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An impact study on COVID-19 and tourism sustainability: intelligent solutions, issues and future challenges

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An impact study on COVID-19 and tourism sustainability: intelligent solutions, issues and future challenges

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Abstract: Tourism is the deed of every individual who loves to travel for leisure, entertainment, sports, or other purpose and usually stay in places outside their environment. It involves hospitality, health, sports, education, or entertainment. Tourism is often connected with the individual intentions to discover the facts and findings of the environment. But, the COVID-19 pandemic contamination has furiously affected the kind of tourism industry across the world and waiting for the biggest downfall ever in the history of tourism. It not only affected the common inter and intraregional travel but also badly hit the global tourism sectors. In this article, an impact study of COVID-19 on tourism sustainability is performed with an in-depth discussion on various issues and challenges. Further, an effective analytical perspective is presented on the applications of intelligent computing techniques to meet the challenges of tourism concerning COVID-19. This study will be helpful for effective analysis on different tourism sectors in a post-pandemic scenario along with a special focus towards the enhancement of domain knowledge of different stakeholders, industries, and government organisations.

Keywords: tourism; sustainability; COVID-19; pandemic; machine learning.

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1 Introduction

Travelling is an entertaining mode to assemble visitors who discover new visiting places where the path is absolutely free from sickness, catastrophes, and crime. Conversely, often with the right experience, hazards can be diminished or moderated, and the travel records fill up with all memorable experience. Pandemics and epidemics are the two most terrifying news for travellers. In such cases, it should be tough or not possible to avoid the illness. Besides, not solely the travellers however additionally individuals they contact throughout the trip are in danger. Travellers play a crucial and critical character within the transfer of pandemics amid different locations. Since travel is an important source of income for this commercial world, any obstacles impact the tourism industry and restrict travelling also. Over the last few months, the entire world is looking at this

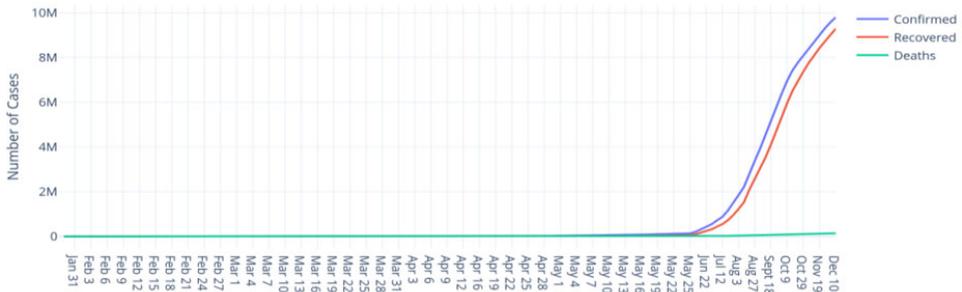
epidemic for the severe effect of a novel coronavirus. The destruction of such occurrence reemphasises the frailty of the tourism sector.

Pneumonia of unidentified cause recognised in Wuhan, China on 31 December 2019. Although the novel coronavirus quickly widens in Wuhan country's section, it was originally unnoticed by other parts of the world due to some political cause. However, the authorities of Wuhan hold the spread of the virus with the help of local and individual quarantine method (lockdown) to alleviate the number of cases in China. On average 80,000 cases were alleviated by mid-February, 2020 and today it crosses some millions of sufferings (Figure 1). As such the fly of international flights had previously transmitted the coronavirus to other continents and the verified infections quickly doubled throughout the globe. To prevent the disease with no vaccine, the majority of the countries reacted with several forms of non-pharmaceutical-interventions (NPI) like home isolation or quarantine (lockdown), closing of schools/colleges/workplaces/business, maintaining social distancing, postponing or cancelling of events like conferences, festivals, elections, summer Olympics, sports seasons, etc, and ban on assembling of individuals over the crowd. Global, provincial, or native restriction in travel immediately affected nationwide revenue and also business enterprises, i.e., worldwide tour, local business enterprise, day visits, and other divisions such as shipping, cruises, conveyance, hotel, restaurants and cafes, conferences, festivals, meetings, or sports events. As a result of the crisis, international travel quickly reduces and plenty of countries commanding travel restrictions, shutting borders or initiating quarantine period, global and marital business enterprise fallen sharply in several weeks. Many nations disorganised the revisits by travellers destination within the case of vital outgoing markets concerned many thousands of individuals across the globe. International travel is turning tougher with the restrictions of entry into borders, cancellations of flights, temporary shutdown of airports, forbidden exit and many limitations are also initiated. The prevailed situation is unique. The framing of the world tourism rapt from over-tourism to non-tourism within months that are vividly exemplified by newspapers as well as blogs portraying well-liked tourism sites in 'before' and 'after' pictures. The COVID-19 epidemic has strictly wedged the various tourism sectors across the world covering fields like hospitality, tour workers, travel mediators, air, land, and ocean shipping trades, etc.

The Tourism industry is constantly providing changing customer needs, safety, enjoyment and above all mental and health satisfaction. Most of the tourist places attract the people by its natural beauty, purposive destination, amusement, adventure, or recreation. Undoubtedly, the tourism industry is considered to be the principal sector in the world providing ample job opportunities compared to other service industry. The tourism industry is often considered as an ornament of World's beauty. Tourism is the touchstone to cover both demand and supply of activities across the globe. Essentially the term tourism refers to the activities involved by tourist which considered as tourism economy. It includes an overall activity which directly or indirectly linked with the tourist economy such as hotel staying, meal ordering or visiting a tourist destination. Further, it involves some indirect activities like transportation, communication or entertainment. Globalisation played an important role to attract tourist worldwide. May it inbound or outbound visit, people love to visit their affectionate places which became a larger contributor to the world economy. According to source tourism and travel sectors have extended its growth to 3.5% in 2019 compared to the global economy worth 2.5% for the successive ninth year. The tourism industry contributed about US\$8.9 trillion to

the world's GDP which is a significant contribution among all industry. It has created 330 million jobs through hotel and hospitality industry.

Figure 1 Analysis of the number of confirmed, recovered and the death cases (see online version for colours)



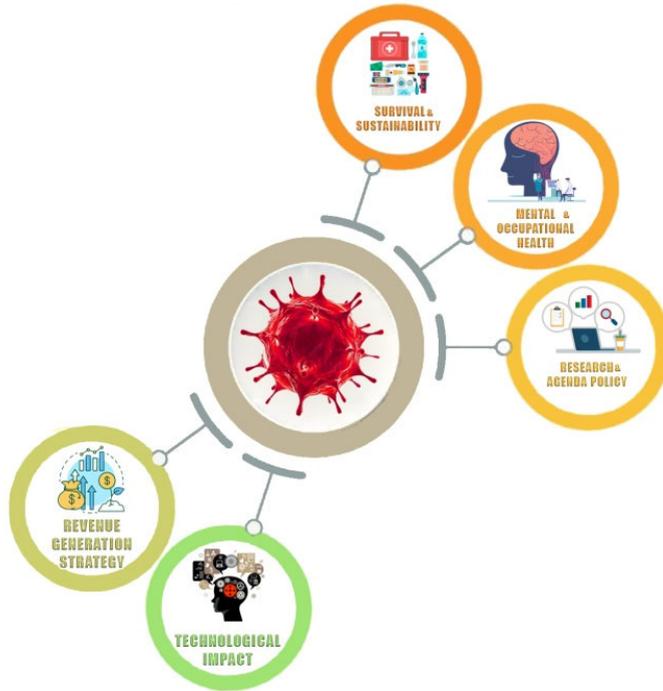
COVID-19 outbreak changed the scenario drastically because of mobility restrictions and cancellations of international flights. The lockdown impact since December 2019 changed the shape of revenue and greatly affected employment. Many people have lost their jobs; the situation became worsen in hotels and hospitality industry. Direct and indirect employment is affected by this pandemic. Analysing the difficulty, United Nations World Tourism Organization predicted the flow of international tourist might be decreased by 58% to 78% in 2020 and may suffer from a significant loss of US\$0.9–1.2 trillion in global tourism receipts¹. The fear coronavirus reflected in the domestic tourism industry also. Particularly, hotels, hospitality service, transports, information and communications, entertainment have lost their revenue for 10 years. The SMEs, micro industries, food and handicraft business have fallen sharply as the pandemic appeared. Most of the countries reduced the manpower in the airline, cruise and other industries.

