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Original article

Scientific risk performance analysis and development of disaster management framework: A case study of developing Asian countries

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ABSTRACT

Disaster is a state of serious disruptions in the functionality of any society or county. Disasters pose serious economic or environmental impacts that surpass the capacity of the affected country or society to compete with the use of their assets. Recently, Pakistan significantly prone to health disasters due to COVID-19 among developing South Asian countries. The long-term impact of health disasters and other natural hazards put additional pressure mostly on the government's economic policy. It forces the government to follow a constructive approach like a disaster relief-based approach rather than a conventional mitigation management formation to reduce the impact of disaster risk. This study elaborates on the main issues associated with disaster preparedness as well as recovery of the economy and businesses of the country. For Scientific risk performance analysis, open-source data from the National Institute of Disaster Management (NDMA) has been utilized to study the current situation of COVID-19 in Pakistan. Results show Pakistan has been facing a highly vulnerable situation as more than three hundred and fifty thousand confirmed cases have been reported. Poor health and technical management facilities have been exposed against COVID-19 as Pakistan has a low heath budget because of its declining GDP growth rate in the world. This research will help in disaster preparedness and the development of a disaster risk management framework while designing strategies to deal with such pandemics in the future.

1. Introduction

Population wise South-Asia has a weighted scope on the globe, and it covers developing countries like Pakistan, Afghanistan, and Bangladesh (Shabbir and Ahmad, 2016). One of the important strategic countries is Pakistan (A. Nawaz et al., 2019). The country has a total cover area of 770,875 km^2. It has been divided into three main regions: the northern mountain ranges, Indus river plains, and the Baluchistan plateau (Ali and Kandhro, 2015). The climate is based on its topography and its 60% area are consists of arid (deserts) where annual rainfall is less than 200 mm. Despite this, Pakistan covers a wide spectrum of ecosystems (Asgary et al., 2012). For example, it has been classified into 12 vegetable regions. It has also four seasons' namely summer, winter, monsoon, and spring. In aspects of hazards, Pakistan is one of the most disaster-prone Asian countries (Shabbir and Ahmad, 2016). During the last 10 years, Pakistan had experienced severe disasters and losses of approximately $18 billion. These natural disasters may be classified from moderate to severe. Northern and west areas are causing seismic instability in the region. There is often periodic flooding that comes in the Indus River (Asgary et al., 2012). Flood events occur during the Monsoon season, especially in July and September. At the start of the summer season, the melting of snow

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from glaciers are also causes flooding at different sites. Some other hazards include heatwaves, earthquakes, drought, floods, landslides, locusts attack, and epidemic disease that put Pakistani society at risk. According to the climate vulnerability index 2019, Pakistan is ranking 8th among the 10 most climate-prone countries from 1997 and 2016 (Sattar et al., 2020). From the last two decades, Pakistan is making significant improvements in economic growth and social developments by reducing extreme poverty and economic stability (Dzigbede et al., 2020; Lettieri et al., 2009; van Niekerk, 2016; Sattar et al., 2020). Natural disasters are not prominent in Pakistan and they happen worldwide (Hao, Mehmood, et al., 2020). The natural disaster is sometimes unexpected, like earthquakes, floods. These may be slow such as droughts or famine. In the past years, Pakistan had faced following major disasters. The Hindukush earthquake in October 2015, had a magnitude of 8.1 on the Richter scale (Deen, 2015). According to a survey report of NDMA, 272 deaths occured, 2,152 badly hurt, and 25,367 houses are affected. In July 2015, Pakistan faced severe damages from flooding due to monsoon seasons. The report of NDMA claimed that 1.6 million peoples have been affected. Because of the Monsoon season, Pakistan has suffered the worst floods in the past. Hence, there is a need to adopt effective strategies and plans for disaster management (Ministry of National Health Services, 2020).

Nowadays, COVID-19 is a novel infectious disease. It was primarily spread in Wuhan, China in December 2019 and resulting in current pandemics (Dzigbede et al., 2020; Perry, 2007). On 11 March 2020, the World Health Organization (WHO) has announced a global health emergency and declared an infectious disease (WHO, 2020). It was first reported in Karachi, Pakistan in February 2020 when a student return from Iran. Many corona cases had been reported in all four provinces of Pakistan by 18 March (Hao, Mehmood, et al., 2020). There were around 66,457-suspected cases in Pakistan with 24,131 recoveries and 1,395 deaths since 30 May 2020 (Ahsan Nawaz, Su, Iqbal, et al., 2020). Sindh has registered more than 26,113 cases, while Khyber Pakhtunkhwa has confirmed 430 death cases as the highest number of deaths in the country. The government had announced a countrywide lockdown from 1 April to 9 May and then extended twice after that. The lockdown was relaxed in phases after its completion. By 25 April, a survey report of Pakistan officials predicted more than 50,000 cases. However, the number of cases remained below 13,000 compared to what was expected (Ahsan Nawaz, Su, Iqbal, et al., 2020). At the start of March 2020, a religious gathering of Tablighi Jamaat was held in Lahore. This had become a super spreader of COVID and adding 27% of corona cases across the country by the end of April 2020. In April 2020, Pakistan initiated vaccine trials in cooperation with the Chinese pharmaceutical firm Sino pharm (Bakir, 2020). Currently different countries are working on their policies to introduce new laws on people's mobility as well as on non-essential businesses that temporarily closed for specific regions (Hao, Shah, et al., 2020). This could have a significant impact on several industry sectors ranging from hospitality and tourism to department stores and recreational activities (Sharma et al., 2020). Many governments across Europe have responded by providing temporary financial assistance to the affected businesses and workers (Yıldırım and Güler, 2020). Similar policies were followed in Pakistan. A series of researchers have also conducted research on current scenario of COVID 19 in Pakistan and have found policy gap within management system of the country specially to deal with such type of disasters. A detail map showing history of hazards and disasters (Fig. 1).

