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ICT in Sustainable Tourism: A Systematic Review

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Abstract

The emergence of sustainable tourism has been seamlessly replacing many facets of traditional tourism. ICT is regarded as an ideal partner to sustainable tourism as it can proficiently disseminate information and services. Several research studies have been conducted to study this synergy. This systematic review aims to investigate the emerging ICT discourse in sustainable tourism using the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA). Relevant articles were searched in the most common databases. Out of 357 articles retrieved, 41 articles were selected for the final analysis based on inclusion-exclusion criteria. MS Excel and Zotero applications were used. It has been observed that most commonly researched topics in ICT in sustainable tourism include GIS, web applications, gaming, Augmented Reality, IoTs and social media. This review identifies a need for a larger body of research focusing on ICT use in sustainable tourism and supports its advancement by identifying future directions.

Keywords Sustainable tourism, ICTs, systematic review, technology

1 Introduction

Tourism is a major contributor to the economy and accounts for 10.4% of the world's GDP, according to the World Travel and Tourism Council (WTTC) (WTTC 2019). It is also a strong driver to employment as it affects numerous other industries like transport, agriculture, construction, hospitality, travel agencies, heath etc. (Vellas & Bécherel, 1995). With its ability to impact a large number of people both locally and globally, it has a potential for business growth and exploring opportunities for economic expansion. These opportunities pave the way for positive development, create employment but also comes with a cost. Increasingly, there is a move towards making tourism more responsive to minimise environmental impact, which brings the notion of sustainable tourism development. Sustainability has always been part of tourism discourse, with key objectives to retain the economic and socio-cultural advantages by optimal use of environmental resources to maintain biodiversity and alleviate poverty. Since the inception of sustainable development, it has been a topic of debate (Perles & Ivars, 2018) which progressively morphed into the concept of sustainable tourism development (Postma & Schmuecker, 2017).

The research on sustainability goes back to more than 30 years ago, first raised in Brundtland Commission in 1983. However, the core principles of sustainable tourism development was established in 1995 (France, 1997; Martin, 1995), which identifies economic, social and environmental aspects as the three pillars of sustainable development to balance an array of impacts for long-term sustainability in the tourism sector (Aminu et al., 2017). According to the World Tourism Organisation (UNWTO 2020), sustainable tourism (ST) should:

- Maintain and make optimal use of environmental resources; help conserve natural heritage and biodiversity
- Respect the socio-cultural authenticity of host communities; contribute to inter-cultural understanding and tolerance
- Ensure viable, long-term economic operations; providing socio-economic benefits to all stakeholders that are fairly distributed and contribute to poverty alleviation

In line with this ethos, it focuses on minimising the risks and introducing development of operative plans for restoration (Peterlin & Pranicevic, 2016). This concept of ST has been prevalent for a long term with a view to preserve the environment for future generation; although not always realistic and attainable, it is an important consideration to work towards becoming more sustainable (Negrusa et al., 2015).

The tourism sector has been recognised to create a positive environmental and economic perspective to the destinations (Herath, 2002), reduce negative impacts (Ali & Frew, 2010; Asafe et al., 2013) and foster the principle of healthy and sustainable development (Cosmescu & Chindris, 2017). This experience can be enhanced by using Information and communication technologies (ICT) as a catalyst for ST development (Kim & Garkavenko, 2019; Pradhan et al. 2019). More broadly, the Information System (IS) can bring together both human and social welfare through long-term viable economic operations (Hilty et al., 2005).

ICT has expedited many aspects of tourism businesses from booking, advertising, managing and recommending (Bethapudi 2013). Furthermore, ICT acts as an impetus to innovative approaches for ST development of destinations (Ali & Frew, 2014). Emerging ICT technologies such as Geographical information systems (GIS), Internet of Things (IoT), mobile applications (apps), location-based services, geo-tag services, Virtual Reality (VR), Augmented Reality (AR), social media, and smart devices even open wider doors for the exploration of ICT in ST (Ye et al. 2020).

