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ORIGINAL ARTICLE

Assessing Geosites for Geotourism Development: Case Studies from the Southern Part of Sri Lanka

Daminda Sumanapala[1,2] · **Lucie Kubalíková**[3] · **Isabelle D. Wolf**[4,5]

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Abstract

Although Sri Lanka is known for its many geodiverse attractions, it has not fully recognized and capitalized on its potential to promote geotourism. This study evaluates the potential of two geotourism case study areas, Ussangoda and the Kudawella blowhole, in the southern part of the island which is well frequented by tourists. We provide a blueprint on how to assess the development potential of geotourism sites by employing three types of analyses: Firstly, we estimated the numerical value of various characteristics of the sites important for the development for geotourism, including their scientific, tourism, and conservation values along with the value added by other (non-geotourism) features. Secondly a strengths, weaknesses, opportunities, and threats (SWOT) analysis was performed which builds on the results from the numerical evaluation but provides a more in-depth narrative evaluation. Thirdly, the SWOT analysis can be extended and used to generate a threats, opportunities, weaknesses and strengths (TOWS) matrix which identifies the relationships between these factors and enables to select strategies by providing a succinct tabular overview as the basis for tourism development strategies. We exemplified this multi-step analysis on the Ussangoda and Kudawella blowhole and identified that both sites harbor significant potential as geotourism sites. A private–public partnership between communities and local authorities, as well as universities should be considered to develop geotourism in Sri Lanka.

Keywords Geotourism · Geodiversity · Assessment methods and criteria · Sustainable tourism · Sustainable development · Sri Lanka

✉ Daminda Sumanapala
Daminda.Sumanapala@murdoch.edu.au

Lucie Kubalíková
Lucie.Kubalikova@ugn.cas.cz

Isabelle D. Wolf
iwolf@uow.edu.au

[1] School of Art, Business, Law & Social Sciences, Murdoch University, 90 South Street, Murdoch, Perth, WA 6150, Australia

[2] Tourism Research Cluster (TRC), Faculty of Business and Law, Curtin University, Perth, Australia

[3] Department of Environmental Geography, Institute of Geonics of the Czech Academy of Sciences, Drobného 28, 602 00 Brno, Czech Republic

[4] Australian Centre for Culture, Environment, Society and Space, School of Geography and Sustainable Communities, University of Wollongong, Wollongong, NSW 2522, Australia

[5] Centre for Ecosystem Science, University of New South Wales, Sydney, NSW 2052, Australia

Introduction

Geotourism was originally defined as the "*provision of interpretive and service facilities to enable tourists to acquire knowledge and understanding of the geology and geomorphology of a site... beyond the level of mere aesthetic appreciation*" (Hose 1995). This definition considered geotourism as a geologically focused niche tourism with an explicit interpretation and education component (Dowling and Newsome 2018). This definition was further developed and refined (Slomka and Kicinska-Swiderska 2004; Dowling and Newsome 2006; Joyce 2006; Robinson 2008; Hose 2008), a process from which the concept of geographical tourism emerged (Stueve et al. 2002; National Geographic 2005). This dynamic understanding of geotourism is reflected in the Arouca Declaration (2011), which defined geotourism as "*tourism, which sustains and enhances the identity of a territory, taking into consideration its geology, environment, culture, aesthetics, heritage and the well-being of its residents*". Currently, such a holistic definition of geotourism is

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widely accepted (Dowling and Newsome 2018; Olafsdottir 2019; Olafsdottir and Tverijonaite 2018). However the definition by Dowling (2013) Accounting for the abiotic, biotic, and cultural (ABC) aspects of geotourism is also widely accepted. According to tha,t geotourism is defined as tourism which "*focuses on an area's geology and landscape as the basis of fostering sustainable tourism development.*" It requires an understanding of the non-living (abiotic) and living (biotic) environment as well as the present and past history of the cultural environment of a place. This definition is therefore similar to that offered by others (Dowling and Newsome 2018; Olafsdottir 2019; Olafsdottir and Tverijonaite 2018) but emphasizes more clearly the distinction between the living and non-living, and that both need to be accounted for. The authors also argue that geotourism may present a more holistic form of tourism than other niche forms of tourism.

