourism; cultural heritage, diversity and values including spiritual and religious practices, inspiration and aesthetics, cuisine) • Education: scientific research and teaching
Savanna	• Food and Forage • Raw materials for construction • Habitat for wildlife • Freshwater sources • Inland fisheries • Medicine varieties	• Carbon fixation and atmospheric regulation • Water filtration and storage • Biogeochemical process • Biodiversity services • Regulation of N_2O and CH_1 • Recycling of wastes • Filtering of nutrients • Detoxification	• Stability of soil ecosystem processes • Filtering of nutrients • Plant zonation • Physical support for vegetation • Suppression of diseases and biological control of pests	• Sense of place • Spirituality • Ecotourism • Scientific research
Manmade village	• Cultivated crops and animals • Traditional medicine	• Fertilization of soil • Pest control • Recycling • Establishing wildlife preserves and parks • Creating and enforcing environmental protection laws	• Biodiversity support • Suppress poaching and other unlawful environmental activities • Protection law development and enforcement	• Amenity value (recreation; ecotourism; cultural heritage, diversity and values including spiritual and religious practices, inspiration and aesthetics, cuisine) • Education: scientific research and teaching

This table was modified from the Fourth National Report of Trinidad and Tobago to the Government of the Republic of Trinidad and Tobago (2010).

the activities of service providers are largely unregulated in Aripo, which can have severe negative impacts on ecosystem sustainability.

4.2.1.2. Activities of tourists (AOT)

Consideration of the impacts of traditional tourism on ecosystems prominently separates ecotourism activities from traditional tourism activities. According to Page and Dowling (2001), true ecotourists are those who enjoy visiting places that look and feel pristine and once degraded, will search for the next pristine undiscovered destination. These characteristics, motivations, and activities, therefore, allow for the specific classification of such a group of tourists. Despite ecotourism relying heavily on natural settings with visits to ecotourism sites being primarily to enjoy flora and fauna in their natural element, if ecotourism activities are not effectively managed, the possibility of several negative environmental, economic, and social issues which are critical to long term sustainability stand to be a potential outcome (Peake et al., 2009).

Although ecotourism is founded on the principle of sustainability, if the AOT is not conservational, the impacts could be similar to mass tourism's disruptive activities, which include increased accumulation of solid waste, habitat loss and destruction, noise, air, and water pollution, and overcrowding (Sustainability Leadership Kosova, 2022). These concerns however can be minimized if the factors influencing tourists' conservation perception are considered. The motivation to undertake the trip, attitudes toward nature, as well as openness to participate in local community development activities, should be the basis for sustainable AOT.

4.2.1.3. Ecosystem extraction activities (EEA)

Unsustainable ecotourism has arisen out of indiscriminate activities that disregard local communities and capitalize on economic gain while exploiting natural resources. Unsustainable ecotourism has led to habitat alteration, trail erosion, and pollution in fragile areas directly affecting flagship species and resulting in population decline and behavior alteration (Krüger, 2005). It also reduces the ability of the ecosystem to provide goods and services thereby decreasing its carrying capacity. In Aripo, this problematic exploitation of natural resources and local communities is mainly due to activities such as quarrying, agriculture, residential squatting, and timber harvesting (Atwell et al., 2018).

TABLE 2 The biodiversity of Trinidad and Tobago with emphasis on plants and animals found in and around Aripo.

Major categories of plant and animal species	Number of species recorded in Trinidad and Tobago	Additional notes	Number of recorded endemics	Source
Plants	3,337	Includes sp. subsp. and variations of indigenous and introduced records	59	Eynden et al., 2008
Birds	467	Of which 400 in Trinidad and 170 in Tobago	1 Pawi/Piping guan (Piplie pipile)	Starr, 2001; Kenny, 2008
Mammals	>100	In 22 families. Bats (60 spp) and Rodents (17 spp) are largest groups	0	Kenny, 2008
Reptiles	Ranges between 85 and 90	Of which there are 40 to 55 species of snakes; about 30 species of lizards, and 5 turtle species	1 Luminous lizard (Proctoporus shrevei)	Kenny, 2008
Amphibians	between 30 and 32	There are no newts or salamanders in T&T	1 Golden Tree Frog (*Phyllodytes auratus*)	Kenny, 2008
Freshwater fishes	50	In 21 families	0	Can find no evidence of endemics in the records
Butterflies	659		5	Starr, 2007
Mangroves	7	Of which seven in Trinidad and four in Tobago	0	IMA, 2010

Source: Modified from Fourth National Report to the Government of the Republic of Trinidad and Tobago (2010).

Quarrying is mainly carried out for the acquiring of construction materials, specifically sand, soil, and gravel. Active quarrying generally results in the loss of soil organic matter, sheet erosion, drought, increased surface mobility, compaction, wide temperature fluctuations, the absence of soil-forming fine materials, and the shortage of essential nutrients (Wong et al., 1999a,b). Indiscriminate quarrying activities, therefore, lead to the deposition of large volumes of wastewater and the destruction of vegetation.

Due to limited land space and population pressures in SIDS, the demand for producing food has increased. This is reflected in the Aripo system where more land is cleared every year for the expansion of agriculture. Poor agricultural practices such as frequent tillage and the overuse of fertilizers and pesticides reduce soil stability, resilience, and quality.