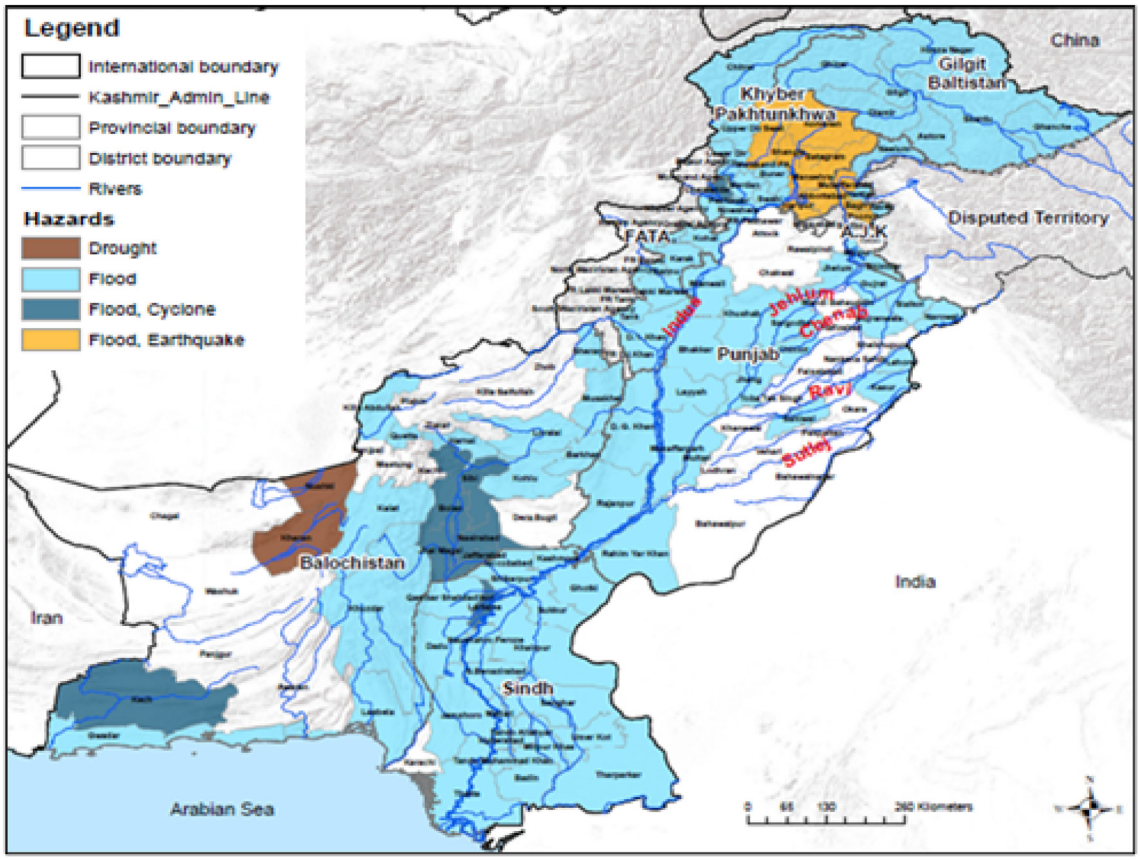


Fig. 1. Hazard map of Pakistan from 1950 to 2011 (Mahmood et al., 2020).

In the past, most disaster research has focused on the economic impact of natural disasters, but little research has been conducted on disaster management including preparedness, mitigation, response, and recovery in Pakistan. The ongoing COVID-19 is a test case for Pakistan and other countries. The novelty of this study is that it covers all aspects of humanitarian emergencies especially during the COVID-19 crisis as well as elaborates on the overall impact of the disaster on economic recession in the country. The data collected from publicly available sources on the internet. Also, the prevention measures and responses are taken by the government of Pakistan were also analyzed for taking necessary steps in the future to deal with such a pandemic situation. This study finds that provincial and local governments can play a vital role in dealing with current health disasters and more efforts are needed to mitigate the impact of disaster using training and awareness of disaster preparedness.

2. Materials and methods

Disaster management analysis and operations have divided into four main stages as shown in Fig. 2. The model assists in addressing main issues associated with disaster preparedness as well as rehabilitation of economic and business affected by disasters.

These stages are interconnected, and each stage has specific needs, strategies, and resources that face different obstacles. Data utilized is collected through available online data to evaluate the current scenario of the COVID-19 infection in Pakistan and its preparedness. We analyzed the problems related to disaster management by reviewing daily survey reports on webpages from the Ministry of National Health Services Regulation and Coordination (Ministry of National Health Services, 2020). The main steps of disaster management (Buttenheim, 2010; Deen, 2015) are given below.