Even the early works on definitions recognize the potential of geotourism to conserve geodiversity (Hose 2008, 2012; Newsome et al. 2012; Dowling and Newsome 2018; Gray 2018). Successfully implemented geotourism ventures can significantly contribute to the protection of geodiversity and promote geological features of an area while providing economic incentives to local communities including in developing countries (Dowling 2009; Dowling and Newsome 2010, 2018; Farsani et al. 2018).

The island of Sri Lanka has many geological sites that are highly attractive to local and foreign visitors. The island's geological basement is composed of highly metamorphosed Precambrian rocks (90%). This Precambrian basement is subdivided into a few main lithotectonic units: (a) the Highland Complex (HC) – aged about2 000 million years; (b) the Vijayan complex – aged about 1 100 million years; (c) the Wanni complex – aged similar to the Vijayan complex; and (d) the Kadugannawa complex – aged about 550 million years (Ranasinghe 2002). Rugged mountain ranges, flat plains, deep valleys, and isolated hills offer diverse features of interest for geotourists. Ranasinghe (2002) has explored this potential and published a geotourist map including geomorphologically important sites (e.g., Minihagalkanda, waterfalls), mineral deposit sites (e.g., silicon graphite and ilmenite sites), geologically important sites (e.g., the Horton plains, Danigala circular rock), archeologically and geologically important sites (e.g., Sithul Pawwa, Sigriya, Dabulla), and sites featuring petroglyphs (e.g., Dorawakakanda, Hulannuge and Ampara districts) to develop geotourism in the country (Ranasinghe, 2002; Ravibhanu et al. 2020; Somadeva et al. 2019). The author also lists the two case study areas, Ussangoda and the Kudawella blowhole, which are the subject of this study.

Sri Lanka attempts to develop geotourism, especially in environmentally sensitive areas that are the most popular destinations in the country. There is even an expertise proposal to develop a designated geotourism trail, which would cover and connect many of the abovementioned geotourism sites including our study sites. However, there is no systematic assessment of the geotourist potential of specific sites and concrete proposals for specific management measures to meet needs by potential tourists in balance with conservation strategies (Gray 2013, 2018; Dowling and Newsome 2018). Such complex assessments have however successfully been undertaken elsewhere (Reynard et al. 2007, Reynard 2008; Pereira and Pereira 2010; Reynard et al. 2016; Uña Alvarez et al. 2017; Kubalíková and Kirchner 2016; Cocean and Cocean 2016; Bouzekraoui et al. 2018; Kubalíková 2019, Selmi et al. 2019).

The Sri Lankan legislation stipulates that all highly environmentally sensitive sites belong to government, and are administered under the national protected area ordinance (Sumanapala 2018). Thus, these sites are typically not open to conventional visitors. Consequently, local authorities promote only a handful of other geological sites for geotourism, and they do so mainly without a proper understanding and detailed analysis of the sites and possible challenges. A key issue is that there is a lack of understanding of the principles of geotourism, as we discussed earlier while defining this concept, and the scientific values of the sites. They simply consider such locations as esthetically attractive places for tourism development (Sumanapala et al. 2012).

Identifying the values for geotourism development of geological sites will help with the promotion and the sustainable development of geotourism throughout the country delivering widespread benefits to the communities who provide local services such as catering, accommodation, and transport within rural areas. It will also help with managing and conserving geological sites and their significant scientific and cultural values (Hull 2010; Ashley and Roe 1998; Farsani et al. 2012; Khoshraftar and Farsani 2019).

This paper presents a blueprint to assess the development potential of geotourism sites by employing a multi-level analysis on two geotourism sites in Sri Lanka. The reason for selecting these two sites was that the southern part of the island already receives large numbers of international tourists, in contrast to other parts of the country, pursuing cultural activities, SCUBA diving, whale watching, elephant watching, and visiting archeological sites. Geotourism sites would therefore add diversity to the existing offer in this area. Compared to some other geotourism sites, Ussangoda and the Kudawella blowhole already attract some tourists and provide a certain tourism infrastructure, which enables a more rapid development, should these sites be deemed suitable.

