Shaping Urban Resilience in the Wake of COVID-19

By

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DEDICATION

This research is dedicated to my esteemed parents, whose steadfast faith in the power of education enabled me to achieve this great milestone. Their constant love and support have given me the courage and resolve to overcome every obstacle in my path.

I dedicate this to my beloved siblings, whose ongoing counsel and encouragement have been important in defining my journey. Their presence in my life has been an inspiration, inspiring me to achieve success in all parts of life.

I'd also want to thank my Thesis Supervisor, Dr. Abdul Waheed, whose experience, guidance, and steadfast support have been vital throughout this research project. This accomplishment would not have been possible without their intelligent guidance and mentorship.

Finally, I dedicate my work to Allah's almighty bounties for bestowed upon me excellent health and the opportunity to reach such big life milestones. I am grateful for the courage and perseverance that have enabled me to overcome hurdles and reach new heights.

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Signature of Student

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ABSTRACT

This study highlights how the Covid-19 pandemic exposed vulnerabilities in urban systems, necessitating the adoption of resilience measures to mitigate socio-economic disruptions and enhance the cities' ability to withstand future shocks. This study aims to evaluate the socio-economic impacts of Covid-19 on two cities by fostering a composite index for urban resilience and socio-economic indicators. This study contains four sub-indices for economic, social, environment and utility aspects. For this purpose, separate sub-indices are being planned for economic, social, environment and utility dimensions and these sub-indices are built to figure out a composite list for measuring the impacts of Covid-19. In addition, this study utilizes a broad data to appraise the condition of the twin cities from 2020 to onward in Pakistan. A sample size of 349 people was selected and it includes 79 people from unplanned area and 270 people in unplanned areas of Islamabad and Rawalpindi. This study has utilized the index-construction methodology and then the min-max method is being used for normalizing the data. Afterwards, the selected variables are weighted by the application of principal component analysis. Lastly, all the weighted factors are collected to shape up the required indices. In addition, selected areas were positioned in light of their score got in every one of the four dimensions as well as for the composite index. The findings are the rate of Coronavirus cases in the area appears to be higher in unplanned areas with a low rate of Coronavirus cases, while planned areas with a high rate of Coronavirus cases had the lowest number of cases. There are mixed outcomes for social maintainability. This study suggests enhancements in economic as well as social aspects of Covid-19 while keeping up with the urban resilience standards.

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CHAPTER 1

INTRODUCTION

1.1. Background

Resilience refers to the capacity of a system to effectively absorb shocks. Pandemics, along with other sudden economic, social, and environmental threats, can shape the resilience of populations. The analysis delves into the specific challenges posed by COVID-19, which stands out from other health risks. It explores the problems arising from pandemic-control measures and recommends strategies for communities to enhance their preparedness, response, and recovery from pandemics and other disruptive events (Litman, 2020). Pandemics serve as critical triggers for the global planning of resilient cities and regions, highlighting both vulnerabilities and resilience at various scales, from individual buildings to entire regions. The intersection between the ongoing coronavirus pandemic and climate change prompts a comprehensive examination of the urban system's response. This examination encompasses factors such as the importance of place, cyberspace, population density, access, and the broader urban region. It draws upon historical assessments and synthesizes enduring concepts in urbanism theory and practice. The use of pandemics as agents of change and the strategic utilization of comprehensive planning and regulatory zoning codes are explored as tools to effectively reconfigure future resilient urban structures (Syal, 2021). In preventing, identifying, responding to, and recovering from epidemics' impacts, communities assume a central role. They are not passive recipients of interventions, but active participants in addressing the physical, psychological, social, and economic challenges posed by epidemics.