Step.1: Risk Evaluation and Assessment
Step.2: Risk Management-Response
Step.3: Risk Management-Recovery
Step.4: Risk Management-Mitigation
Step.5: Risk Management-Preparedness

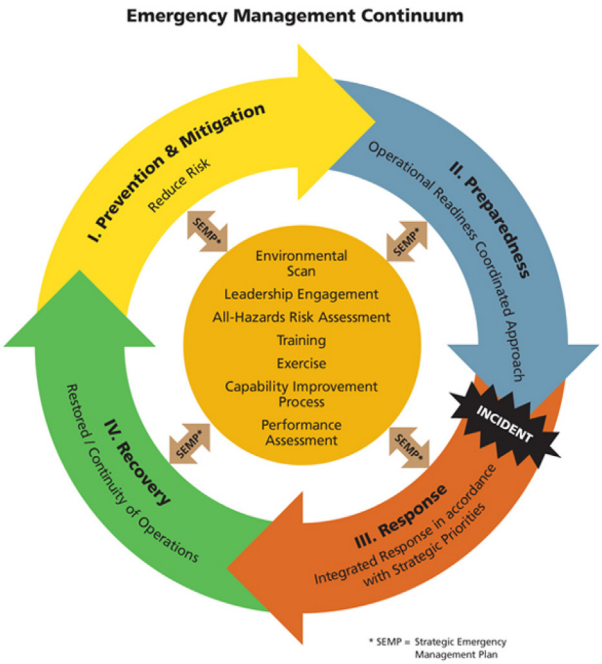


Fig. 2. Emergency management continuum or cycle (van Niekerk, 2016).

2.1. Risk Evaluation and performance Assessment

Risk is evaluated regarding the damage assessment. One of the prime outcomes of any damage level assessment is death occurrence during any event. The information about the situation of COVID-19 in each country in terms of death cases along with the population covered in each country is shown in Fig. 3. Pakistan has the largest number of death cases when it is comparing with other countries through comparative analysis by the number of death cases, GDP per capita, inflation, and heath budget spending (Ahsan Nawaz, Su, Barkat, et al., 2020).

The chart (Fig. 3) shows the numbers of death (in thousands) caused by COVID in the countries (Afghanistan, Bangladesh, Bhutan, Maldives, Nepal, Pakistan, and Sri Lanka). There has been a small number of deaths in each country except Pakistan. Bangladesh comes on 2nd number and both countries show a slight difference in their number of deaths. Sri Lanka has a smaller number of deaths obviously due to a small population. However, their GDP per capita rates tend to be matchless. Maldives has the highest GDP per capita compared to other countries. Afghanistan stands last in GDP per capita.

The chart (Fig. 4) gives information about the GDP growth (%) in each country. Bangladesh has the highest GDP growth rate as compared to other countries. Sri Lanka and Afghanistan have shown similar trends. Pakistan has a low GDP growth rate of approximately 212.2 million. Nepal has the largest population in comparison to Pakistan, but the GDP growth rate is high.

The graph (Fig. 5) shows the inflation rates in percentage for each country along with the number of deaths and population. The inflation rate is quite similar in both countries Afghanistan and Nepal. Pakistan stands 3rd in this category but Bhutan has an approximately close inflation rate.

2.2. Risk performance analysis within country

Focusing on Pakistan, the risk performance of the country during COVID 19 was satisfactory. But every time miracles did not

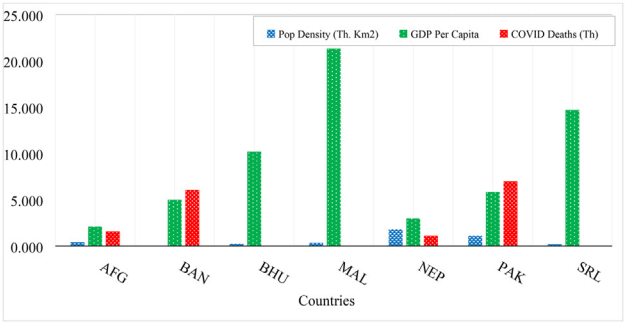


Fig. 3. Comparative assessment of GDP per capita with COVID deaths.

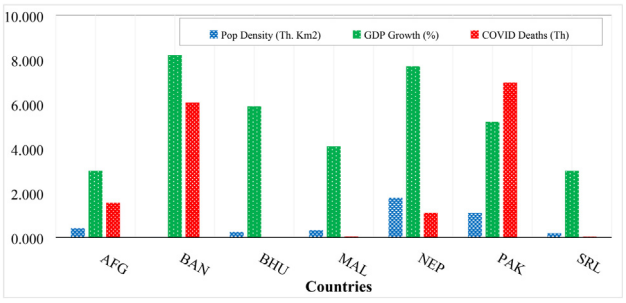


Fig. 4. Comparative assessment of GDP growth with COVID deaths.

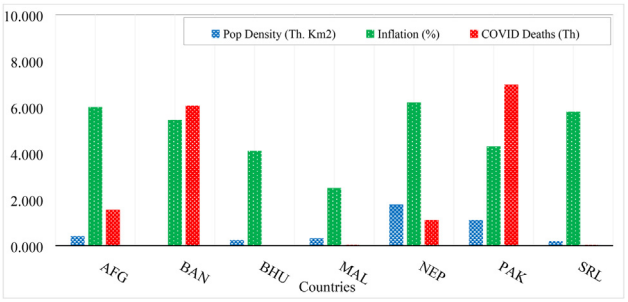


Fig. 5. Comparative assessment of inflation with COVID deaths.