Methods

Assessment Procedure

Prior to the analysis, a detailed literature review and fieldwork was undertaken to assess the geological sites and create an inventory (see Brilha (2016) and references therein for details). This was to collate information on the name of the site, location, owner (private/public), legal protection (if any), geological and geomorphological description, description of other natural features present (hydrological, pedological, ecological), description of cultural or historical features related to Earth-science features, description of characteristics such as accessibility, vulnerability, and limitations of use. Our inventory of the selected sites was based on on-site observations, discussion with site staff and stakeholders, and complemented by information provided in government or regional reports and survey reports.

Adopting these definitions, numerous assessment methods were proposed and applied for the evaluation of different types of geological sites both for geo-conservation and geotourism purposes. An overview of these methods is provided by Kubalíková (2013), Štrba et al. (2015), Brilha (2016), Reynard et al. (2016), Zwoliński et al. (2018) or Mucivuna et al. (2019).

Here, we provide an overview of the steps involved in our analysis which we explain in further detail below: The first step in our assessment was to generate a numerical evaluation of the geotourism potential with a focus on the scientific, tourism, added (i.e., accrued from non-geo features), and conservation values of the two sites. Secondly a more in-depth narrative evaluation was performed with a focus on the SWO analysis). The SWOT analysis then provided the base to generate a TOWS matrix (Weihrich 1993) outlining specific strategy dimensions for geotourism development. The TOWS matrix constitutes an advanced analysis system for developing strategies to sustainable development and has previously been developed for management and marketing purposes in a business context.

As for the numerical evaluation, a set of criteria based on the works of Pralong (2005), Pereira and Pereira (2010), Kubalíková (2019), Reynard et al. (2016), Bouzekraoui et al. (2018), and Kubalíková et al. (2020) was implemented. Selecting criteria is a difficult task and we followed recommendations by Pereira and Pereira (2010), Kubalíková (2019), and Kubalíková et al. (2020). Every criterion was rated on a scale from 0 to 1 where 0 is considered low, 0.5 average, and 1 is high (Table 1). In order to minimize subjectivity, three investigators participated in the evaluation. Simple averages were used to derive the final score of each criterion. The total geotourism potential is the sum of the averaged criteria values.

A site needs to reach 10 points (from a maximum of 15) to be considered suitable for geotourism development (Kubalikova et al. 2020). Assessing geocultural sites adopting a quantitative approach to determine the potential/suitability for development as a geotourism site has been used in a number of studies successfully (e.g., Kubalikova, 2016; Kubalikova, 2019). The quantitative assessment should however be a first step in assessing the geotourism potential of a site as the consequent SWOT-TOWS analysis provides the actual foundation for a management proposal.

Table 1 Criteria used for the quantitative assessment of the geotourism potential of two sites in Sri Lanka

Values	Criteria	Score
Scientific values intrinsic	Conditions of main Earth-science features: integrity	0–1
	Diversity of Earth-science features: number of different features	0–1
	Education about the site: includes representativeness and educational facilities for visitors at the site	0–1
	Rarity: number of similar sites in the study area	0–1
Added values	Ecological features	0–1
	Historical features	0–1
	Cultural features	0–1
	Asthetic features	0–1
Tourism values	Accessibility: distance between site and transport	0–1
	Safety	0–1
	Tourist infrastructure and facilities	0–1
	Visibility of Earth-science features	0–1
Conservation values	Present conservation activities (legal protection status)	0–1
	Protection from current threats including both natural and anthropogenic hazards that can damage the site	0–1

Following the quantitative assessment, the study conducted a SWOT and TOWS analysis as the basis to more deeply explore the potential of these geotourism sites. While the SWOT analysis narrates the SWOT, the findings of this can be collated in a TOWS matrix of the threats, *opportunities*, *weaknesses, and strengths* to develop effective tourism strategies for developing geotourism site. While the SWOT analysis looks at the individual component more singularly, the TOWS matrix considers the relationships between threats, opportunities, weaknesses, and strengths (Weihrich 1982). This type of combined analysis has been used in many contexts including the marketing and development of tourist destinations and products (Goranczewski and Puciato 2010; Kubalíková and Kirchner 2016, 2013; Carrión et al. 2018; Ates and Ates 2019).