With the ability to proficiently disseminate information and services, ICT is regarded as an ideal partner to tourism. In addition to this, the smart tourism ecosystem is reliant on ICT through the application of technologies to develop value propositions (Ye et al. 2020; Lama et al. 2020). The complementary nature of smartness and sustainability (Shafiee et al. 2019) enables efficient environmental management (Perles & Ivars, 2018).

Rationale for research

Benefits of using ICT has been highlighted by numerous research studies and many more on topics related to both ICT and tourism. Although ST has been gaining popularity and the term was coined over 20 years ago, there has been limited research for the use of ICT in ST (Negrusa et al., 2015; Perles & Ivars, 2018; Ali and Frew, (2008 & 2010); Buhalis and Law, 2008; Touray & Jung, 2010). Among the few research, they use diverse approaches which may be due to the multidimensional spectrum of the topic (Perles & Ivars, 2018). The rapidly growing popularity of ST and the outlook to uplift the body of

research in this discipline creates the need for a comprehensive review of existing literature on the use of ICTs in ST.

This study aims to investigate the emerging ICT discourse in ST and identify the area within ST to provide a direction for future research. It also enables the corpus of research to examine the emergent trends, relevant themes and technology applications.

Research question

Research questions are formulated as follows: (i) what knowledge has been produced by the use of ICT for sustainable tourism; and (ii) what trends are evolving in use of ICT for sustainable tourism research.

It aims to provide a clear picture of research that has been carried out through investigation of ICT usage for ST and portray the actual status of the discourse. The remainder of this article is structured as follows: First, we describe the methodology of the research, which includes a description of data collection and data selection of relevant articles. Second, we present the results obtained from the systematic literature review, which includes details of the search steps for transparency and descriptive statistics of the research articles.

2 Methods

A systematic literature review was carried out to investigate the research trends on how information and communication technologies have been shaping the sustainable tourism sector of the tourism industry. It is a proven method to search, identify, synthesize, evaluate and combine the results from published literature on a specific topic (Shafiee et al. 2019). Researchers recognised the importance of systematic review as a tool to synthesize emerging knowledge, identify research gaps and direct future research (Olafsdottir and Tverijonaite 2018). This type of literature review allows to search for the whole truth rather than just one part (Mulrow 1994), hence widely used in the research process.

In this study, we used the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) Flow diagram, which provides clear guidelines for conducting systematic reviews and meta-analyses to synthesize information accurately and reliably. This diagram was introduced by Moher et al. (2009). The PRISMA Flow diagram from our study is shown in Figure 1. It shows three steps, initial search of the literature, selection of relevant articles and review of selected articles.

2.1 Data Collection

A rigorous search was conducted in some of the largest and most commonly used databases to find the relevant publications: Scopus, Web of Science, SpringerLink, ProQuest and EBSCOhost. Google Scholar was also included to avoid relevant articles which are available through open-source but not listed in the aforementioned databases. However, ProQuest was excluded in this review, as it yielded only a few articles (N =3) for the same search criteria.

Since this review focuses on investigating the use of ICTs in sustainable tourism, Boolean operators are used to capture and filter better results. Boolean "OR" is used to search any of these terms 'technology', 'ICT', 'e-commerce', 'internet', 'digital' in either title, abstract and keywords with "AND" to join the main search term 'sustainable tourism' in titles. These search terms were applied to the selected databases and produced a total of 357 results (Scopus - 81; Web of Science - 72; SpringerLink - 97, EBSCOhost - 57 and Google Scholar - 50) as shown in Figure 1 below.

All the results were exported to MS Excel using the Zotero application. As each database adopted a different format for exporting, this application allowed exporting all the results from different database sources to be exported in a single format for further processing.

2.2 Data Selection

A set of explicit criteria applied to include and exclude research articles to reassure the quality of this review. For example, only papers published in peer-reviewed journals and international conferences were included, whereas non-peer-reviewed publications as well as book chapters, research notes, reports, newspaper articles and editorials were excluded. Similarly, the other criterion was publications only in the English language.