Uncertainty of travel and risk is associated with tourism and tourist. The contagious infections of coronavirus made the people locked for months in their respective environment. The sciences of tourism have changed with the slogan ‘stay home, stay safe’. This statement burst the entire ideology of the tourism and hospitality industry. The spread of coronavirus have abandoned by various countries and not allowed any international flights for example New Zealand has not allowed any foreigner for five months. Safety, hygiene, security, social distancing etc. are considered to be the very toughest task to manage the tourism sector. No hotels are permitted by the government. This overwhelming situation changed the psychology of tourist and occupational workers. The workers are under stress and mentally disappointed. The practitioner, economist, academicians, psychologist, philanthropist are finding the solution to revive after the pandemic.

There are thousands of articles published on problems and prospects of the tourism industry; however, the future is uncertain and dark. Subsectors like survival and sustainability, mental and occupational health, research and agenda policy, revenue generation strategy and technological impact are the main broad concern of tourism (Figure 2). Many researchers suggested that domestic tourism, handicraft, agriculture, technology should be developed to manage the differed economy. Some of the practitioners advised improving the health consciousness among the tourist. However, there was no concrete solution for the survival and sustainability of this industry. Travel

and quarantine restrictions triggered tight budgets and the spread of infection have significantly declined tourism sector. The e-tourism or technology adopted tourism may have the efficiency to survive after the pandemic. Because the post pandemic situation it needs a balance between public safety and economic recovery where machine learning (ML) could replace physical transmission.

Figure 2 Impact of COVID-19 on subsectors of tourism industry (see online version for colours)



Source: <https://www.unwto.org/news/covid-19-international-tourist-numbers-could-fall-60-80-in-2020>

From the ancient times, worldwide tourism has defeated major damages as well as loss stemming from a variety of adverse events that includes natural, manmade, and epidemic disasters. When these actions take place, they impose the direct and indirect fatalities not only on the tourism sector although the overall economic system of the distressed nations, who are highly depending on tourism. The occurrence of SARS in 2003 augmented as a global concern due to rapid and transmissibility spread of the virus by airlines resulted in strict financial losses of the world tourism industry. During the 2nd and 3rd quarters of 2003, the international travellers have reduced by 42.83% to 7.24% as a result of the SARS eruption.

Most of the countries have quickly restricted the limit of travellers coming from badly affected areas to secure safety inside the country because of the COVID-19 pandemic effect. As predictions signified, there will be a fall in tourist actions of 20% to 30%, which will affect a slump in global tourism revenue of around \$300 to 450 billion. Even though technology may have previously altered how tourists plan, book and board on their expedition significantly over the last decade, some intelligent techniques such as the artificial intelligence (AI), ML, artificial neural network (ANN), deep learning (DL) and

many more are probable to have a crucial role at this juncture in serving the industry recommencing back to the normal. Before the epidemic, AI and other types of ML were just beginning to penetrate the tourism sector. Their major benefit is the capability to personalise occurrence and reorganise services based on customer information. Learning is the process of attaining knowledge; we can utilise the learning machine advance to predict the outcome of the novel coronavirus outbreak on traveller arrivals.

Forecasting is an important prerequisite for any decision making. It is extensively conducted in a variety of areas, including the tourism sector. Many studies emphasised on tourism demand and forecasting produced two kinds of outcomes in terms of prediction quality that include correctness of error magnitude and improvement of understandability based on knowledge rules. But all these advances usually are deficient in simplification capability, which significantly confines their applications. However, the prediction correctness of these methods may be unacceptable when noise and nonlinearity exist in tourism demand information. Intelligent methods such as ANNs, ML, and support vector machines (SVMs), etc. have newly gained considerable interest due to their generalisation capability and prediction accurateness. Generally, ML is employed for categorisation, clustering, and regression; however, in the tourism sector and hospitality, ML has been used for revenue management, equipped analytics, and client expertise development. The target of ML in cordial hospitality is to collect the arrangements of assembled information and learning from it and advance self-capability through expertise while not the concern with human and plain re-programming. At first, specialists assemble, select, organise, pre-process, and transform into the machine as the information set to build analytical forms. Usage of ML has authorised hotels to own progressive tools to assess and develop performance and fashionable days. The tourist industry is developing based on technical availabilities ranging from looking for data on a particular travel intention. Moreover, reservations and bookings through the web system became easier to pick and shift from one to a different area with advance offers. The support and usage of ML-based techniques have created hotel activity additional versatile than ever before, to achieve some extent wherever hospitality organisations can use ML systems for customer's satisfaction and support of staff within the task.

Likewise, many intelligent techniques provide tough autoregressive patterns of tourist arrivals, use SARS information to teach DL algorithm, develop the long short-term memory (LSTM) ANN respectively. The majority of the countries have initiated unusual limitations related to transport as well as the use of public spaces. These intelligent techniques are emerging at the front position of research in data recovery and data filtering systems. Recommender schemes are a better example of such intelligent technique approaches. Such schemes have been urbanised to suggest appropriate training to users dynamically and with no need for an open search query. The collaborative filtering (CF) technique is one such recommender system that is popularly utilised in most online shopping websites. On the other side, the commercial services are moving ahead towards assuming the smart tourism field after the COVID-19 outbreak with the advancement of web technologies (WT's) and improvement in AI allowed applications, along with the development of the internet of things (IoT) into the internet of human things (IoHT) respectively.

In this paper, an impact study of COVID-19 on tourism and sustainability is performed with a wide discussion on the various issues and challenges of the pandemic. Further, an effective analytical perspective is presented on the applications of intelligent

computing techniques such as AI, ML and DL to find the major problems and prospects of the tourism concerning COVID-19 disease. The main contribution of this paper is:

- 1 A systematic study on various sectors of tourism such as survival and sustainability, mental and occupational health, impact of research agenda and policy, revenue generation strategy in light to COVID-19.
- 3 An in-depth discussion on the applications of intelligent algorithms for various issues and predictive analysis of tourism sectors.
- 3 Critical analysis of all the factors affecting tourism in connection to post-pandemic.
- 4 Analysis of all the issues, challenges and other consequences related to various tourism along with intelligent solutions.