Study Area

Sri Lanka's southern coast is popular among national and international tourists because of several famous tourist attractions including the coral reefs in Hikkaduwa, whale watching at Mirissa, and other wildlife watching at the Yala and Udawalawa National Parks. Hence, the southern part of the country attracts more visitors compared to the other provinces. Although our study sites are located within this area, these two sites have been overlooked for strategic development, and thus harbor great potential for geotourism, especially considering that they already have a basic tourism infrastructure available (Table 2).

Table elements adapted from Newsome et al. (2012)

Ussangoda is a geologically important site and known for its ultramafic rock type/rock body, which is composed of serpentine group minerals. The area is rich in ferromagnesian mineral (Brooks 1987). This area is also known for its very unique vegetation, and its diverse ecosystem landscapes including mangrove, scrublands, salt marsh reed beds, and grasslands (IUCN 2004).

The environmental conditions of Ussangoda are not conducive for supporting plant growth due to high heavy metal concentrations of *Mg*, *Fe*, *Ni*, and *Co* (Weerasinghe and Iqbal 2011). As a result only a few plants grow in the Ussangoda area compared with other adjacent non-serpentine areas. Among these, two plants are endemic to Sri Lanka: *Vernonia zeylanica* and *Scolopia acuminate* (Weerasinghe and Iqbal 2011). Similar types of serpentinite sites are found elsewhere locally and in other Asian countries such as India (Brooks 1987) and Malaysia (Brooks 1987; Proctor 2003). Apart from that, archeologists have identified and noted the location as a prehistoric site where microliths used by ancient man were discovered. Currently, visitors are largely foregoing the unique experience of geodiverse features (including rock diversity comprised of ferro-laterite, serpentinites and ochre) combined with endemic flora and archeological attractions because of the lack of proper infrastructure to facilitate access.

Kudawella is also considered a geomorphologically important site. This area is also known as the "Blowhole," or "*Hummanaya*," in the local language. It is located in the Kudawella village in the Tangalla Divisional Secretariat, which is closest to Matara town with easy access from the Matara-Tangalla main road. The blowhole was formed through erosion by wave activity. The most eye-catching event occurs when the water spouts many meters high up into the air during May to August. The blowhole attracts a regular influx of local and foreign visitors. The site boasts other scenic features including living corals, rocky shores, and pocket bays. A recent assessment confirmed that the environment suffered from environmental degradation of the surrounding area due to tourism activities. This site is also of geomorphological and geological value with significant rock formations along a Precambrian fault or joint. Although a

Table 2 Key characteristics of geotourism in Ussangoda and the Kudawella blowhole, Sri Lanka

Characteristics	Ussangoda	Kudawella Blowhole
Location	Southern Sri Lanka Tourism destination	Southern Sri Lanka Tourism destination
Status	Protected as a National Park	Protected by the Coastal Conservation Department and governed by the local authority
Attraction/features	Known for the ultramafic rock type composed of serpentine group minerals; known also for the unusual placement of soil structure; location and archeological values	The blowhole was formed by the erosion of rock along a fracture through wave action. The cliff causes the water to sprout many meters high
Visitation Access	Private transport	Private transport
Site management features	Sealed road, gravel road	Sealed road, footpath, safety fence for visitors
Interpretation	None	Visitor center, interpretive panels
Biophysical impact	Erosion, damage to local plants, souvenirs collected, informal trail development	Erosion and damage to the rocks in the nearby area, souvenirs collected, informal trail development
Social impact	Over-crowding, waste	Over-crowding, waste

road provides access, same as for Ussangoda the blowhole's features are not properly accessible to visitors or enhanced by adequate infrastructure. In addition, proper visitor experience management is lacking (Hambantota Integrated Costal Zone Management Project (2000).

Although these two sites are open for tourism, the significance of their geodiversity is not conveyed effectively to visitors. Ussangoda, for instance, does not have any visitor information available to highlight the geological significance of the site. As a result visitors leave without proper understanding of the uniqueness of the local geodiversity. At Kudawella, some efforts have been made to explain various site characteristics, however, suprisingly with the exception of the geological features.