The data in the Excel spreadsheet were sorted based on the title of the articles. In the first round of screening, 73 duplicate records were found, and they were removed. Some articles almost appeared in all those databases. The additional manual checks were conducted to verify the duplicate records, and they (N=4) were indeed removed. If an article appeared in both Google Scholar and any other databases,

the record extracted from Google Scholar was removed as the abstract is missing at the first glance in Google Scholar, without downloading the paper. For the remaining articles yielded in Google Scholars, each link was manually visited to extract abstracts to populate in the MS Excel spreadsheet for further processing.

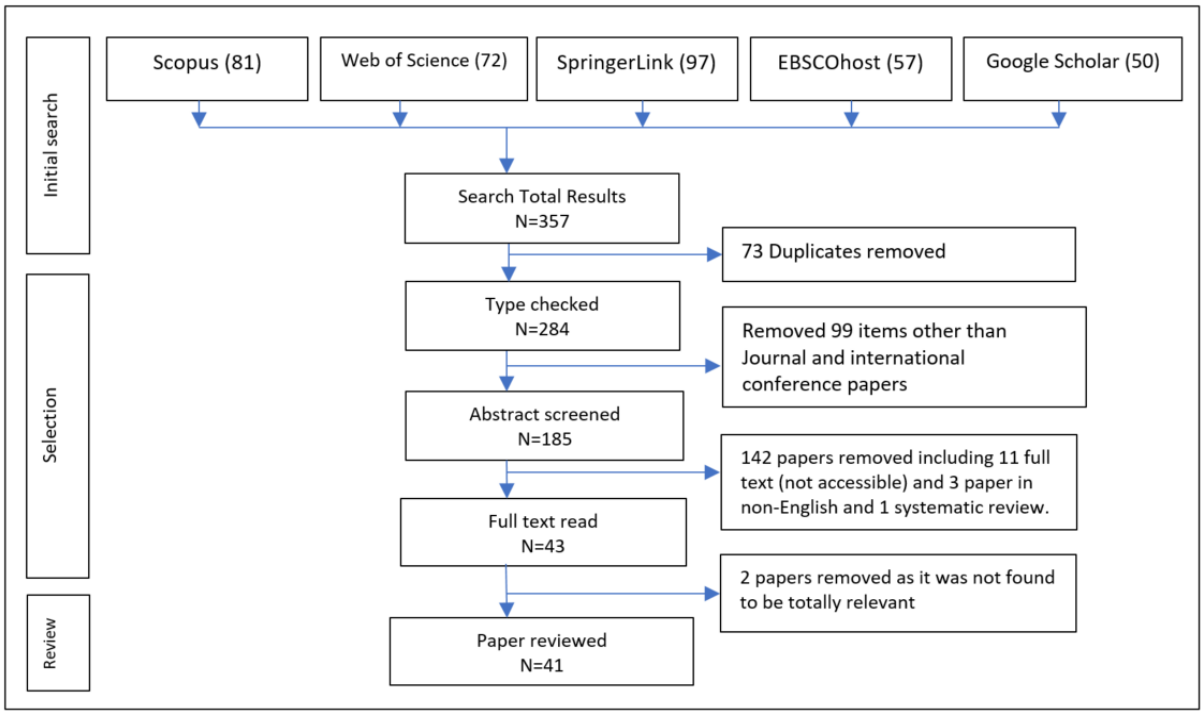

Figure 1: PRISMA Flow diagram - research process of literature search and selection

As shown in the figure above, the second round of screening was conducted to remove the articles which are not peer-reviewed journals or international conference papers. They include books, book chapters, reports, newspaper articles etc. A careful screening was conducted and removed 99 items, which yielded 185 articles for further review. In the next round, both authors screened abstracts of all 185 articles separately in the Excel. Author 1 and Author 2 selected 45 and 42 papers respectively for the next round. All the papers were the same except four. The inter-rater reliability of almost 98%. The paper which was mismatched between two authors was screened again collaboratively, and the consensus was reached to add and remove it. A large portion of the articles (N=142) was removed in this stage, as they were not related to the investigation of using ICT for ST. Majority of rejected papers did not address sustainable tourism primarily but included ICT or digital in their abstracts, including 11 papers whose full-text versions were not available in the library, 3 papers with abstracts in English but the full paper in different languages (Korean and Spanish) and one systematic review paper.