The article is segmented as follows. Section 2 explained the survival of the tourism industry and sustainability strategies in post-pandemic. A thorough study of the impact of mental and occupational health is being analysed in Section 3. The impact analysis on the developments of various research agenda and research policy in tourism is analysed in Section 4. Section 5 dedicated to revenue and crises management with different research challenges. The impact of technology for developmental solutions of tourism is highlighted in Section 6. All the tourism sectors and their adverse impact on COVID-19 are being critically analysed in Section 7. Section 8 concludes the article with necessary future directions for the possible sustainability of tourism.

2 Survival and Sustainability strategies in post pandemic

The impacts of coronavirus have changed the intention of the tourist severely and also they fear to travel tourism places. In this context the survival of the tourism industry after the pandemic is challenging. Most of the researchers observed that great concern should be adopted to mitigate the situation. Fear of tourist could be subsidised through health insurance, protection or safety measures. The government also have a proactive role to implement various provisions relating to subsidies, taxes, ban restrictions etc. The mobility of travellers should hold for some time to recover the loss. The rural or domestic tourism should be enhanced to recover the damage caused by the pandemic. From December 2019 to November 2020, many contributors explored their research in sex tourism, perceived risk, individual risk, rural tourism or other sustainability measures. Therefore the sustainability or rival after pandemic becomes a crucial term of discussion where the tourism industry could prosper in future.

Chang et al. (2020) propelled the recovery or sustainability of the tourism industry which alarm as a serious issue and a matter of concern after this epidemic or pandemic. They articulated unpredictable damage due to COVID-19 that changed the world economy and employment unexpectedly in various aspects, i.e., international travel, tourism, hospitality, hotels, recreations or other allied industries. The future is risky as the SARS Corona virus-2 is highly infectious and contagious that causes the COVID-19 disease and a threatening to visitors' worldwide. Further, it materialises as a serious concern associated with risk for the visitors. Thereby, the tourism, hospitality, and travel industries have closed due to these restricted pandemic regulations (e.g., social distancing, entry restrictions, lockdown, personal protection, and hygiene, medical and

mental health). According to sources, hospitality and tourism industries are the important employment provider in the world but COVID-19 changed the scenario dramatically since December 2019. Now, strategist, economist, educationalist or researcher should pave the idea of recovery after the pandemic which could be a solution for the revival of the tourism sector worldwide.

Haywood (2020) revealed the re-envisioned or re-exploration on future tourism in his article. Unprecedented death during the COVID-19 pandemic created a furious climate where people afraid to hold their responsibilities, many have left the job and stayed in the home. Therefore it became a violent loss in tourism-related employment where 75 million unemployed, many overloaded with debt and poverty which resulted in a loss of \$2.1 trillion revenues for travel and tourism. For survival and growth, tourism becomes smarter by the design of all communities.

Chen et al. (2020) stated the sustainability does not mean a matter of modernisation rather waning competitiveness ethic for survival that has to interplay between competition and cooperation. Survival or sustainability could be possible when confident awareness developed. Now, UNWTO reported that tourism crisis is unexpected as confidence and trust among the tourist or traveller have busted. However, media players, policymakers or government should develop confidence among the tourist.

Zheng et al. (2020a) pointed out that tourism has been severely smashed due to travel being regarded as a high-risk commotion during COVID-19 outbreak. Still, it is worse due to the ambiguity and false information about the pandemic in social media and the traveller perceptions have led to major reductions in travel demand. To remove the COVID-19 impact on tourist, tourism destinations it is to better study public's psychology in post-pandemic journey rather than simply forecast tourism demand. The study investigated that threat severity and susceptibility can cause travel fear, which leads to defence motivation and defensive travel behaviours after the pandemic outbreak. The authors articulated on coping strategies that reduce resilience behaviour on travel fear.

Rogerson and Baum (2020) revealed that there is a crisis in the tourism industry worldwide due to spread of coronavirus. People viewed it as a watershed moment. The outbreaks of disease have changed the entire world drastically. Within a short span of period huge loss in revenue, employment has been observed. Substantial developments in tourism sector became doubtful and waning the allied industry to overcome after Post COVID-19. In this article the authors scarce about the developments of tourism in Africa and other regions. They suggested that community-based tourism could be the only possible way to survive in the pandemic where locals could be prioritised. So the policymakers should consider the African agenda for localisation of the tourism industry.

Tsionas (2020) revealed that the global pandemic has burst the hotel and airline industries and changed the economy. The author again stated that major airlines in the USA have destroyed its originality and as a result, the tourism and hospitality sectors face acute financial problems as demand has fallen to an absolute minimum. To subside the problem former President of the USA Trump has signed a stimulus bill of US\$58 billion in aid for airlines, US\$29 billion in payroll grants for workforce and US\$29 billion in loans for the airlines. Results of this case indicating the transformation in government policies which could adjust the severity of economic loss in the tourism industry. In his article, the author developed two models for gradual adjustment of revenue after post-COVID-19.

Kourgiantakis et al. (2020) investigated tourists' aim on the island of Crete the largest island of Greece. According to the source, Crete is a wonderful destination for

international and domestic tourists generates above 40% of regional GDP coming from tourism. The researchers conducted the study between 23 to 27 April 2020 among 1,281 individuals from Crete. Analysis of this study revealed that local tourism should be given more preference than international as travel restrictions are still imposed. Further, considerable steps to be taken in hygiene, safety, health issues in hotels and catering facilities.

Seyfi et al. (2020) proposed a new form of a selection of border limits by major world tourism destinations though the lockdown. COVID-19 pandemic is a burgeoning wellbeing crisis stimulating loss of revenue, health and threatens to human beings. In the study, they discussed the mobility of tourist within the localisation and removal of restrictions or banning orders. However, the restriction should be made on the border.

Gaffney and Eeckels (2020) investigated that the current reduction in international travel will be economically dependent on the physical circulation of tourists. The physical flow of tourist could only balance the revenue, so the GDP of any country depends on it. In this paper, the authors have given detailed on the inbound and outbound tourist data to exhibit the exact future. In this paper 2017 data published in the United Nations, World Tourism Organization compendium has used to identify the risky places easily, so that it can be accesses transformation after COVID-19.

Niewiadomski (2020) demonstrated that de-globalisation could be machinery for re-shape the world after COVID-19. Particularly the dark side of tourism could be changed with a temporary de-globalisation where foreign tours could be banned for a few days to review the pandemic effect. The author emphasised that the temporary withdrawal will help to reboot new opportunities in the crisis. In this context, the agenda on global tourism should combat the economy from tourism.

Wibisono and Sulistya (In Press) investigated the current urban development of Yogyakarta peri-urban areas where tourism sector was neglected. Therefore, the municipal authorities should pay more attention to geographical location and conditions, population expansion and demands for inhabited spaces, local regulations or policies, economic pressures, as well as education and tourism developments as the leading sectors in Yogyakarta. They suggested that the tourism industry can also improve urban municipality through physical and spatial developments.

Buckley and Westaway (2020) investigated that outdoor tourism and recreation could help to improve mental health and social health among the women particularly. The pandemic has damaged the local economy where outdoor tourism and recreation have created opportunities. Particularly, leisure tourism is a flexible activity to improve individual wellbeing and also mental health strong. Human civilisation is largely affected by poor mental health and directly connected with social and economic costs. Before pandemic, the social and economic cost was ~10% of global GNP. Currently, they are increasing by COVID-19 lockdown, isolation and quarantine measures. By recovering wellbeing, tourism can reduce these costs. This improves the economic cost in the healthcare sector. Substantially natural exposure is also important to expect to improve mental health. The authors analysed that women purchased the tourism products though outdoor to improve their fitness which signifies wellbeing of the tourism sector. Table 1 indicates some other major contributions on survival and recovery strategies with the outcome.