Numerous management measures are needed to convey the geotourism benefits and other cultural, historical, and environmental benefits of visitation to these areas. Visitor interpretation and experience offers need to be designed such as geotourism-related activities, educational panels, panorama viewing points, geotrails, and visitor centers. This will support the development of a geotourism destination for visitors in line with global trends of geotourism development (Newsome et al. 2012).

Results and Discussion

The first objective of the study, namely the numerical assessment of the values of Ussangoda and the Kudawella Blowhole for geotourism development, was achieved by assessing the criteria specified in Table 2. For the evaluation, we considered academic literature and auxiliary data/evidence gained for example through site visitation. Outcomes of the assessment are presented in Table 3 and discussed in the following:

As for the first criterion, Ussangoda has gained scientific value as evidenced through the many scientific publications featuring the Ussangoda vegetation diversity and special soil characteristics (e.g., Rajapaksha et al. 2012; Tennakone et al. 2007).

As for the second criterion, the "*added values to the site*," Ussangoda also holds greater value due to the presence and study of its ecological, historical, cultural, and asthetic features. Ecologically, the site is known for its serpentinite ecology ("*ultramafic rock*" *providing space for vegetation)*; further notable are its prostrate plant species producing very low biomass per unit area, and

Table 3 Numerical assessment of the values for geotourism of two selected geosites in Sri Lanka, Ussangoda, and the Kudawella Blowhole—for detailed definitions of criteria see Table 1

Criteria	Values*		Source of information	
	Ussangoda	Blowhole	Ussangoda	Blowhole
Scientific values			Rajapaksha et al. 2012; Tennakone et al. 2007	HICZMP, 2000
Integrity and current status	0.50	1		
Diversity of the Earth since features	1	0.50		
Rarity	1	1		
Exemplarity and representativenesss	0.50	1		
Paleogeographical significance	1	0.50		
Added values			Weerasinghe and Iqbal 2011; Chiarucci and Baker 2007; folk stories; on-site assessment	HICZMP, 2000; on-site assessment
Ecological features	1	0.50		
Historical features	1	0.50		
Cultural features	1	1		
Esthetic features	1	1		
Tourist values			On-site assessment	On-site assessment
Accessibility features	0.50	1		
Safety	0.50	1		
Tourist infrastructure and facilities	0.50	1		
Visibility of geofeatures	0.50	1		
Conservation values			Fauna and Flora Act, management plan	National Costal Conservation Act, management plan
Legislation protection	1	1		
Protection from threats	0.75	0.50		
Total values	11.75	12.50		

*Various information was also collated from Pereira and Pereira (2010), Kubalíková (2019), Kubalíková et al. (2020)

small isolated patches of thorny shrubs of higher biomass encompassing locally restricted and endemic *taxa* such as nickel hyperaccumulator plants. Systems with serpentine ecology attract the interests of plant ecologists, evolutionaty biologists, and environmental physiologists alike (e.g., Weerasinghe and Iqbal 2011; Chiarucci and Baker 2007). Historically, significant folk stories are connected to the Ussangoda area. Culturally, this site has prehistoric value because it adjoins archeological sites. Esthetically, the site is attractive because of its costal vegetation and the appearance of its unique landscape with stunning red colors (Fig. 1, Ussangoda).

As for its tourism value, Kudawella blowhole scored higher because of a more developed tourism infrastructure (Fig. 2a). Compared to Ussangoda, which provides few visitor facilities apart from small-scale vendors, Kudawella blowhole provides many services to visitors through the local community such as restaurants, shops, an information center, and parking facilities, along with features available to ensure the safety of visitors such as an observation deck. Because Ussangoda has no visitor center and does not display any information boards for visitors to convey the most basic information about the site, the Kudawella blowhole scored higher than Ussangoda for tourist infrastructure and facilities (Fig. 2a and b). The"visibility" of geofeatures at Kudawella is greater than at Ussangoda, thus contributing to its higher tourism value.