The full text of the remaining 43 papers was then reviewed in depth. Further 2 papers were removed as they were not relevant for the objective of this review. One of them focussed on tourism education while the other one discussed the challenges for marketing strategies. The final list of 41 papers was manually checked for missing details in the Excel sheet. From the final 41 research articles, the main research trends are identified and discussed the areas where further research can be conducted on how ICTs can be enhancing the delivery of ST.

3 Results

Across the selected five databases, initially, a total of 357 articles were obtained by using the search criteria. After the several rounds of screening the results, as shown in Figure 1 above, we have finalised 41 research articles to review thoroughly. Table 1 below shows the comparison of the number of research articles initially found and finally selected across the selected five databases.

Databases	URL	Initial Search Results	Final Selection
Scopus	scopus.com	81 (23%)	13 (32%)
Web of Science	apps.webofknowledge.com	72 (20%)	6 (15%)
SpringerLink	Springerlink.com	97 (27%)	7 (17%)
EBSCOhost	ebscohost.com	57 (16%)	5 (12%)
Google Scholar	scholar.google.com	50 (14%)	10 (24%)

Table 1. Comparison of research articles found and selected from five databases

Academic studies on how ICTs could be helping the ST industry have been conducted dating back in 1995. Due to our focus on investigating how ICTs have been enhancing the operation of the sustainable tourism market, the oldest article we selected one from 1999. The rest were from 2008 onwards. The number of publications grew in 2013 and decreased for the next 3 years and picked up since 2017. Almost 50% of the articles (N = 20) out of 41, was published in the last 4 years (2017 to 2020) inclusive of this year. Figure 2 shows the summary of research articles distributed across the last 21 years.

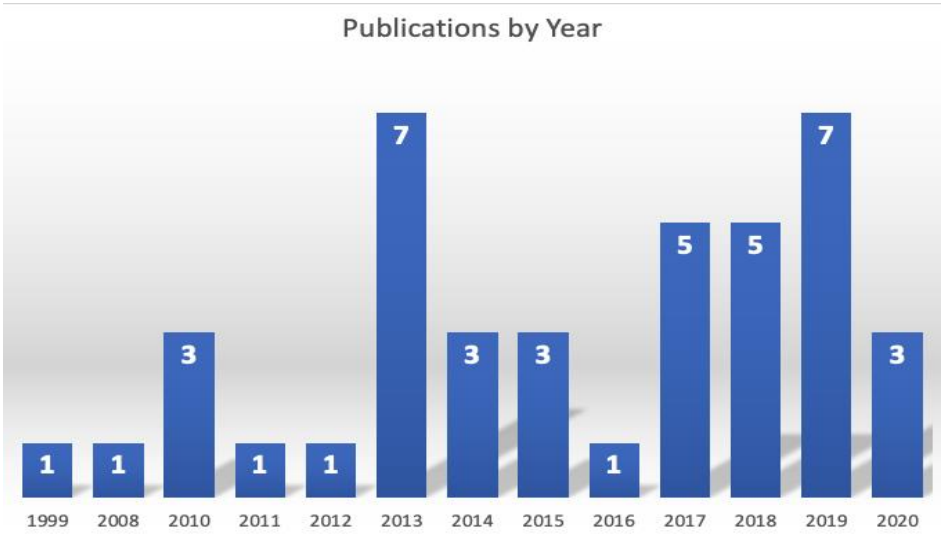

Figure 2: Distribution of research articles across publication years

Table below shows where the selected articles were published more than once. The analysis showed that most of the articles were published in Sustainability open-access journals followed by Journal of sustainable tourism. This is validated since it is a journal related to sustainable tourism. Although the search criteria were related to Information Technology, only one information systems journal (i.e. Communication of the Association for Information Systems) was listed.

Journal / Conference	No of studies	Percentage
Sustainability	5	12%
Journal of Sustainable Tourism	3	7%
Information and Communication Technologies in Tourism	3	7%
Environmental Earth Sciences	2	5%
IEEE Conferences	2	5%

Table 2. Distribution of selected articles across different journals and conferences.

The selected articles have been studied in many different countries across the world. Most of the studies were conducted in Europe. The table below shows how the results were distributed across continents. 10 articles belonging to other categories were studied in two or more countries.