Table 1 Different contributions on survival and recovery strategies with outcome

<i>Sl. no.</i>	<i>Contributions</i>	<i>Suggested outcome</i>	<i>Reference</i>
1	Tourism recovery policies	<ul style="list-style-type: none"> • Recovery policies • Co-word analysis 	Shao et al. (2020)
2	Tourism recovery	<ul style="list-style-type: none"> • Physical factors • Tourists' visit intention 	Ahmad et al. (2020)
3	Sustainability	<ul style="list-style-type: none"> • Economic stimulus package 	Foo et al. (2020)
4	Sustainability	Urban developments	Wibisono and Sulistya (In Press)
5	Survival strategy	Six foot-tourism world by delinking of tourism	Lapointe (2020)
6	Global sustainability	<ul style="list-style-type: none"> • Reorientation of tourism • Role in societal and economic change 	Hall et al. 2020)
7	Survival strategy	Change society, the economy, and tourism	Gössling et al. (2020)
8	Future of adventure tour and travel	All inclusive tourism rather adventurous	Nepal (2020)
9	Recovery strategy	Recovery through governments and public health	Grech et al. (2020)
10	Recovery strategy	Climate change	Prideaux et al. (2020)
11	Industry recovery and reform	Reformation of tourism through tourism education to the students and create awareness among the student	Higgins-Desbiolles (2020b)
12	Rethink the affect	Require community-centred tourism framework at local communities and local peoples	Higgins-Desbiolles (2020a)
13	Global consciousness	Transformational value of tourism	Galvani et al. (2020)
14	Reshaping tourism	Human flourishing is important to explore	Cheer (2020)
15	Transformation of tourism through festivals	Festivals and ritual will change tourism after COVID-19	Rowen (2020)
16	Greener and balanced tourism	Survival need a balance tourism with proper ecosystem	Ioannides and Gyimóthy (2020)
17	Negative impact on future tourism	New awareness	Newsome (2020)
18	Conservation of resources theory	Corporate social responsibility could improve the hope among the stake holders	Mao et al. (2020)
19	COVID-19 impact on tourism	Adventurers tourism like mountain tourism can solve the expectations	Seraphin and Dosquet (2020)
20	Relationship management	Fear of transition can replace with exact information on death troll	Farzanegan et al. (2020)

Table 1 Different contributions on survival and recovery strategies with outcome (continued)

<i>Sl. no.</i>	<i>Contributions</i>	<i>Suggested outcome</i>	<i>Reference</i>
21	Reactions of travellers	Travel insurance will be the best practice to attract the visitors	Uğur and Akbıyık (2020)
22	Perceived risk	Rural tourism	Zhu and Deng (2020)
23	Risk perception on destination travel	Preventive measures on declining international tourist, global health, sector taxes, political stability, etc.	Folinas and Metaxas (2020)
24	Untact tourism and individuals' perceptions of COVID-19 risk.	<ul style="list-style-type: none"> • Perception of risk is a important antecedent of attitude • Cognitive risk of perception is positive 	Bae and Chang (2020)
25	Measurement of impact	Recover the impact with predictive measures	Hoque et al. (2020)
26	Perceived risk on tourism	Relief packages should be designed to benefit the society at large in tourist destinations	Qiu et al. (2020b)
27	Sex tourism	Scale-up preparedness	Hillis et al. (2020)
28	Perceived risk in tourism	<ul style="list-style-type: none"> • Short-to medium-term of tourist behaviour • Future recovery of the tourism sector. 	Matiza (2020)
29	Survival strategies	<ul style="list-style-type: none"> • Developments of risk management methods to deal with the crisis • Public policy and private support 	Škare et al. (2020)
30	Sustainable development	Environmental changes affect transition	Jones and Comfort (2020)
31	Predicted impact	Significant impacts all across the globe	Hoque et al. (2020)

3 Mental and occupational health in post-COVID-19

Health is an important area of every occupation. People cannot work with a proper health condition. The circumstances of COVID-19 broken down the health conditions across the world. Particularly, the people who are directly connected with the tourism industries lost their health and suffering from occupational health. Because of lockdown, many of them lost their job and not able to get a position local. So, some of the contributors have suggested generating local employment through domestic tourism. It is also seen that unless proper health consciousness and hygiene conditions, tourist may not prefer to visit places. Sports tourism is one of the choicest areas where mental health could be possible. Further, tourist psychology is accelerating directly where they feel secure for travel.

Chebli and Said (2020) stated that the impact of coronavirus changed the behaviour of the consumers who visit many tourist places worldwide. Now they are thinking of health, safety, and hygiene conditions in the tourist place, thereby COVID-19 made the

people furious. They did not feel secure when they go out of the home. The study tried to explore the intentions of tourist which will appear as a result of this pandemic. The study was conducted among 308 travellers, particular on a non-probabilistic basis. The research used the Chi-square method and content analysis to test the impact on traveller behaviour intentions, in terms of individual safety, economic expenditure, conviction and attitude. Therefore it can be observed that health is a prime factor for recovery the loss in the tourism industry in this pandemic.

Madani et al. (2020) observed that health is a major issue in the tourism sector because traveller feels insecure about their safety. So all the stakeholders have to pay more concentration to the safety measures and maintain hygiene conditions in the tourist places. The study was conducted in Algeria with a sample population of 203 people. They reacted that unless a greater change in health consciousness the country's economy cannot develop. So health sectors should take necessary steps to commit the traveller and also the insurance companies should cover all kinds of facilities.

Couto et al. (2020) investigated that tourism is one of the mainly affected sectors in COVID-19 pandemic crisis. The situation has demanded cancellation of the foreign flight to stop the virus which directly affected the economy but the individual psychology made the tourist sector crisis. The study was conducted among the residents' of Azores Archipelago to examine tourism potential during the COVID-19 crisis. The current moment experience on health issues, so we must pay more attention to the crisis.

Weed (2020) articulated physical and mental health through sports tourism. He emphasised that sports tourism could be the only option to improve the wellbeing of the individual. However, international sports events somewhat cancelled due to COVID-19 pandemic. Travel has been banned affected sports tourism which turns a great loss to the world. In this paper, the author appealed before the researcher to contribute more research papers in the *Journal of Sports and Tourism*. Hence we must create awareness on the health and wellbeing of people and should also develop sports tourism.

Sönmez et al. (2020) investigated that the occupational health of immigrants and minorities became an important concern of US tourism and hospital workforce. So, proper health check-up is necessary to reduce the spread of the coronavirus. Occupational health of workers who engaged in many hospital and tourism industries are fear about their health because lockdown made them more stress and created mentally offset.

Kock et al. (2020) developed an exceptional method on evolutionary tourism concept based on the biological epistemology and theory to represent post-COVID-19 tourism research. They utilised an empirical relevance of the model to generate both a broad and deep perceptive of how the Coronavirus pandemic changes tourists' psyche and mental health. Table 2 indicates a few important contributions to mental and occupational health in post-COVID-19.