As for the conservation value, it needs to be noted that both Ussangoda and the Kudawella blowhole were granted legal protection, and thus we assigned a value of 1. They are both designated conservation areas. Ussangoda is demarcated as a protected area (national park) under the Sri Lankan Fauna and Flora Act. The National Costal Conservation Act protects the Kudawella blowhole. According to the Ussangoda management plan, the area is declared as a special management area. It is proposed to increase tourism activities and local community involvement as long as this remains compatible with the management goals. The Kudawella blowhole management plan also declares it as a special management area. It was implemented by two government organizations including the Southern Development Authority and Sri Lanka's Coast Conservation Department. This plan is mainly focused on implementing community-based projects combined with environmental conservation activities. Ussangoda is less impacted on by tourism because of a lower influx of visitors while there is a substantial

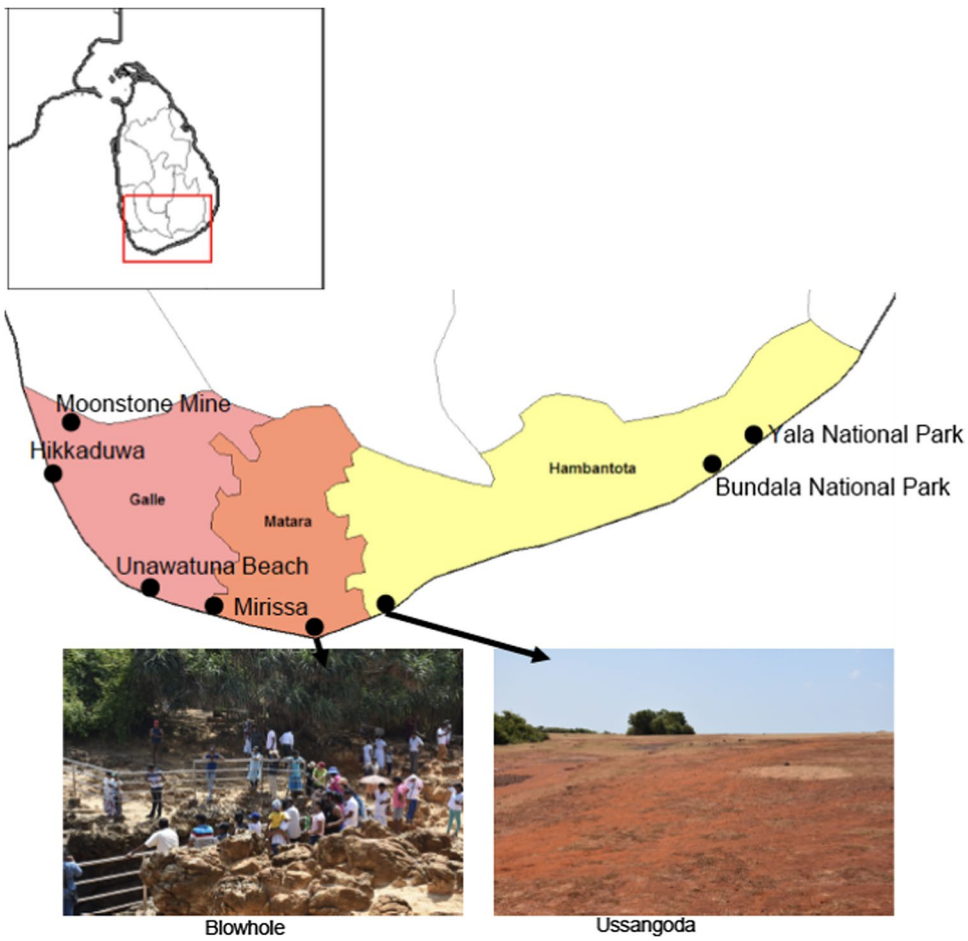

Fig. 1 Location of the Kudawella blowhole and Ussangoda two sites located within the southern part of Sri Lanka and other key tourism attractions nearby

Fig. 2 **a** Kudawella Blowhole, Sri Lanka: visitors use the visitor information center. **b** Ussangoda, Sri Lanka: marginally developed shops at the car park.

impact noticeable at the Kudawella blowhole from pedestrian traffic with adverse effects on the geodiversity of the site (Green et al., 2019; Sumanapala & Wolf, 2019, 2020). In lack of properly established permanent nature trails, visitors need to walk on the outer rocks to the blowhole causing soil erosion (Fig. 3). Consequently, Ussangoda scored higher compared to the Kudawella blowhole for the protection from threats.