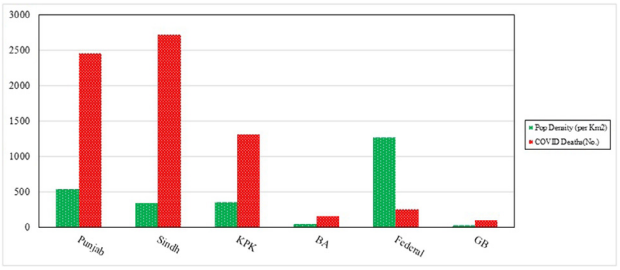


Fig. 7. Comparative assessment of population density with COVID deaths.

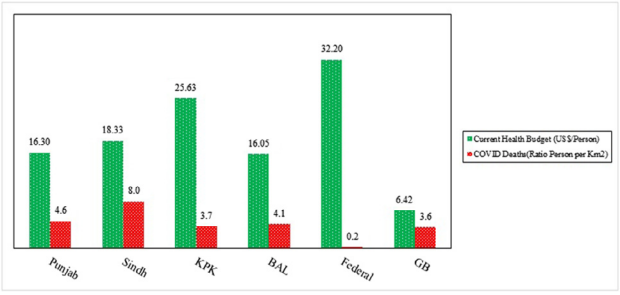


Fig. 8. Comparative assessment of health budget with regional COVID deaths.

happened, and a country must learn from the world-changing parameters and should develop its disaster management policy to counter such epidemic situations. Fig. 6 shows the updated data showing fatalities during COVID 19 in Pakistan.

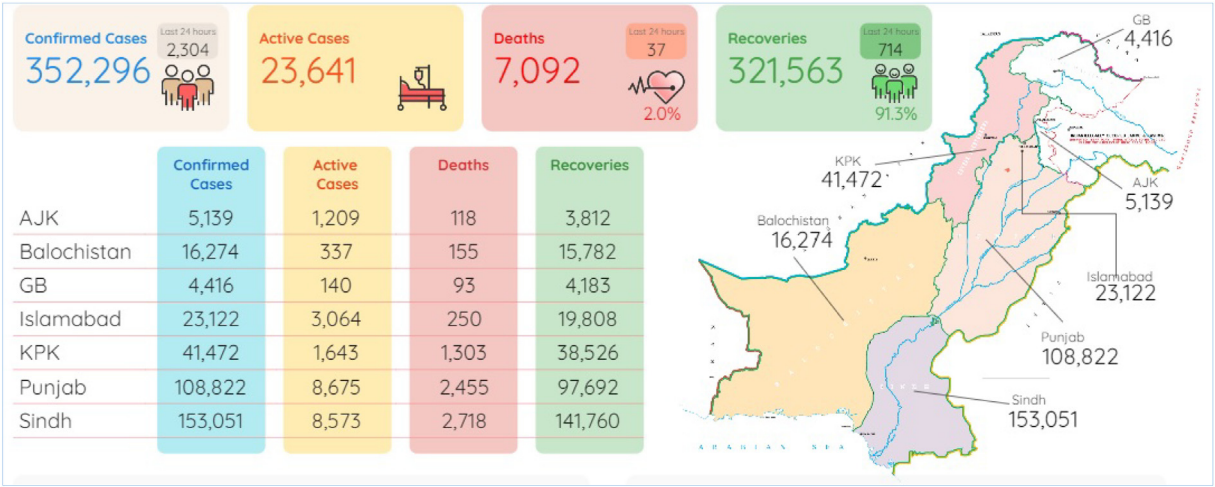
Further, we can analyze, the fatalities concerning the population density because the spread of coronavirus is related to human contact and the density of area also differs there, we can see that according to Fig. 7 that density is not having an impact on that. It also shows that research must be geographically focused. Sometimes patients visiting a certain area are infected and have that coronavirus infection from abroad. Thus, patients from a certain area can help to produce a map consisting of certain clusters of data points.

Financial spending is also a major factor to be evaluated for the seriousness of problem-solving policy. Fig. 8 provides information about the health budget (USD/Person) of Pakistan in each province. It gives figures about the health budget which clearly shows the federal area has the highest budget spending on health, however Punjab which the most populated province needs a higher level of budget for health issues. Gilgit Baltistan is an exceptional condition region because it is directly attached to the China border. From the low budget policy, it can be analyzed that ana emergency disaster management platform is required to deal with such type of health level emergencies. Hence, there is a need for large numbers of health workers for health challenges. Baluchistan province has the least health budget it has the least population.