Table 2 Important contributions on mental and occupational health in post COVID-19

<i>Sl. no.</i>	<i>Contributions</i>	<i>Focussed outcome</i>	<i>Reference</i>
1	Challenges of health strategies	Changing tourist satisfaction levels with B&Bs before/after COVID-19.	Hong et al. (2020)
2	Health crisis became global crisis	Survival of tourism (local, national and international) through proper health management	Romagosa (2020)
3	Employment crisis in health sector	Employment is directly linked with health	Kumar (2020)

4 Pros and cons of research agenda and research policies after pandemic

The effect of coronavirus across the world devastated the economy and also changed the lifestyle of the people. Now people are living with fear and stress. The tourism sector is scarce of this crisis and afraid of the contagious spread of the virus. Mobility completely stopped, international flights cancelled and domestic lockdown changed the situation where people needlessly cancelled their travel. Among all the sectors, tourism is highly affected and no provisions held with the authorities to active it after the COVID-19. In this regard research agenda, future policies, research regulations are important ascendant for survival and growth of the tourism industry. So the policymaker and government should make the policy stringent to revive the tourism sector in the world.

Rogerson and Baum (2020) proposed a research agenda in Africa with the response to the effect of COVID-19 and supported regional and domestic tourism. In this paper the author appeal to develop recover the community-based tourism; survival of the informal sector; the climate change; and also addressed prevailed situations in African tourism scholarship. The African government is addressing the issue of crisis management and survival. In this context, the research agenda should be developing to recover the losses caused by COVID-19 and research agenda is vital for the survival of domestic tourism.

Baum and Hai (2020) revealed that COVID-19 has changed the scenario of tourism across the world in terms of physical condition, lives of millions of public and health. It considered a life-threatening and consequently shot down the tourism sector. North America, East Asia and Europe affected hugely as the international and domestic flights are cancelled; this resulted from a change in the revenue. However, human rights are not considered as it is part of their entertainment and health. COVID-19 made various restrictions through hospitality and tourism is important aspects of life. In this paper, the author emphasised the value of tourism in terms of human rights. Future after COVID-19 is dark, so a healthy tourism regulation can only revive the industry.

Bausch et al. (2020) articulated the future scenario of tourism regulations after the pandemic. They revealed that the future is unknown, so it is necessary to implement potential research models which could resolve the problems of hospitality and tourism. In this article, the authors develop a grid to pursue the effects of policies and involvement on tourism objects and subjects. This grid could be able to substantiate the flow of money from the tourist. So, real research could provide a beneficial outcome after the pandemic.

Prayag (2020) suggested that tourism researchers observe the hardiness of the tourism industry from a socio-ecological system perspective. The author explored a three-level approach (macro, meso, and micro) which could affect various aspects of tourism resilience in COVID-19 and worthy area of research. The author proposed a research agenda on COVID-19 and tourism system hardiness and contributes to further understanding of the scale of change (temporal and spatial), impacts, and resilience. Therefore the tourism resilience of tourist destinations or tourists is an important area of research. It is an opportunity for the stakeholder to mitigate and transform the regulations to revive tourism.

Sigala (2020) identified the research challenges and opportunities of tourism industry after COVID-19. So the academician and researchers should involve in active research to bring the fundamental values of this crisis. This paper discussed more on the impact of tourism demand, supply and destination management organisations and policymakers who experienced during three COVID-19 stages (i.e., recovery, response and reset). The author suggested that the stakeholders and researcher could able to know the impact of

COVID-19 and the importance of tourism research in new normal. So it is necessary for transformative research and open discussion on the impact of COVID-19 for the stakeholders and policymakers rather than replications.

Agbola et al. (2020) investigated the connectedness between tourism demand and tourism policy across the world. The change of tourist attitude and institutional circumstances across countries has created the importance of considerate the factors of tourism demand for developing effective strategies for meeting the global issues and challenges. Understanding these factors tourism policy is the only option to revive the tourism industry after the pandemic. Therefore advances in the theoretical and empirical analysis could replace the tourism demand research and uncertainty.

Shao et al. (2020) explored on the evolution of research policy measures to recover tourism sector in China. The research was initiated to bring policy on regional differences to develop the economy in various stages. To recover the crisis the authors identified many tourism recovery policies, prophylactic measures, policy support and departmental management system. However the administration needs to tackle a proactive equilibrium between prevention and control and tourism endorsement in this epidemic. Also the research policy should focus on tourism recovery in various regions within China. The government also should make the policy clear for providing better solutions for tourist after the pandemic. Table 3 illustrates various research contributions on research agenda and research policies in post COVID-19.

Table 3 Various contributions towards research agenda and research policies in post-COVID-19

<i>Sl. no.</i>	<i>Contributions</i>	<i>Focussed outcome</i>	<i>Reference</i>
1	Tourism research	Opportunities for research	Lew et al. (2020)
2	Interdisciplinary research in COVID-19	More opportunities are available in collaborative studies	Wen et al. (2020)
3	Mobility restrictions	Tourism policies	Seyfi et al. (2020)
4	Training and internships in hospitality and tourism	Tourism industry internship potential approaches is proposed	Bilsland et al. (2020)
5	Negative information	Ethical and reliable information must be communicated	Chemli et al. (2020)
6	Negative media coverage	Factual message should provide to sensitise tourist	Zheng et al. (2020b)
7	Geopolitical apprehension of tourism	Negotiation between government and public demanding	Mostafanezhhd et al (2020)

5 Revenue generations strategies after COVID-19

Revenue is the backbone of any country. It reflects the GDP of a country. The revenue which was generating from the tourism destroyed due to this pandemic. The fear of travel and restrictions has closed the tourism sector since December. Nowhere in the world is free from the virus attack. Due to this pandemic or epidemic hospitality and tourism industry severely affected and employees lost their jobs, hotels have closed and streets became empty without tourist. Now it is time to rethink the growth and prosperity of the tourism sector. The revenue generation is the first steps where the tourism sector can

survive. Most of the authors contributed their thoughts on ecology in tourism, trade balance, and deficit balance to balance the revenue which lost during this pandemic. So there is a need for integration required to manage the crisis and tourism.

Tsionas (2020) articulated that revenue from the tourism industry needs a gradual adjustment in the industry where the government should play an active role to attract the tourist in form of providing the subsidies to the stakeholders. It observed that after the reopening of the hotels and hospitality industry may not accumulate the same type of profit. In this article, the author advised either the same kind of profit and non-profits are possible after the new normal. So the government should not think only about revenue but it should prioritise the industry too.

Gaffney and Eeckels (2020) proposed a different kind of method to identify the loss of revenue in different countries and regions of the world due to COVID-19. It observed that countries hugely lost their economy due to fall in the international travel revenue occurred and physical transition of tourist. Because the country's GDP depends on international currency. So it requires a more balanced, sustainable and secures revenue management to recover the loss caused by COVID-19. In future, the inbound tourist, international travel expansion, etc. could only improve the revenue.

Carr (2020) reported about the balance of revenue in New Zealand. The government adopted the policy to improve the domestic revenue in the lockdown period. The government permitted community development through the local to enhance revenue. The author connected the nature with indigenous entrepreneurs to balance the revenue domestically. A proper legislative policy should be implemented to interact with the indigenous to overcome the challenges in future. So socially and culturally the government could plan to build the future of tourism and create huge revenue from locals.