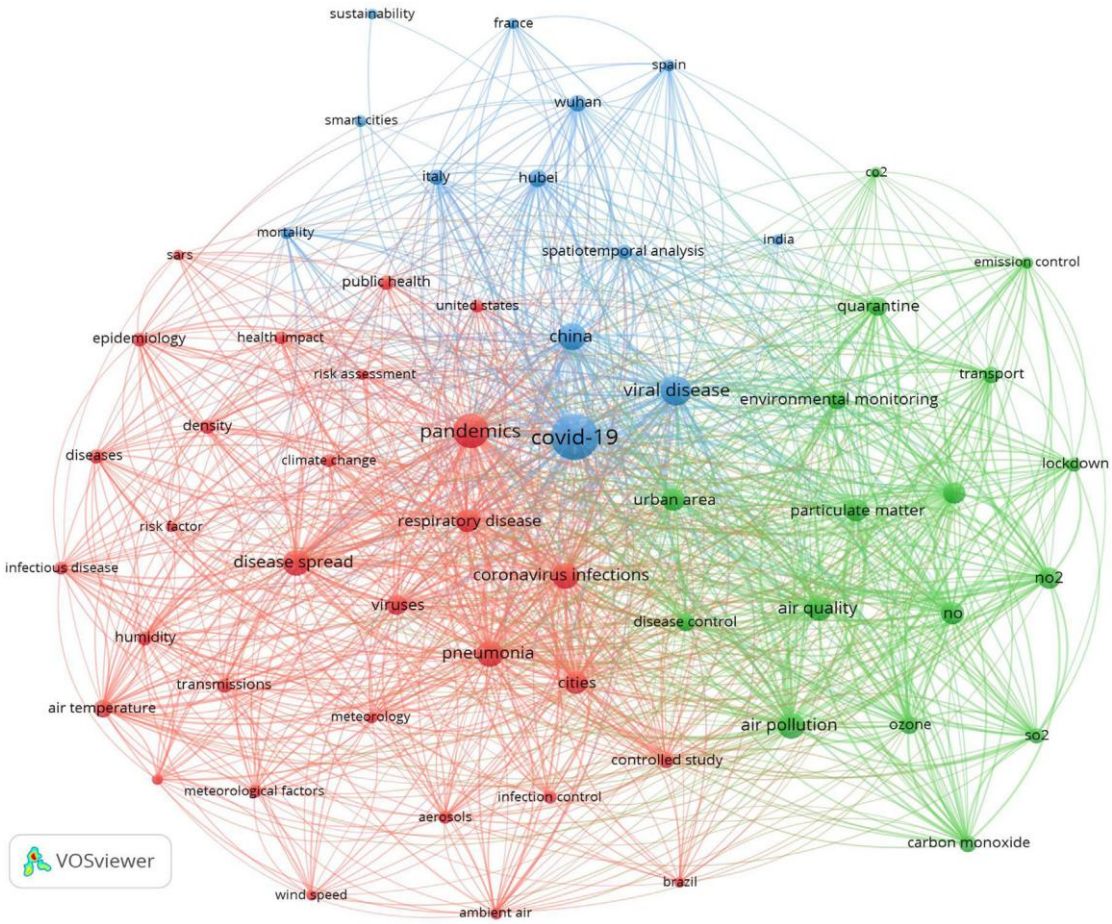


Figure 1 Co-Occurrence Map

Throughout history, pandemics have always influenced the development of cities, with architecture and urban design reflecting the health challenges faced. Presently, the world is grappling with the COVID-19 pandemic, perhaps the most severe in over a century, which has brought forth a range of new issues for cities to address. However, what will transpire after the pandemic? Will the global epidemic reshape cities and urban regions? The increasing number of Coronavirus infections and deaths may necessitate a reevaluation of conventional city-planning approaches (Eltarabily & Elghaznawi, 2020). The concept of health-led temporary urbanism

emphasizes the need for interdisciplinary discussions, fostering a stronger connection between urban planning, development, and public health. (Andres, Bryson, & Paul, 2021).

The ongoing COVID-19 pandemic, like previous ones, compels us to reevaluate the nature of urban spaces and presents an opportunity to foster more secure and sustainable settlements (Martinez & Short, 2021). The outbreak of the global pandemic has resulted in significant transformations across various aspects of urban life. Measures such as lockdowns, social distancing, travel restrictions, and the closure of schools and public institutions have led to a decrease in street activity, reduced use of public transportation, and limitations on interpersonal interactions in public spaces. These circumstances have posed challenges to conventional urban planning principles, including the emphasis on high building density, the promotion of public transportation, and the importance of direct human contact