Population pressures in SIDS have also compounded the proliferation of squatting. The lack of legal housing options has forced many residents to seek illegal options, as a result, many squatter settlements have developed in the Aripo ecosystem. Development of these settlements has had detrimental effects within Aripo, these include removal of vegetation, contamination of soil due to the improper disposal of wastes, paint particles, bonfires, contaminated material used for site leveling, runoff from metal surfaces, use of ash and mineral waste for constructing paths, the burial of metal-containing wastes, soil compaction, loss of habitats, erosion and soil loss (Alloway, 2004).

The Aripo ecosystem has a long history of timber harvesting dating back to the 1930's. Selected trees were harvested mainly for charcoal burning, firewood, handicraft, and rods. By 1935, a management plan for the controlled harvesting of timber came into being, however, due to the leasing of the Aripo lands to the US military many more trees were cleared for buildings, drains, ammunition bunkers, and roads. Illegal logging for the removal of valuable timber soon came into being once the US lease was finished. This mass deforestation has led to the loss of habitats, decline of species, instability of the soil, reduction of soil nutrients, and erosion.

4.2.1.4. Environmental-climatic factors (ECF)

Climate change is considered to be one of the major challenges facing ecotourism globally. Global warming has led to changes in precipitation patterns, frequency and intensity of extreme weather events, droughts, heat waves, floods, and hurricanes (Jamaliah and Powell, 2019). Ecotourism depends heavily on climatic conditions and natural resources, as climate influences the length and quality of the season, tourist satisfaction and experience, quantity and quality of natural resources, infrastructure, and the overall sustainability of tourism facilities and activities (Jones and Scott, 2006; Scott and McBoyle, 2007).

In Aripo, ECF has greatly impacted the ecosystem and, by extension, the entire island. An increase in extreme rainfall events has resulted in flooding causing irreparable ecosystem and economic damage. Many ecotourism lodges are unable to accommodate tourists during these events, as access roads are impassable due to landslides and slips. Like extreme rainfall events, droughts have also increased, leading to the loss of crops and flora and fauna, and increased air pollution due to dust particles in the atmosphere. These consequences of increased drought periods influence tourist satisfaction and experience as water resources are dried and ambient temperatures are increased.

An increased frequency of hurricanes and tropical cyclones is also a major effect of climate change that affects SIDS. In Aripo, damages due to hurricanes can amount to millions of dollars, cause the loss of lives, and affect the local economies. Natural resources that are needed for ecotourism activities can be completely wiped

out or severely damaged, resulting in the loss of habitats and species and thereby crippling the ecotourism industry.

4.2.2. Solutions to the disruptive influencer activities

Given that disruptive influencer, activities can cause damage either directly or indirectly to ecosystems, and these effects can range from minimal to catastrophic, solutions to alleviate these disruptive activities should be all-encompassing. Active collaboration among all influencers, government and regulatory bodies, policy creators, and communities is warranted since, through active collaboration, influencer engagement and increased awareness of the importance of sustainable tourism stand to be an outcome. Engaged influencers are better informed, which increases willingness to actively participate in collaborative sustainable tourism efforts.

Additionally, adequate and timely information sharing can be considered as part of the solutions. Adequate and timely information sharing not only ensures that awareness of disruptive activities is highlighted and ultimately minimized but also ensures that the combined effects of any proposed conservational influencer activities outweigh the combined disruptive influencer activities.

4.3. Synthesis of IPF for the development of ecotourism in SIDS

The goal of this ecotourism framework was to propose guidelines for the sustainable development of ecotourism using the case of Aripo ecosystems. The complex interrelationship between tourism, and environmental and natural resource sustainability, which the IPF addresses, transcends regional precincts and could have global application. Despite the intended applicability of the framework to SIDS, it is important for communities to find a balance that best suits their needs, ensuring that the uniqueness of the area is respected and preserved. Some of the challenges in implementing the IPF include the increase in human resources needed for effective management of ecosystem capital, the longer time required for consultation and consensus among influencers, a lack of appreciation of sustainable ecotourism by various influencers, and limited policies and regulations to preserve the environment. Therefore, varying motivations can make establishing a functional ecotourism governance structure tedious.

5. Conclusions

SIDS is an ideal ecotourism destination due to its abundance of natural flora and fauna, unique ecosystems, and rich, diverse culture and heritage. Ecotourism has enormous untapped economic potential, nevertheless, this industry has not yet evolved to its full potential in the region. An ecotourism framework with an influencer pathway is important as it highlights the needs of a community while ensuring that ecosystems are properly managed. In this study, an IPF framework was developed to increase influencer understanding of different processes and feedback within Aripo ecosystems. As a result, increased awareness and cooperation amongst influencers are achievable, and issues that arise can be quickly addressed. In turn, influencers can make meaningful contributions to government policies. Increased vulnerability to natural disasters emphasizes the need for a clear ecotourism outline that facilitates an all-encompassing approach to policy development. Empowering influencers to make environmentally sound choices facilitates local protection and the contribution of new knowledge. Local or traditional knowledge is invaluable in the quest for sustainable ecotourism. The implementation of traditional conservation strategies targeted at the preservation of natural resources ensures that Aripo and similar ecosystems continue to be an ecotourism hotspot well into the future.

Data availability statement

The original contributions presented in the study are included in the article/Supplementary material, further inquiries can be directed to the corresponding author.

Author contributions

MW, SD, JJ, and MA conceptualized, analyzed data, and wrote the paper. AL-C contributed to the analysis and writing of the paper. All authors contributed to the article and approved the submitted version.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/frsut.2023.1117006/full#supplementary-material

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