Rogerson and Rogerson (2020) examined the radical changes in revenue in South Africa. COVID-19 has transformed the positive residual to negative return in revenue. It is a serious concern for every stakeholder associated with the hospital and hotel industry. To generate revenue, the authors recommended that unless the supply of protection, the government cannot earn revenue. This should be an opportunity for the government to recover its loss by the expansion of services.

Sah et al. (2020) articulated that the pandemic is a challenge for the economy and healthcare system in Nepal. The crisis may be difficult to resolve when the situation normal. So the government of Nepal is providing incentives to the farmer community to strengthen the economy and attracting the migrant workers also. The COVID-19 pandemic has ruined the economy as well the entire population scarce of healthcare also. So the government of Nepal has increased the health sector financial plan to over 6% for the coming fiscal year, although this is still well below the recommendation of WHO (10%). So to prevent this condition Nepal Government must provide the health care service properly where common people can concentrate on their work and as a result revenue balanced.

González-Torres et al. (2020) pointed out that tourism supply chain (TSC) have an important reduction in revenue in Spain. It is due to spatial diffusion of the COVID-19 epidemic outbreak which resulted in the total financial disruption of the Firms in TSC. The author considered the role of relationship management between hotel chains and their key TSC agents to solve the economic disruptions caused by epidemic outbreaks. This paper proposed four different areas to be developed, i.e., the identification of governments, tour operators, and competitors as the key relationships to be managed by

hospitality firms. As the hotel business is a global perspective all kinds of facilities to be provided to raise revenue. In this paper, 60 hotel chains have examined and found that there is a need for cooperation's between the government and the hotel chain. However, the operational risk should be control by the government.

Mariolis et al. (2020) estimated the revenue from the international travel, total employment, and trade deficit of the Greek economy. The article is based on a multi-sectoral joint production model and using data from the Supply and demand tables for the year 2015. It is the unexpected outcome from international travel receipts in the range of 3.5 to 10.5 billion Euros would lead to a *ceteris paribus* decrease in GDP of about 2.0% to 6.0%, a decrease in the levels of employment of about 2.1% to 6.4%, and an increase in the trade deficit of about 2.4 to 7.1 billion Euros, respectively. This decrease would mainly influence hotels and restaurants, land transport, agriculture, and real estate when the trade deficit affected by hotel and restaurant services revenue. This modelling can easily determine the demand and supply of hotels and hospital industry across the world revenue in the post-COVID-19 scenario. Other than these research works, some other important contributions to revenue management strategies in post-COVID-19 are indicated in Table 4.

Table 4 Important contributions on Revenue management strategies in post-COVID-19

<i>Sl. no.</i>	<i>Contributions</i>	<i>Focussed outcome</i>	<i>Reference</i>
1	Pre-pandemic's effect on the shares performance of OTC	<ul style="list-style-type: none"> • Increased the investment risks • Rates of price decline 	Liew (2020)
2	Tourism crisis and disaster management (TCDM)	<ul style="list-style-type: none"> • Open communication • Government-sponsored loans 	Yeh (2020)
3	Impact of coronavirus on Italian economy	<ul style="list-style-type: none"> • Financial support to ensure social distancing • Public finance used to maintain the demand which is lowering because of coronavirus 	Aiello et al. (2020)
4	Tourism ecology	Regenerative economies through destination travel, travel management and sustainability plan	Sheller (2020)
5	Deployment of mass cruise tourism	Development of a niche cruise tourism industry	Renaud (2020)

6 Impact of technology in post pandemic

Ever since the first case accounted, various studies have been made on COVID-19 by enhancing several points of view into considerations. The technology could be the best practice in tourism development. All kinds of estimations and predictions are possible through technology. The fear of COVID-19 could be suppressed by technology and innovation in future. Major researches have conducted in the area of LSTM, e-tourism, e-education and innovation to justify the requirements of tourism in COVID-19. Therefore innovative ideas could replace the old process of tourism and bring the innovative tourism process. Most of the investigations attempted to predict the number of

the affected the people, a few other investigations have been made on the impact of COVID-19 on financial economies, health, environment, and other sectors such as hospitality and tourism respectively. The spreading virus has a destructive impact on the tourism sector because of travel restrictions and falling demand amid tourists. The pandemic has majorly affected the tourism sector as the majority of the nations have given travel limitations to contain its spread. Many assessments have been made by using a various intelligent algorithm such as AI, ML, ANN, etc. these intelligent algorithms have been used in various areas like the LSTM approach, recurrent convolutional neural network (R-CNN), conventional CF recommender systems, weighted stochastic imprecise data envelopment analysis (WSIDEA) model, generalised dynamic factor model (GDFM), fuzzy Takagie Sugeno rules from trained SVMs, blockchain technology, human-machine interactive (HMI) technologies, including both AI and well as VR enabled applications respectively.

Polyzos et al. (2020) have compared the arrivals of Chinese tourist to the USA and Australia with 2003 SARS epidemic and COVID-19 outbreak and tested it with LSTM network. In this paper, they used LSTM model to test the effect of the COVID-19 crisis and proposed through back testing predictions. It observed that a significant drop seen in tourist arrivals from China to the USA and Australia which will take a minimum of one year and six for new normal in the tourism industry. Again they suggested that the study is not limited to China but can extend to other countries. So the pandemic has delayed the economy which needs a speedy recovery through technology-enabled predictions. Their finding has suggested that revival of arrival to pre-crisis stages may get from almost one year and that has a major effect on not only to the tourism sector but also on various other fields respectively. The authors have estimated the social as well as economical costs associated with the pandemic.

Verma and Thakur (In Press) in their article articulated on technological adoption in the hotel industry of India. They reviewed about 100 hotel industry in Himachal Pradesh where 8.04% of hotels adopted the technical amenities like keyless entry, electronic lockers, smart rooms, smart mirrors, etc. In this regard, they suggested that there are ample opportunities for the remaining hotels to implement such techno-savvy generations for the traveller. These types of implementations remove the fear among the visitors in this pandemic as a hygiene factor and attract more number of visitors in future.

Gretzel et al. (2020) revealed that there is a need for re-thinking on the technology-enabled tourism industry. The long-lasting epidemic has transformed the generic thought of tourism to e-tourism where recovery could possible immediately. To realise this transformational change in e-tourism research which could be the best practice than existing paradigms and critically examine its ontological and epistemological foundations. The authors have developed six pillars to transform e-tourism through historicity, reflexivity, equity, transparency, plurality, and creativity. In this regard, the paramount importance of rethinking contemporary science, growth, and technology paradigms is indeed to sustain in this global village.

Qiu et al. (2020a) demonstrated the need for e-education in the tourism and hospitality industry. The study was conducted at Nankai University, China. The university adopted online education like MOOCS, SPOCS, and other online teaching tools and techniques in their teaching and learning. During the period of the pandemic, the Chinese Ministry of Education released guideline and protocol for disrupted classes and undisrupted learning for universities teachers and students. Students can enhance their skills through these virtual classes during the closure of school and colleges. These

technology-enabled platforms like Web 2.0, virtual reality (VR), and the smart classroom could also focus on the tourism industry and tourism education. Therefore it can assume that COVID-19 provided an opportunity to demonstrate the importance of technology in tourism education.