Continent	Countries	No of studies	Percentage
Europe	Czech Republic, Italy, Greece, Greece-Albania, Poland, Portugal, Slovenia, Spain, Thailand, UK	13	42%
Asia	China, Iran, Japan, Kazakhstan, South Korea, Spain, Thailand,	13	42%
North America	Canada, USA	2	6%
South America	Columbia, Ecuador	2	6%
Africa	Nigeria	1	3%

Table 3. Geographical distribution of selected articles across the world

Out of 41 selected articles, 21 employed an empirical approach, but the others conducted reviews and simulations. The table below shows the distribution of research methods used.

Research Methods	Empirical?	No of studies	Percentage
Mixed (Quant and Qual)	Yes	8	20%
Quantitative	Yes	8	20%
Review and content analysis	No	8	20%
Qualitative	Yes	5	12%
Review and observation	No	5	12%
Experiment - simulation	No	4	10%
Design and development	No	3	7%

Table 4. Distribution of selected articles based on research methods

The selected papers are divided into several broad categories based on their focus on the use of ICT in ST. Table 5 below shows the top five focuses on what ICT tools have been used. Majority of them (18 out of 41 articles) appeared to focus on one-off focus such as security, gig economy, agility, lexicon reviews, etc. although the categories were overlapped across several topics. One clear focus found to be on the use of geographical information systems (GIS) applications in sustainable tourism products.

ICT use in ST	No of studies	Percentage
GIS (Geographical Information systems)	9	22%
Web applications	6	15%
Audience Response System (ARS), Gaming and Augmented Reality (AR)	3	7%
Internet of Things (IoTs)	2	7%
Social media	2	5%

Table 5. Top five ICT related applications in ST among research articles

4 Discussion

The concept of ST has emerged as a response to the negative impacts from mass tourism and minimise the detrimental effects on environment and society at destinations (Asafe et al., 2013; Touray & Jung, 2010; Pradhan et al. 2019). Beyond this notion, ST can also provide competitive advantages to tourism businesses to differentiate from the traditional tourism market, and ICT has a significant role in achieving those advantages. From the beginning, the probable use of ICT in ST was discussed, and the need for integrating the technologies is increasing with the rise of ST. The study shows that most commonly researched topics in ICT in ST include GIS, web applications, ARS, gaming, AR, IoTs and social media. The topic being discussed varies from very technical to non-technical, such as ICT use for collaboration and quality of life. Many papers include ST as a theme but do not directly contribute to the theme or show how ICT will help ST rather than tourism in general.

With the proliferation of the mobile era, GIS use is growing, and several studies have been conducted using GIS as a tool for ST. GIS helps to identify the area of conversation and suitability for sustainable tourism or preserve the environment and avoid gradual devastation (Aminu et al., 2017; Brach & Górski, 2014) as such evaluation helps in better planning and ensuring goals of sustainable tourism (Aminu et al., 2017). The GIS has been used to collect geographical data and create digital maps to plan routes for sustainable tourism (Aminu et al., 2017; Brach & Górski, 2014). It has not only been used to identify the location but also to present cultural heritage in maps, creating awareness to benefit the local community, which ultimately assist ST (Brovelli et al., 2013). The research using GIS in sustainable tourism ranges from finding suitable locations (Bahaire & Elliott, 1999), access water quality (Aminu et al., 2015), plan tourism destination (Aminu et al., 2017; Brach & Górski, 2014; Brovelli et al., 2013) as well as to identify tourism activities that can aid in ST (Aminu et al., 2017). Location-based service analysis is another most investigated area (Efraimiadou & Zafeiri, 2013). Tools such as the virtual globe, visitor tracking can be excellent tools using the power of GIS to support ST and benefit the local community by combining heritage with IT to support sustainable tourism (Brovelli et al., 2013; Zejda & Zelenka, 2019).