3. Results and discussion

3.1. Risk evaluation and assessment

Pakistan is sharing borders with China and Iran and Pakistan has a high rate of trade and travel with both countries. The first case was officially reported in Wuhan, China. Hence, there is a high spread risk of COVID-19 in Pakistan (Wang et al., 2020). The first case of COVID-19 was reported on 26 February in Pakistan. By 13 November 2020, nearly 352,296 confirmed cases, and 7092 deaths had been officially reported. The COVID-19 has circulated all across Pakistan whereas; Sindh and Punjab provinces are highly affected. After that, the government of Pakistan takes responsive actions against COVID-19 with mutual corporations of local and federal governments by improving coordination, preparedness, awareness campaigns, and disease management (Tribune, 2020). To control the spread of disease, the government of Pakistan has created a preparedness and response plan (PPRP) to respond to pandemics with the help of international financial assistance (Ministry of National Health Services, 2020). It is established in keeping the Pakistan National Action Plan. The plan has estimated the required amount of $595 million from April to December month to prevent COVID-10 spread in Pakistan. Disaster can occur due to manmade or natural way. The occurrence of disaster can be minimized by taking preventive measures. However, sometimes it happens sud-



	Confirmed Cases	Active Cases	Deaths	Recoveries
AJK	5,139	1,209	118	3,812
Balochistan	16,274	337	155	15,782
GB	4,416	140	93	4,183
Islamabad	23,122	3,064	250	19,808
KPK	41,472	1,643	1,303	38,526
Punjab	108,822	8,675	2,455	97,692
Sindh	153,051	8,573	2,718	141,760

Fig. 6. COVID 19 fatality data for Pakistan (Up to Nov 13, 2020) (Ministry of National Health Services, 2020).

denly causing serious disruption at a massive scale, so it is difficult to handle at that time. Disaster can happen by accident that always results in serious consequences such as collateral damage, property, economic crisis, environmental impacts, etc (Perlman and Netland, 2009). Disasters pose serious economic or environmental impacts that surpass the capacity of the affected country or society to compete with the use of their assets. In this current scenario, provincial and local governments can play a vital role in dealing with current health disaster. Hence, more efforts are required to mitigate the impact of disaster using training and awareness of disaster preparedness.

3.2. Risk management-response

3.2.1. Immediate response from administration

It seems to have a contagious impact on the economy of Pakistan. There are also strong signs of the economic downturn as most workers start to fall ill; factories stop their working and quality of health systems are badly fractured due to the highest number of cases. The country of above 200 million is still experiencing macroeconomic stabilization, and most of the population are ranks below the average human growth of the world (Pakistan Today, 2020). It is difficult to distinguish the spread of infectious disease within and into Pakistan on a global scale. According to statistics, approximately 4.2 billion populations of the world are live in urban areas that already surpassed the rural population of the world. A survey reported that 40% of the population of Pakistan is lives in cities (Ahsan Nawaz, Su, Din, et al., 2020). Based on statistics nearly 7 million population are using airline services in the country. Whereas nearly seven million people use air transport in the country. Research on the COVID-19 outbreak shows that it had already exceeded the mortality rate from the past disease of Ebola, MERS, and SARS (Perlman and Netland, 2009). According to the initial survey report of COVID 19, it estimated a loss of 360 billion dollars. On the other hand, past epidemic SARS estimated nearly $50 billion (PBOS, 2017). In the past, Pakistan had faced many healthcare problems of localized diseases such as dengue fever, measles, and hepatitis C (Ahsan Nawaz, Su, Barkat, et al., 2020). Researchers have predicted that a global full-blown epidemic will boost the serious consequences of economic crisis.

3.2.2. Immediate response from heath sector

Epidemics reveal vulnerabilities and flaws involving in the healthcare sector. This could be associated with earlier disease identification, quality of healthcare system, contact tracing, lockdown or social distance policies, and disaster management techniques. In a resource-limited setup, all of these problems are especially prominent. The government of Pakistan is spending 2% of its GDP on the healthcare system as compared with a world average of 10% (Saqlain et al., 2020). It also rates even worse in contexts of health-related measures than its neighbor's countries like Iran and India. In 2016, the latest reports of the World Bank show that Pakistan spent nearly $40 per person in the healthcare sector (Maliszewska et al., 2020). In comparison, India was spending $62 per person while Iran spending $415 in the healthcare sector (Ahsan Nawaz, Su, Barkat, et al., 2020). Iran is facing an economic crisis like Pakistan despite this they were spending more than Pakistan on healthcare sectors that indicate why Pakistan officials or policymakers are especially worried (Wu et al., 2020).

3.3. Risk management-recovery

3.3.1. Using technology to create awareness

Currently, Pakistan is using a social media platform to educate people and to raise awareness among them. The government is working with the telecommunication industry to promote awareness to mobile users about the risks of Covid-19 (University, 2020). The Government of Pakistan has recommended that stay at home, avoid gathering, and maintain social distance to reduce the transmission of COVID-19 (Sheikh et al., 2012). The GOP also recommends that wash their hands with soap or sanitizer and wear facemask at a public place (Hao, Mehmood, et al., 2020). Officials are using mobile tracking services to contact victims of confirmed cases.

3.3.2. Managing with resistance

The government of Pakistan is actively working to reduce the impact of COVID-19, as there is no vaccine available for the treatment of coronavirus patients (WHO, 2020). Hence, resistance has been taken by governments or enforcement forces to endorse preventive measures to treat this disease. Pakistan's governments follow a social distance approach to minimize the chances of coronavirus by infected people. As a result, a large number of educational institutes, offices, and restrictions of gathering have been closed and people are enforced to follow SOPs or guidelines by police (Samaa Tv, 2020).