Brouder (2020) proposed the need for institutional innovation to rejuvenate the crisis in the tourism industry. It suggested that a vigour bounce back is possible through a radical transformation in the tourism industry. Evolutionary paths should rebuild to transform to reciprocate the loss during the epidemic. The imbalance of demand and supply of tourist is only possible through a potential pathway in evolutionary transformation. So technology is indeed where institutional development possible to bring back the tourism industry in new normalcy.

Szczepanek (2020) has utilised the HD webcam time-lapse in Cracow to estimate the activities of pedestrians during COVID-19. The author has used the previously collected data of several urban zones from the year 2016 to 2020. They have categorised the different zones such as tourist zone, residential zone, and the combination of both tourism and residential into various stages. The latest ML algorithm (YOLOv3) has been utilised to identify people. They have introduced the non-standard relevance of the YOLO technique. It was found to have fewer prone to pedestrians but has a drawback of more computational time. The major aim of the proposed method is to measure the identification of HD webcam images and to evaluate the changes in pedestrian movement before as well as during the pandemic in Cracow.

Nilashi et al. (2017) has proposed a novel technique that depends on CF to improve the prognostic correctness of recommender methods in the tourism field with forecasting, reduction of dimensionality, and clustering techniques. The authors have utilised principal component analysis (PCA) as a dimensionality reduction method. Also support vector regression (SVR) and adaptive neuro-fuzzy inference systems (ANFIS) have used as forecasting techniques, expectation-maximisation (EM) and self-organising map (SOM) as well-recognised clustering methods. The advance of cluster groups and hypergraph partitioning algorithm (HGPA) has been used on both the EM as well as SOM clustering outcomes to enhance the accurateness of projected CF. It was found to measure the accurateness of the suggested technique on the TripAdvisor dataset.

Aydin and Yurdakul (2020) have introduced a technique for evaluating the performance of countries against the pandemic by using ML and WSIDEA algorithms. The authors have aimed to analyse the performance of 142 countries against the COVID-19. Clustering investigations were done with hierarchic as well as k-means techniques. They have examined the parameters with decision tree (DT) and random forest (RF) algorithms. It was found to have 20 countries out of 142 has completely effective. The smoking, diabetes, and GDP rate were found to have no consequence on the effectiveness stage of the countries.

Van et al. (2020) has aimed to study the role of HMI methodologies of both VR as well as the application of AI for the post-COVID-19 inventive tourism in Vietnam. The authors have tried to concentrate on tourists who seem for vital safety with the declaration of sympathetic, adapted concern in post-COVID-19 times. They have used structural equation forms to assess the objectives of travellers both empirically as well as structurally for destination tourism.

Li et al. (2017) has proposed a process and structure for building a composite search index that is assumed in a GDFM. They have empirically tested the framework in forecasting traveller volumes to Beijing. It was found that the projected technique

enhances the prediction accurateness better than the two standard methods like a conventional time series as well as a model with an index created by PCA.

Xu et al. (2016) has presented a new method of tourism demand that extracts fuzzy TakagieSugeno (TeS) rules from trained SVMs. The removed fuzzy TeS rules exhibit high forecasting accuracy and include comprehensible pre-condition divisions for practitioners due to the representative fuzzy rules and the generalisation capability of SVM. It was found that the projected approach executes comparably with SVMs and achieved better forecast correctness than other prediction methods for most origins. The authors have confirmed that decision-makers can simply interpret fuzzy TeS rules extracted from SVMs and found them to have a high advantage for the tourism sector.

Wei et al. (2020) has explored the utilisation of big data methodologies like genetic algorithms (GA) to expand huge travel information and to found an inclusive tourism data check stage for tourists, governments, enterprises, and scientific research institutions. The authors have introduced the whole design of an industrial data service platform that relay on tourist information. They have concentrated on the whole function, the application range of platform, data source, and standard data.

Sampaio et al. (2020) has introduced a method for assessing perceptions of tourism agents by using AI. The authors have made a study based on 9 semi-configured interviews that intend to recognise and investigate the insights of tourist agents about the benefits or drawbacks, confront, and usage as well as non-usage implications of AI in the present and future situation of COVID-19. The results emphasise the undisputed perception of the significance of using the knowledge that will not reinstate the human constituent but adds importance to it.

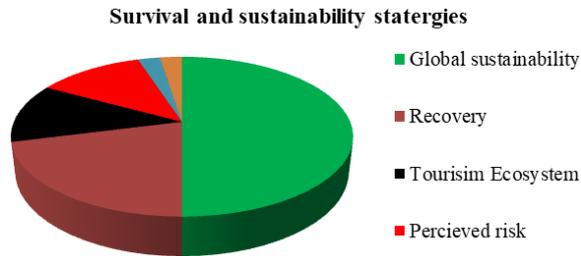
Linka et al. (2020) has combined a network epidemiology technique with ML to gather constraints and predicted the COVID-19 dynamics on partial and overall airport reopening with perfect as well as imperfect quarantine conditions. The authors have suggested that upon complete reopening, every new day, a novel COVID-19 case would penetrate the province. Their study presented the quantitative imminent of the efficiency of travel limitations. The overall results of the projected method have suggested that relaxing journey restrictions exclusively is possible, but would need severe quarantine conditions.

7 Critical analysis

The breakthrough of climate change, destruction, depreciation affected by the pandemic turned the situation to worsen. Mobility of individuals has stopped due to lockdown and long-standing restrictions posed by the government. Most of the individual are scarce about the epidemic. Revenue of the government has shut down due to the crisis in tourist movement. The international flights have cancelled and people waiting for new normal. No one is thinking of destination selection rather survival. The studies mainly conducted for revival strategies and sustainability of the tourism sector beyond the COVID-19. The contributors have tried to focus on rural tourism, sex tourism, community tourism, perceived risk in tourism, individual risk in tourism, adventure tourism, etc. They have tried to understand the critical values of this situation and implemented in the tourism theory after the pandemic. However, some of the points like eco-tourism, medical tourism, agricultural or farm tourism could also make a gradual adjustment in the tourism industry. More special conventional or heritage kind of program should be organising to

sustain the tourism industry. Figure 3 indicates the graphical illustration of various subsectors analysis on Survival and sustainability strategies. From this analysis, it is clear that the global sustainable strategy has higher impact followed by recovery and other subsectors such as tourism ecosystem, perceived risk and relationship management. With several uncertainty situations throughout the globe, many contributions are highlighted on global sustainability to direct the correct path towards many complex situations.

Figure 3 Various subsectors analysis on survival and sustainability strategies (see online version for colours)



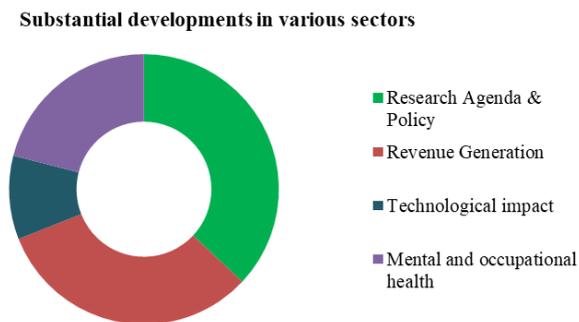
COVID-19 marked as a space in the history of the tourism industry. Many hotels and hospitality industries have closed due to the lockdown. Health and occupational safety are the basic points which could replace the fear of the individuals. Because of health consciousness, the flow of tourist to the destination travel banned and employees lost their jobs. The health security and safety, employment, stress management, occupational health, challenges in health are the main contributions since December 2020. However, 6 feet to 6 feet social distancing, mask, hand wash, warm water, etc. created a consciousness among the entire individual to resist the epidemic. In this context, the health education program to all stakeholders, health management for employees and environmental wellness program could be the best practice to manage the pandemic and flow of tourist could be possible.