Our overall analysis shows that both sites score relatively similar but both have different strengths or weaknessess. Since both sites scored more than 10 points, they both show potential as geotourism sites as a value of 10 was previously deemed as a cut-off point (Kubalikova et al. 2020). However, both sites can improve on various aspects: Ussangoda for example should focus on developing its tourism infrastructure and facilities. Our assessment also teases out the strengths of each site on which management could capitalize in order to direct their marketing efforts targeted at specific audiences. Finally, assessment highlights some weaknesses that could be addressed through for instance further research. The fact that the Kudawella blowhole has received less attention from the scientific community is not necessarily an expression of its reduced value but perhaps greater efforts could be made to explore the scientific value of the paleogeographical significance of the Kudawella blowhole.

Fig. 3 Kudawella blowhole, Sri Lanka: people walk along an informal rock path rather than a designated trail causing soil erosion

The SWOT analysis was the second step with the aim to identify the strengths, weaknesses, opportunities and threats of the sites to inform visitor experience management (Table 4). The numerical evaluation provided above feeds into the narrative evaluation of the SWOT. The SWOT analysis then unearths factors to design short- and long-term strategies to manage tourism sites so they fulfill visitor expectations, and expands on the numerical evaluation in more detail. It yields vital information for developing sustainable local tourism programs (Ates and Ates 2019) and creating attractive tourism destinations (Kubalíková and Kirchner 2016) with adequate infrastructure (i.e., roads and visitor services) and outcome-focused management targeting economic benefits (Carrión et al. 2018). Table 4 showcases the depth of the analysis, which SWOT provides for the two geotourism sites. It presents the building blocks for tourism development and marketing (strengths), and raises awareness of future opportunities for improvements, along with the various weaknesses and threats that need to be addressed.

Table 4 The basic SWOT analysis for the Kudawella blowhole and Ussagoda, two potential geotourism sites in Sri Lanka

Strengths

1. Both sites hold a high scientific value
2. Both sites are of high ecological, geological, historical, and geographical value
3. The blowhole site has already capitalized on the value of visitor education
4. The local authority has taken efforts to promote and protect the both geosites
5. Both sites are already located in popular tourist destinations in the south of the island
6. The blowhole has easy access from the main road
7. The local community and local government of the area gain financial benefits via providing transport facilities, local food, and handicrafts (especially at the blowhole site)
8. There are stakeholders such as small vendors selling distinct cultural crafts among other, which likely will attract high number of visitors if adequate visitor facilities are provided
9. The Sri Lankan government has acknowledged the value of tourism for the country's economy
10. Both study sites are legally acknowledged as geologically and geomorphologically important

Weaknesses

1. Neither site has adequate trails and observation decks for visitors
2. Neither site has proper education tools to convey the significance of the sites for Geography and other Sciences
3. Management authorities of the sites do not recognize the importance and future potential of the sites to promote geotourism
4. Lack of education may lead to physical impacts at both sites
5. Social and biological (e.g., informal trail use/development) impacts are already noticeable

Opportunities

1. Actions must be taken to establish rules and guidelines for protecting the blowhole environment from visitor impacts
2. There is a potential to promote geotourism locally and regionally to attract local and international visitors. This can help create a positive economic impact on the local community and relevant agencies
3. Local authorities can team up for business ventures with local communities to provide visitor facilities (e.g., parking, trading facilities) financed through increased economic revenue
4. Both sites can showcase the benefits of geotourism and educate other regions on how to promote geotourism
5. Local authorities can promote both sites as a pilot project for geotourism development in the country using the Private Public Partnership (PPP) project as a model. This involves a long-term partnership between private parties and government
6. A geotourism research hub could be created with the help of universities
7. A management plan can be established to orchestrate efforts afforded by various stakeholders and the local community to optimize the tourism offer and educational services with the aim to develop, for example, visitor experiences engaging with the communities' life style through local fishing activities
8. A monitoring plan of tourism activities should be implemented with the help of various government organizations lead by local authorities
9. A monitoring plan should be implemented with the help of other government organization lead by local authorities