ICT has been promoted as a tool enhancing information sharing, enhancing user participation, gaining community inputs and collaboration among stakeholders aiding sustainable tourism development (Efraimiadou & Zafeiri, 2013; Jomsri, 2019; Zejda & Zelenka, 2019). The use of ICT in ST is found to impact the decision making process as well (Bae & Han, 2020). Web 2.0 tools have significant positive impacts on sustainable tourism and customer decision making (Gharama et al., 2018). Such tools raise cooperative knowledge and aid development needs practices (Efraimiadou & Zafeiri, 2013) and enable creative products and enhance visitor interaction, providing them avenues for the community to consult and collaborate on proposed tourism plans (Peterlin & Pranicevic, 2016).

The increasing range of ICT tools has been investigated for ST. Gamification has been implemented to promote tourism (Negrusa et al., 2015). Gamification can enhance tourism sustainability and found that gamification motivates the visitors, enhances collaboration among visitors, encourages in charities acts such as poverty reduction and positive change which are aligned with the goals of sustainable tourism (Negrusa et al., 2015). Similarly, augmented reality (AR) technology used in research to assess community preferences for sustainable tourism development in the US and found such applications increase user enthusiasm and participation making the overall process more meaningful and enjoyable (Keske & Smutko, 2010) whereas in Asia, Augmented experiments for tourists across nine templates in Thailand found that such technology is perceived as innovation. The cultural resources can be utilised using ICT, for example, combining tourism resources and performing a digital picture-story show preserving old and heritage resources (Oguri et al., 2019). In addition, Ab Rahman et al. (2012) have proposed a 3D simulation architectural design scheme for marine ecologies to use for ST that yielded positive results.

As IOT application was investigated as an architecture proposed for sustainable movement of tourists using a mobile phone app and activity simulation, IoT tools are found to be helpful for sustainable tourism (Nitti et al., 2017). IoT tools can maximise visitors' satisfaction and save their travel time (Nitti et al., 2017). With the wide use of mobile technologies, ST can utilise mobile technologies to avoid beach overcrowding by allowing tourists to choose the right beach for a better experience (Girau et al., 2018). The social media and its ability to promote and develop sustainable tourism have been investigated, providing a framework to promote sustainable tourism (Guzzo et al., 2013). Social media is a useful tool for knowledge-oriented co-creative practices, for example, ecotourists formed a network and developed collective wisdom to create ecologically conscious tourism (Peterlin & Pranicevic, 2016; Sarkar & George, 2018).

Sharing concept is on the rise in tourism with the rise of platforms such as Airbnb, Loft, Booking.com (Cosmescu & Chindris, 2017). The use of ICT for sharing economy in ST is not only useful for accommodation but also helps to create sustainable private transport for car-sharing to solve the problem of traffic bottlenecks and to reduce pollution (Singh 2017). The "peer to peer economy" supports sustainable tourism development as it posits rural households in tourism businesses as they can register their services or goods on a sharing economy e-commerce platform. Tourists, on the other hand, are not confined to only big hotels but have access to private homes accommodations, which is part of ST. Applying ICTs to facilitate or enhance sustainable tourism development is profoundly becoming beneficial and significant for tourism destinations, and it also can be used to minimise negative impacts at tourism destinations (Touray & Jung, 2010).

The ICT use in ST is not limited to technical use, various studies showing ICT tools not only help to mitigate some of the negatives associated with tourists but also enhance user satisfaction (Ali & Frew, 2010; Oguri et al., 2019). Tourism organisations can also demonstrate sustainability capability and

strategies by adopting various ICT tools for eco-friendly practices, reducing energy in their organisation consumption, reduction in carbon emission (Gholami et al., 2017). The literature shows there is a consensus that ICT can help sustainable tourism development enabling tourism product, monitoring, measuring and evaluating (Ali & Frew, 2014) and influencing the flow of visitors and act responsibility for suitability (Ali & Frew, 2010; Zejda & Zelenka, 2019). The ICT tools can not only facilitate the tourism process, enhance economic potentials and conserve the environment (Ali & Frew, 2014) but also help to connect to visitors and enhance tourist satisfaction and experience (Ali & Frew, 2010; Oguri et al., 2019; Perles & Ivars, 2018).