3.4. Risk management-mitigation

Mitigation actions are involving lessening the risk of human life or property through preventive measures. These steps can be taken before or during disaster occurrence and vary with the types of disasters. For example, preventive measures include structural changes in seismic areas such as the installation of an earthquake valve to block the supply of gas and the implementation of seismic design codes(Dar et al., 2019, 2020; Huo et al., 2020). In 2010, when floods occurred the government of Punjab established 22 villages as a resilient model against disaster. There is no meditation is recommended by the National Institute of Health (NIH) for the treatment of COVID-19. The flattening of the curve as shown in Fig. 9 will help to provide effective healthcare services in dealing with numbers of affected cases.

Similarly, a rising line of health care capacity will help to fulfill the increased demand in terms of the number of beds, staff, and equipment, etc. Pro-active steps of mitigation help to reduce the number of cases if these are taken before time. In the case of COVID-19, the government of Pakistan is taking preventive measures on a large scale. The government of Pakistan is strictly enforced peoples to follow the guidelines of the World Health Organization (WHO) to prevent COVID-19 pandemics (WHO, 2020).

- Wash hands for at least 20 sec with soap and water.
- Do not touch eyes, nose, or mouth with unwashed hands.
- Before coughing or sneezing, cover the mouth with tissue paper and dispose of it immediately.
- Wear a facemask in public places.
- Do not share foods or any gadgets like mobile phones, utensils, etc.

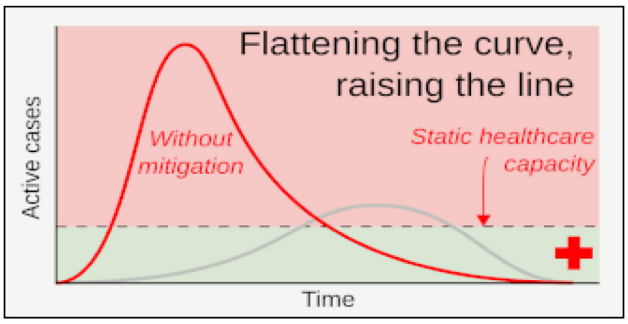


Fig. 9. Active cases vs time curve- mitigation (Barclay, 2020).

- Avoid contact with ill people.
- Maintain social distancing
- Seek medical care regularly.

3.5. Risk management-preparedness

Preparedness involves the preparation of equipment and procedures used in the case of a disaster. The preparations of equipment help to lessen the impact of the disaster in an effective way (Ali and Kandhro, 2015). The government of Pakistan as well as the private hospitals have very few ventilators. These are too less in quantity to deal with COVID-19 diseases if the number of cases significantly increased in Pakistan. Hospital capacity is also a key element in control measures of any country or community (Ahsan Nawaz, Su, Iqbal, et al., 2020). Generally, two aspects are mainly essential i.e., the number of beds and ventilation. In this scenario, there is a huge stress on the health system of Pakistan as statistics are very poor. According to the official source, there are only 1650 ventilators working in Pakistan (Hao, Mehmood, et al., 2020). The need for ventilators puts an extra burden on the government's budgets even other developing countries are also facing similar challenges like Iran or Italy. Considering this fact, there is a need to take serious steps regarding the purchase of ventilators in case of emergencies. The officials said that Pakistan has been purchasing 10,000 ventilators in the coming months (Dawn News, 2020). The government of Pakistan is spending the least percentage of its GDP on its health system due having economic constraints.

4. Conclusions

Ongoing COVID 19 highlights the gaps in poverty, health care, and sustainable social protection and governance policies of past governments. Although it is difficult to foresee what will bring when the next massive outbreak comes, and which major steps are required for preventing timely against such an outbreak. Although it is difficult to foresee what will cause the next big outbreak and when early action will help to prepare authorities to effectively deal with it. Any activity, which prevents the current outbreak, needs to address possible risks. In this current crisis, Pakistan is facing serious challenges of economic loss. Results show Pakistan has been facing a highly vulnerable situation and had poor resistance against COVID-19 as Pakistan has the most declined GDP rate of −1.5 in the world. The government of Pakistan is spending the least percentage of its GDP on its health system. However, it found that preventive measures taken by mutual corporations of the local and federal government could be sufficient to minimize the risk of human life and economic hardships. The plan has estimated the required amount of $595 million from April to December month to prevent COVID-19 spread in Pakistan. Data collected through satellite sources play an essential role in disaster preparedness and strategic planning. The availability of data does not rely solely on technical requirements, which are influence by various factors for example distribution of data, exchange of data, and capacity development. Such skills are generally required to cope with disaster management. Therefore, individuals have to develop these skills to deal with disaster management. For this purpose, steps are being made to introduce new resources for the collection of data effectively and maximum utilization of data from source to users. A result of COVID-19 will overwhelm the healthcare system of the country, which has a negative economic effect, and the following recommendations will help for disaster preparedness in the future.