Threats

1. Promoting these sites for geotourism may lead to physical and environmental impacts
2. Crowding and other adverse impacts of increased visitor numbers can be expected at peak periods of visitation, and also lead to social impacts
3. Lack of interest and understanding of local authorities and relevant organizations may impede the development of geotourism
4. Lack of finances will impact the development of visitor infrastructure

Table 5 An extended SWOT analysis generating a TOWS matrix for the Kudawella blowhole and Ussagoda, two geotourism sites in Sri Lanka

S–O strategy (strengths opportunities) 1. Attract more visitors from nearby (possibly competing) tourist destinations 2. Increase the relationship between two site promoters (e.g., tour guides, tour organizers). Both sites can be promoted as day visits among tourists staying in nearby hotels 3. Identify new business models for developing tourist destinations with relevant stakeholders in the region	**W–O strategy (weakness opportunities)** 1. Raise awareness of these two sites among the local people from a geological and economical benefit point of view 2. Focus on visitor information on the sites
S-T strategy (strengths threats) 1. Identify these two sites as important resources for product diversification and future promotion of geotourism in the country 2. Identify and promote other potential sites and raise awareness that they are open for visitors 3. Develop a new management team (committee at the municipal level) especially for promoting tourism in the local area	**W-T strategy (weakness threats)** 1. Develop strategies for short-term and long-term development of tourist infrastructure, conservation, and management 2. Conserve the value of the landscapes by using subject-related expertise and local stakeholders 3. Follow the international geotourism and conservation guidelines and principals to maintain and develop infrastructure and services for tourism

The TOWS matrix presented in Table 5 then relates the individual components of a SWOT analysis and shows how specific opportunities emerge in the context of different strengths, and so forth for the various other elements. For example, the opportunities listed above emerge by capitalizing on the various strengths of the two geosites (e.g., access to a flourishing visitor market in the surrounding areas) and the supportive community and government climate.

Conclusions

Ussangoda and the Kudawella blowhole have been operating as geotourism sites in Sri Lanka without adopting the concept of best-practice geotourism. In this study, we assessed their value as geotourism destinations and their overall potential for further development based on a numerical evaluation. This was followed by an in-depth narrative analysis through a basic "SWOT" highlighting the potential strengths, weaknesses, opportunities, and threats of the sites. An extended SWOT analysis yielding a TOWS (threats, opportunities, weaknesses, strengths) matrix provided further value through its focus on developing specific strategies for development. The combined SWOT-TOWS analysis is a widely implemented tool in a business context, and thus here, we present the value of its application for the assessment of further sustainable geotourism sites.

Other potential geotourism sites such as Udaganawa within the Wasgomuwa National Park which is located in the centre of Sri Lanka or the Moonstone mines located near Ambalangoda-Meetiyagoda in southern Sri Lanka would greatly benefit from such an assessment. An extension of this study to further sites will provide the basis for developing a connected iconic "geotourism trail" which would add great value to the current tourism offer in Sri Lanka and if managed appropriately will contribute to the conservation of these highly significant sites.

Both sites show great development potential to attract geotourists and promote geotourism in Sri Lanka. However, there are significant opportunities to add value by developing visitor experiences, and promoting and educating visitors about the unique features of these sites especially their diverse cultural, historical, and ecological features (Torland et al. 2015; Weiler et al. 2017). Improvement of visitor infrastructure and facilities is necessary to facilitate interpretation, and a safe and comfortable visitor experience (Wolf et al. 2013, 2019). A concerted effort is required to achieve such improvements and capitalize on the opportunities that both sides have, as well as address weaknesses and threats, involving both local authorities who could help with the financing and provision of facilities, and local communities who could enhance the cultural and historical values of the sites. In the future, local authorities would benefit greatly from the assistance of universities to educate them on how to promote and develop geotourism destinations in a developing country.

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