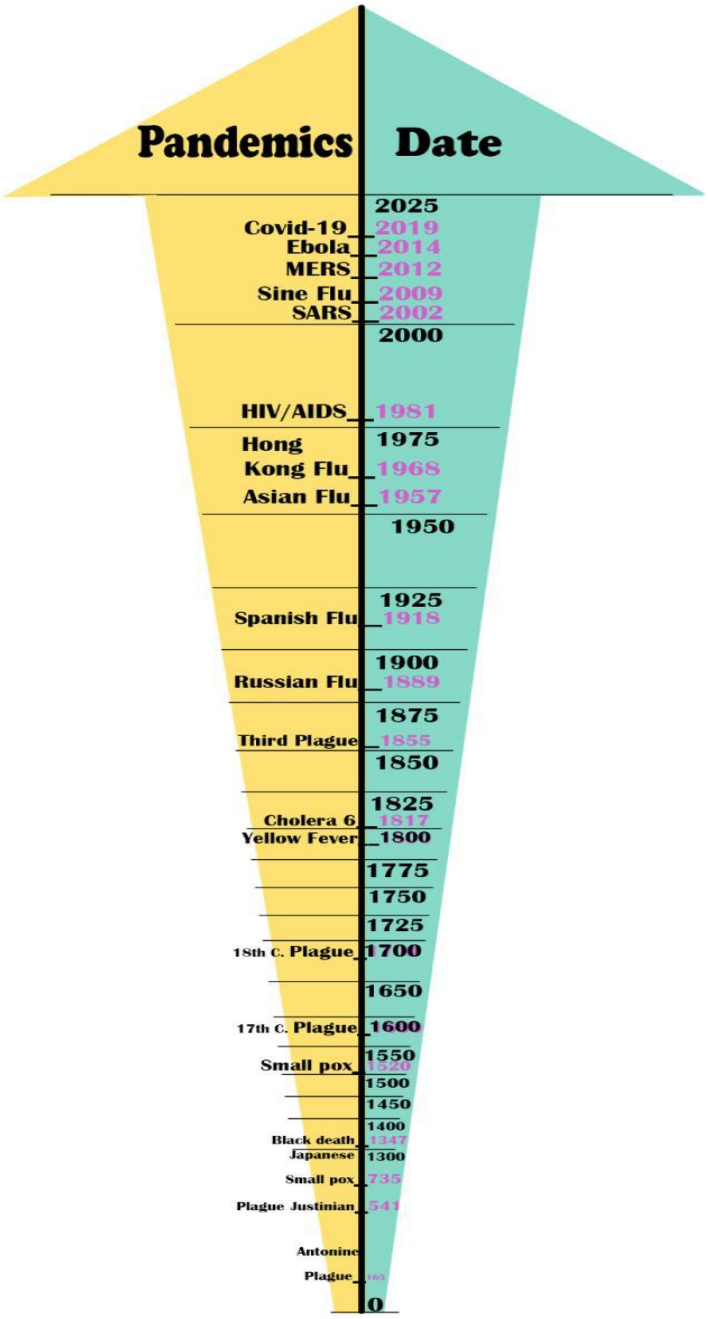


Figure 2 History of deadliest Pandemics

in public spaces for ensuring safety. (Artur & Jaisinski, 2021).