- To avoid the spread of COVID-19, there is a need for a quick response by the government to take immediate action on preventive measures. Because there are no vaccines available, till to date. Hence, this is the only effective way to reduce the impact of the disaster. Information and awareness play a key role in this situation, which helps to prevent the spread of infectious diseases. The government of Pakistan and all stakeholders must apply rigorous steps to control the transmission of infectious diseases.
- Transport is one of the leading reasons for disease transmission. Enforce restrictions on the roadway to reduce the frequency of travel such as train or public transport etc. Self-quarantine and isolation at home help to reduce the extra burden on the healthcare system if the number of affected cases increased. In this Panic situation, the government needs to strengthen the international frame for managing, planning, and assisting.
- The government has to take four steps as soon as possible. The first one is a nationwide shutdown to eliminate unwanted contact in society. Secondly, improving research and increased medical capability on an urgent basis. Thirdly, buildings must re-constructed with better health facilities in isolation units, medical personnel, and quarantine centers. Fourthly, taking steps to ensure a stable and sustainable supply of food, medication, and logistics support.
- By taking preventive measures including social distancing to reduce the impact of the disaster and flatten the curve with an enhancement of medical capacity. For example, the more cases we delay, this will lead to a decrease in the extra burden on healthcare and improves its performance with a risk reduction. In the past, social distancing was an effective strategy for preventing the spread. For example, the Spanish flu pandemic in 1918 (Wang et al., 2020).
- To avoid transmission of the virus, more research on diagnostic testing, vaccinations, and treatments of ongoing pandemics will boost health outcomes more effectively.

The current COVID-19 is a test case for Pakistan and other countries. Hence, seeking guidance and taking action to improve preparedness will help to prevent such infectious diseases in the future. In the future, smarter use of technologies such as artificial intelligence can be used for disease prediction and modeling. There is a need to increase the health funds on a priority basis for preparedness, continuous monitoring, and research work to control the spread of infectious disease.

5. Limitations of the study

This study has been conducted as per the perspective of disaster management framework considering data based on cases reported up to November 13, 2020, which shows that the major issue that has been highlighted is the unavailability of disease detection infrastructure but the implication of COVID-19 will appear later on overall development policy and financial management due to instability of economic infrastructure. So time to time monitoring will be required to evaluate the actual picture of disaster risk management targets and planning scenario to counter this state of emergency.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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References

Ali, R., Kandhro, S.H., 2015. National disaster management authority in Pakistan: role of Pakistan army in disaster management. J. Social Admin. Sci. 2 (1), 11–17.

Asgary, A., Anjum, M.I., Azimi, N., 2012. Disaster recovery and business continuity after the 2010 flood in Pakistan: case of small businesses. Int. J. Disaster Risk Reduct. 2, 46–56. https://doi.org/10.1016/j.ijdrr.2012.08.001.

Bakir, C., 2020. The Turkish state's responses to existential COVID-19 crisis. Policy Soc. 39 (3), 424–441. https://doi.org/10.1080/14494035.2020.1783786.

Barclay, E., 2020. The US doesn't just need to flatten the curve. It needs to raise the line. https://www.vox.com/2020/4/7/21201260/coronavirus-usa-chart-mask-shortage-ventilators-flatten-the-curve

Buttenheim, A., 2010. Impact evaluation in the post-disaster setting: a case study of the 2005 Pakistan earthquake. J. Dev. Effect. 2 (2), 197–227.

Dar, A.A., Chen, J., Shad, A., Pan, X., Yao, J., Bin-Jumah, M., Allam, A.A., Huo, Z., Zhu, F., Wang, Z., 2020. A combined experimental and computational study on the oxidative degradation of bromophenols by Fe (VI) and the formation of self-coupling products. Environ. Pollut. 258, 113678. https://doi.org/10.1016/j.envpol.2019.113678.

Dar, A.A., Wang, X., Wang, S., Ge, J., Shad, A., Ai, F., Wang, Z., 2019. Ozonation of pentabromophenol in aqueous basic medium: kinetics, pathways, mechanism, dimerization and toxicity assessment. Chemosphere 220, 546–555.

Dawn News, 2020. Government urges calm as coronavirus cases in Pakistan rise to 4. www.dawn.com

Deen, S., 2015. Pakistan 2010 floods. Policy gaps in disaster preparedness and response. Int. J. Disaster Risk Reduct. 12, 341–349. https://doi.org/10.1016/j.ijdrr.2015.03.007.

Dzigbede, K., Gehl, S.B., Willoughby, K., 2020. Disaster resiliency of US local governments: insights to strengthen local response and recovery from the COVID-19 pandemic. Public Admin. Rev.

Hao, W., Mehmood, S., Shah, A., Nawaz, A., Qasim, M., Souhail, A., 2020. COVID-19 epidemic spread and the impact on public health & safety policy : an analysis of the adoption of preventive measures and effective management : evidence from Pakistan. Revista Argentina de Clínica Psicológica, XXIX, 722–736. https://doi.org/10.24205/03276716.2020.877.

Hao, W.u., Shah, S.M.A., Nawaz, A., Asad, A., Iqbal, S., Zahoor, H., Maqsoom, A., Khater, M.A.M., 2020. The impact of energy cooperation and the role of the one belt and road initiative in revolutionizing the geopolitics of energy among regional economic powers: an analysis of infrastructure development and project management. Complexity 2020, 1–16. https://doi.org/10.1155/2020/8820021.

Huo, C., Ahmed Dar, A., Nawaz, A., Hameed, J., albashar, G., Pan, B., Wang, C., 2020. Groundwater contamination with the threat of COVID-19: insights into CSR theory of Carroll's pyramid. J. King Saud Univ. – Sci. 33 (2), 101295. https://doi.org/10.1016/j.jksus.2020.101295.

Lettieri, E., Masella, C., Radaelli, G., 2009. Disaster management: findings from a systematic review. Disaster Prev. Manage. Int. J.

Mahmood, K., Ahmad, N., Khan, U., Iqbal, Q., 2020. Seismic hazard maps of Peshawar District for various return periods. Nat. Hazards Earth Syst. Sci. 20 (6), 1639–1661.