The use of ICT tools in ST provides collaboration and coordination opportunities (Peterlin & Pranicevic, 2016) creating a partnership between tourism stakeholder and destination level (Touray & Jung, 2010) and enhancing the social, authentic and reliable interactions among stakeholders (Negrusa et al., 2015; Peterlin & Pranicevic, 2016). The use of ICT in ST enables community-driven tourism approach enhancing consumer participation and contribution, which is one of the pillars of sustainable development (Muganda et al. 2013). Like in any industry in the 21st century, information is critical in managing environmental sustainability, understanding socio-cultural contexts of visitors and providing a better service (xu et al., 2020). The benefits of ICT in local communities are not validated. Involvement of the community in the research process is low. One of the characteristics of ST is reducing poverty, but most of the research studies took place in developed countries. Further investigation has to be done to inquire about this phenomenon. Is it because the communities in developing countries are not ready for ICT?

The review substantiates the help of ICT to understand ST better and provides contextual insights into the drivers, dynamics and impacts of ST (Xu et al., 2020). However, to yield all the benefits, proper training and understanding of these ICT tools are required, which is found to be lacking (Ali & Frew, 2010; Yuan et al. 2006). Some studies (Ali & Frew, 2010; Kim & Garkavenko, 2019) uncovered that tourism organisations are not able to implement ICT in ST due to cost or big initial investment.

5 Implications

The current research trend from this review identified several research gaps. It has been observed that ICT tools and its application are still at an early stage for sustainable tourism development (Kim & Garkavenko, 2019). The transfer of knowledge to the ground level in tourism businesses is slow, but ICT could facilitate better (Perles & Ivars, 2018). Therefore, implementing a sustainable tourism-related ICT strategy can bring other economic, social, legal and political benefits (Gholami et al., 2017).

Another research gap became evident that there are only a few policies related to the use of ICT in ST. Policymakers and practitioners hopefully would take a wider view to accommodate and incorporate many possible benefits to stakeholders. The concept of sustainability will not be realised and delivered by policies only, and it must be embraced by society at large as a principle and helping many choices local communities make every day (Asafe et al., 2013).

This review also helps researchers to identify the future research direction in the discourse. One apparent suggestion would be to expand the research in many geographical regions. In addition, a holistic view for developing better innovative ICT tools can be carried out. Another possible direction would be to identify suitable tools for planning, decision making and validating the process of sustainable tourism development. Such tools can also be developed to avoid conflicts in societies.

6 Limitations

There are several limitations to this review. The most obvious one is the research data was extracted from the selected databases and then filtered to only peer-reviewed papers from journals and conferences. Moreover, synonymous terminology for ‘sustainable tourism’ such as ecotourism, rural tourism or green tourism is not used for search terms. During the search, only research articles having sustainable tourism in titles were filtered with the view that the study of sustainable tourism would have mentioned it in its titles. The results for this review was relatively low because of the objective to investigate ICT use strictly with ‘sustainable tourism’. Furthermore, this process excluded articles for mass tourism, as there are differences between sustainable tourism and mass tourism. Finally, we were not able to retrieve the full-text of some papers for this review.

7 Conclusion and future research

In this contemporary world, the use of ICT is pervasive and has played a significant role in the tourism industry. In some cases, new ICT applications transformed traditional tourism into sustainable tourism due to its features to measure carbon footprint or climate change or enhance community participation etc. Although the relevance of ICT in sustainable tourism development is evident, this topic is under-researched. This review highlighted the need for further research on some key topics.

The advancement of technologies and its possible implications for sustainable tourism can be easily identified. The new trend in technology such as robotic process automation, robots, artificial intelligence and service automation can be considered for the operation of tourism businesses. For example, the possibility of virtual trips as a part of sustainable tourism be looked at as a research topic. The relevance of such ICT tools is even higher while the tourism industry is facing a dire situation due to the recent pandemic.

Similarly, the use of technology for ambient intelligence, geo-caching, context awareness for better service to tourists and to achieve the goal of sustainable development goals can be studied. Another aspect would be to explore sustainable tourism as the forefront for poverty reduction through better utilisation of ICTs for planning, development and management of tourism products and services. Thus, social equity can be enhanced in communities by using emerging technologies for sustainable tourism.

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