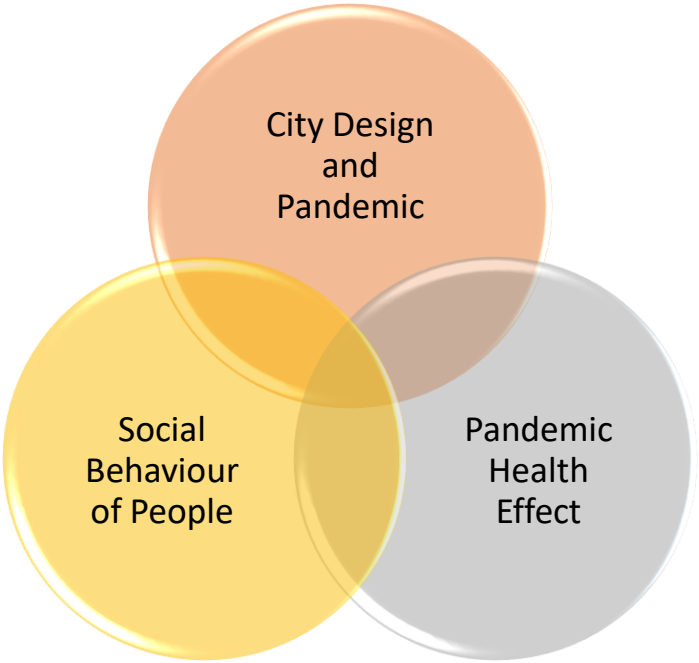


Figure 3 Integration of Health, and Social Effects in the City

1.2. Problem Statement

The COVID-19 pandemic is not the first global health crisis; previous pandemics have affected the world and resulted in the loss of millions of lives. These outbreaks have not only impacted public health but also had repercussions on the urban environment and economy. Pandemics represent a worst-case scenario, where infections spread across borders. To adapt to this reality, it is essential to integrate community health practices and social considerations into urban planning, leading to a transformation in the structure of cities. The current COVID-19 pandemic presents an opportunity to optimize cities by incorporating health-focused planning and design that takes into account social behaviors during pandemics.

Household isolation leads to a focus on home design quality to improve overall house performance. Designers should return to nature when remodeling their homes or applying biophilic design techniques. Natural features may be a beneficial method to alleviate isolation stress and other psychological consequences, which is consistent with a recent study that suggested building rooftops in unexplored areas. Furthermore, retaining the veranda as an outside place offers numerous advantages, including connecting with nature, providing an urban and green view, and providing a social link between neighbors. In this research, we will focus on the issues that are faced by Pakistan because of Covid-19 and its impacts on urban planning and

design. We will propose policies and procedures to help build sustainable and pandemic-resilient communities.

1.3. Research Objectives

The precise objectives are;

- Identify the influence of COVID-19 on urban development activities.
- To identify priorities for planning urban settlements after pandemics.
- To propose a new resilient urban planning approach in Post COVID-19 Scenario.

1.4. Questions about Research

There is list of research questions showing below;

i. How many urban issues in COVID-19?
ii. What is the crisis in twin cities due to COVID-19?
iii. What are the priorities for planning urban settlements after pandemics?
iv. What is the role of COVID-19 for developing resiliency in approach of urban planning?

1.5. Study Area

Research regarding pandemics and their impacts on urban planning is carried out on an international level. We can find no such research in Europe and other developed countries. There exists a lack of this research in case of Pakistan. The researcher decided to research this topic on the national level. It will not only help students and researchers. It will help urban planners and other professionals working in the planning, development, and construction sectors. This research can serve as a user manual for them to design pandemic-resilient designs.

1.6. Scope and Limitations

Covid-19 affects every country present on the globe it took millions of precious lives. It has changed the living style of people. It has also impacted planning and design standards that were opted for before Covid-19. If we talk about Covid-19's impacts on Pakistan it took 30,383 live and almost 1.53 million people were infected. (Pakistan, 2022) The sole purpose of this study is to

formulate policies and guidelines for pandemic-resilient communities while keeping in view the influence of this pandemic on a national as well as individual level. This study is going to see the effect of this pandemic on urban as well as rural communities, following are some major advantages of this research:

- We can educate our communities that how they should respond to COVID-19.
- Because of this, we can prepare and formulate new procedures, policies, and principles that can help the public and private sectors deal with such disasters.
- This type of research leads us toward sustainability. The world is working on smart growth and controlled and sustainable development, but Pakistan is lagging far behind.
- To conduct this research researcher faces several research barriers and limitations. Following are some limitations that come out in conducting the research are as follows:
- Relevant data regarding this research on a national level is not available. The available data is outdated.
- In Pakistan people are not well aware of the research. Sometimes they feel very reluctant in helping researchers. Surveys have faced several such issues in filling out questionnaires.
- Finding surveyors that will help researchers in conducting the survey is not easily available. Researchers have to teach and train them how to conduct surveys.
- Deciding the sample size for the survey is also a difficulty for the researcher.
- The collection of data took more time than the expected response time. Researchers rely on both online and manual data collection. It took more time than the expected schedule of data collection.

1.7. Thesis Structure

In this research, the researcher has tried his best to follow the international standards of research. Every chapter is written very precisely and comprehensively. The structure of the research is as follows,

1) First chapter will be the introduction to the research. In this chapter, the research will cover the introduction, project proposal, objectives of research, research problems, study area, and scope and limitations of the research.