Maliszewska, M., Mattoo, A., Van Der Mensbrugghe, D., 2020. The Potential Impact of COVID-19 on GDP and Trade: A Preliminary Assessment. The World Bank.

Ministry of National Health Services, 2020. National Action Plan for Preparedness & Response to Corona virus disease (Covid-19). https//www.nih.org.pk

Nawaz, A., Waqar, A., Shah, S., Sajid, M., Khalid, M., 2019. An innovative framework for risk management in construction projects in developing countries: evidence from Pakistan. Risks 7 (1), 24. https://doi.org/10.3390/risks7010024.

Nawaz, A., Su, X., Barkat, M.Q., Asghar, S., Asad, A., Basit, F., Iqbal, S., Zahoor, H., Raheel Shah, S.A., 2020. Epidemic spread and its management through governance and leadership response influencing the arising challenges around COVID-19 in Pakistan—a lesson learnt for low income countries with limited resource. Front. Public Health 8, 817. https://doi.org/10.3389/fpubh.2020.573431.

Nawaz, A., Su, X., Din, Q.M.U., Khalid, M.I., Bilal, M., Shah, S.A.R., 2020. Identification of the H&S (Health and Safety Factors) involved in infrastructure projects in developing countries-a sequential mixed method approach of OLMT-project. Int. J. Environ. Res. Public Health 17 (2), 635.

Nawaz, A., Su, X., Iqbal, S., Zahoor, H., Asad, A., Asghar, S., Basit, F., Barkat, M.Q., Souhail, A., Raheel Shah, S.A., Khater, M.M.A., 2020. Validating a phenomenological mathematical model for public health and safety interventions influencing the evolutionary stages of recent outbreak for long-term and short-term domains in Pakistan. Complexity 2020, 1–9. https://doi.org/10.1155/2020/8866071.

Niekerk, D. van., 2016. Local government disaster risk management. https://www.researchgate.net/publication/265216734_Local_Government_Disaster_Risk_Management

Pakistan Today, 2020. Two coronavirus cases confirmed in Pakistan. www.pakistantoday.com.pk

PBOS, 2017. Paksitan Bureau of Statistics. 2017. http://www.pbs.gov.pk/content/population-census

Perlman, S., Netland, J., 2009. Coronaviruses post-SARS: update on replication and pathogenesis. Nat. Rev. Microbiol. 7 (6), 439–450.

Perry, M., 2007. Natural disaster management planning. Int. J. Phys. Distrib. Logist. Manag. 37 (5), 409–433.

Samaa Tv., 2020. Number of Coronavirus Cases in Pakistan jumps to 28. www.samaa.tv

Saqlain, M., Munir, M.M., Ahmed, A., Tahir, A.H., Kamran, S., 2020. Is Pakistan prepared to tackle the coronavirus epidemic?. Drugs Therapy Perspect. 36 (5), 213–214.

Sattar, M.F., Khanum, S., Nawaz, A., Ashfaq, M.M., Khan, M.A., Jawad, M., Ullah, W., 2020. Covid-19 global, pandemic impact on world economy. Tech. Social Sci. J. 11, 165–179.

Shabbir, R., Ahmad, S.S., 2016. Water resource vulnerability assessment in Rawalpindi and Islamabad, Pakistan using Analytic Hierarchy Process (AHP). J. King Saud Univ. – Sci. 28 (4), 293–299. https://doi.org/10.1016/j.jksus.2015.09.007.

Sharma, H.B., Vanapalli, K.R., Cheela, V.R.S., Ranjan, V.P., Jaglan, A.K., Dubey, B., Goel, S., Bhattacharya, J., 2020. Challenges, opportunities, and innovations for effective solid waste management during and post COVID-19 pandemic. Resour. Conserv. Recycl. 162, 105052.

Sheikh, A., Saeed, Z., Jafri, S.A.D., Yazdani, I., Hussain, S.A., 2012. Vitamin D levels in asymptomatic adults-a population survey in Karachi, Pakistan. PloS One 7 (3), e33452.

Tribune, T.E., 2020. Nine new coronavirus cases emerge in Karachi as Pakistan's tally jumps to 16. tribune.com.pk

University, T.A.K., 2020. Seroprevalence study sheds light on Pakistan's pandemic. https://www.aku.edu/news/Pages/News_Details.aspx?nid=NEWS-002322

Wang, C.J., Ng, C.Y., Brook, R.H., 2020. Response to COVID-19 in Taiwan: big data analytics, new technology, and proactive testing. JAMA 323 (14), 1341–1342.

WHO, 2020. Corona Virus Disease (COVID-19) Pandemic, 2020. https://www.who.int/emergencies/diseases/novel-coronavirus-2019

Wu, H., Shah, S.M.A., Nawaz, A., Mahmood, A., Albashar, G., Shah, S.A.R., Syed, T.A., Abrar, M., Asghar, S., Basit, F., 2020. Disaster management policy development and engineering economics: an analysis of game-changing impact of COVID 19 on oil-power industry, environment, and economy. Revista Argentina de Clínica Psicológica 29 (5), 550.

Yıldırım, M., Güler, A., 2020. COVID-19 severity, self-efficacy, knowledge, preventive behaviors, and mental health in Turkey. Death Stud., 1–8