COVID-19 post-pandemic scenario has created an unpleasant situation in the tourism industry across the globe. People are living with fear and scarce. The government is also under threat of economic deficit. Now everyone is rethinking survival after the pandemic. Therefore tourism researches can only the step to solve the problem. Between March to November 2020, there is much research has conducted in the field of the tourism industry and its growth after the pandemic. The researcher suggested that there should vast research in mobility restrictions, negative or oppressive message, tourist psychology, research policy, and geopolitical thoughts. However, they have not covered the research on eco-tourism, sports tourism, health tourism, etc. So it is evident that the tourism sector could attract the tourist through special attention in these sectors.

The tourism industry is the only way that earns revenue from the international market. The flow of tourist is directly linked with international flights and hotel industries. So revenue generation is an important aspect of the tourist industries. The country's GDP is also affecting though the revenue. In this period of the pandemic, the world economy has been slow down in the tourism sector. The social distancing, safety and hygiene, mobility restrictions have de-motivated the tourist which effected the industry severely. In this regard, many studied have conducted to recover the loss after the pandemic. The studies highlighted on TCDM, the risk associated with investors, regenerative economies through transport infrastructure, tourism practices, bordering processes, and questions of

sustainability, development of a niche cruise tourism industry, financial support to ensure social distancing, public finance could be used to sustain the demand which is lowering because of coronavirus. However, they have not suggested areas like event management, sponsorship program or entertainment through the tourism industry. In Figure 4, the other substantial developments such as research agenda and policy, revenue generation, technological impact and mental and occupational health been analysed. Most of the researchers anticipated research agenda and policy developments along with revenue generation in the tourism industry to reduce the detrimental effect in GDP as such government subsidies.

Figure 4 Analysis on substantial developments in various sectors (see online version for colours)



There is a need for re-thinking on technology-enabled tourism industry after the pandemic. The long-lasting epidemic has transformed the generic thought of tourism to e-tourism, e-education in tourism, technology implementation like LSTM approach, etc. where recovery could possible immediately. However technology also could assist through e-heritage, e-sales of ornamental article worldwide, and the virtual message about historical places to ensure safety after the pandemic. Therefore technology could able to balance the ecosystem of tourism industry after this epidemic or pandemic. The tourism sector is deeply suffered due to COVID-19. Thus, tough measures must be taken to bear the industry from destruction. The pessimistic income results hurt major areas of the economy. The tourism sector is a basis of regular income for uneducated labour, which would usually be instigated from lesser income groups. Tourism is significant for generating world peace. ML techniques are leading to technical innovation in all areas, with an immense impact on the field of tourism. Tourism forecasting has engrossed the study of different researchers mostly due to the significance of tourism in general economies. Usage of regression as well as time series techniques has dominated most of the forecasted techniques of the present research advances. Although these conventional methods have demonstrated some success in tourists predicting novel techniques such as intelligent techniques that can extremely contribute to this sector. Utilisation of LSTM network to predict the impact of the current pandemic has regulated for the various results of pandemic crisis and has been authenticated for the robustness of calculation with backtesting on a systematic window of subsamples, where it has executed adequately. The usage of ANFIS and SVM as forecasting techniques, PCA as a dimensionality lessening method has been recommended for novel multi-criteria for the tourism sector. On the other hand, multidisciplinary studies were made on the information of various affected countries during the pandemic. Similarly, some other

clustering studies of the pandemic impacted countries have been carried out and the number of clusters as well as their characteristics was examined respectively. Likewise, many intelligent techniques have gained more attention and been utilised by several researchers for getting better results to assess the effect of tourism field due to the pandemic outbreak.

8 Conclusions

The outbreak of COVID-19 has had a massive impact on the tourism sector due to travel restrictions falling demand and supply amid tourists. The long-standing pandemic has affected the revenue, policy and regulation, demand and supply and balanced the growth across the globe. The world is waiting for a new normal condition where the restrictions of travel, intentions of tourists, fear of travel, individual psychology, health and safety could safeguard the tourist. Many studies have conducted on survival, sustainability, policy resolutions, revenue generations, occupational safety, mental and physical health, the impact of technology on the tourism industry to reorient the industry into normalcy. However, studies are limited to conventional thoughts which depend on preventive measures after the launch of the vaccine. As the situation worse since the pandemic began in Wuhan, China on 31 December 2019 and spread the entire world with few days, now resilience of the tourism industry is a question before all. To optimise the fidelity among the tourist an immediate solution is necessary. This could be possible termed as an intelligent solution for survival and growth strategies after the pandemic. There should be an emphasis on eco-tourism, health tourism, agricultural tourism, domestic tourism, awareness among tourist though technology. An intelligent prediction can only reduce the fear among the traveller. In this context intelligent algorithm such as AI, ML, ANN, etc. have been used in various areas like the LSTM approach, R-CNN, conventional CF recommender systems, WSIDEA model, GDFM, fuzzy Takagie Sugeno rules from trained SVMs, blockchain technology, HMI technologies, including both AI and well as VR enabled applications respectively.

The effect of the COVID-19 pandemic has had a strong domino consequence, as most of the countries have quickly limited travellers coming from badly affected areas. As predictions signified, there will be a fall in tourist actions of 20% to 30%, which will affect a slump in global tourism receipts of around \$300 to 450 billion. However, intelligent based techniques like ML, AI and DL are emerged as novel solutions to deal with various perspectives of tourism. Mainly the applications of various regression and forecasting techniques are emerged as new alternatives to meet the consequences of the adverse effects of factors of tourism. Moreover, the 20th century has witnessed the major technological advancements in the form of DL and Bigdata, which leads to many effective solutions for the existing uncovered sectors of tourism. As future work, such techniques may be adopted for ecotourism, medical tourism, agricultural and farming as well as traditional heritage programs. With an in light hope of vaccine, the whole world is waiting for the solutions to meet the possible challenges of the pandemic and soon, the tourism sector may be an eye-opener for everyone for coping with the challenges in other sectors.

The study has an extensive idea on revival and sustainability strategies of tourism sector beyond the COVID-19. The main pinpoint of the study is to focus on rural tourism, sex tourism, community tourism, sports tourism, perceived risk in tourism, individual risk

in tourism, adventure tourism, etc. For the revival and sustainability of the tourism industry, there should be massive changes require in the areas like eco-tourism, medical tourism, agricultural or farm tourism, etc. health and occupational safety, economic deficit, trade deficit and personality psychology are the main facets which regulate the tourism industry could be managed by the technological implementations across the globe. To implement such technical applications like LSTM approach, ML, ANFIS, SVM and PCA in e-tourism and e-education a greater understanding between the policymakers and stakeholders are demanding. The study can also help to predict the tourism demand for e-heritage, e-sales of ornamental articles and virtual message of historical places. More so, technical fields like AI, Big-data, robotics, and data mining are also the future scope of the study as an intelligent solution for the tourism industry.

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