2) 2nd chapter will be the literature review of the available relevant literature about the topic.
3) In 3rd chapter researcher discussed the methodology of the research. He has discussed how this research is conducted. What are the methods and procedures that were followed for conducting this research?
4) The 4th chapter is about data collection and data assessment.
5) In 5th chapter researcher analyzed the primary and secondary data.
6) 6th chapter covers the recommendations and conclusion of the research.

CHAPTER 2

REVIEW OF LITERATURE

The World Health Organization designated the COVID-19 outbreak as the sixth Public Health Emergency of International Concern on January 30, 2020. This was not the first instance of a coronavirus spreading, as previous outbreaks of the Severe Acute Respiratory Syndrome Coronavirus (SARS-CoV) and the Middle East Respiratory Syndrome Coronavirus (MERS-CoV) had occurred before. The COVID-19 outbreak had a significant impact on neighboring countries of Pakistan, with China being the first origin of the virus.

Given the ongoing increase in the number of COVID-19 cases, Pakistan's geographical location requires significant action, planning, and management. On February 12th, The document titled "National Action Plan for Preparedness & Response to Corona Virus Disease (Covid-19) Pakistan" was released by the Ministry of National Health Services, Regulation & Coordination Pakistan". Local, regional, and national outbreaks can have a substantial impact on the health and well-being of the Pakistani population. Pakistan's government has implemented several measures in response to the COVID-19 outbreak. These measures include the establishment of designated hospitals, quarantine centers, testing facilities, and treatment options. The government has also emphasized public awareness campaigns and highlighted the proactive response of local communities to the outbreak. Furthermore, the Government of Pakistan has set up a COVID-19 Relief Fund to collect donations for public welfare. Social network helplines have been launched in seven local languages by the government to provide assistance and support (Waris, 2020).

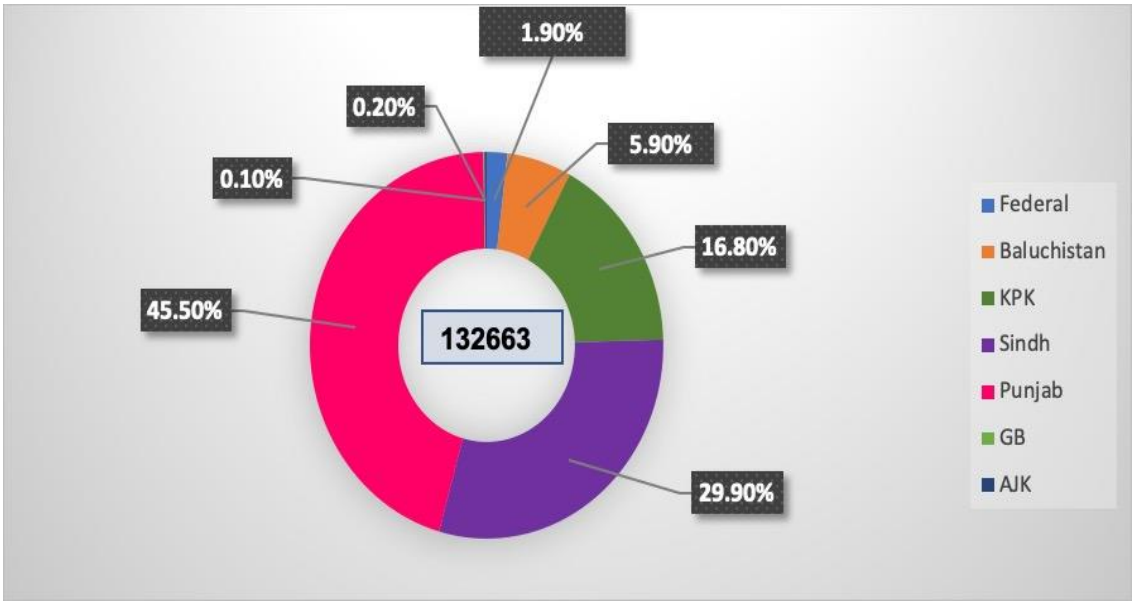


Figure 4 COVID-19 Pandemic in Pakistan

2.1 COVID-19 Impacts on the world economy

Covid-19 shook the world's biggest economies. The catastrophic disaster affects world economies differently. Following are some impacts of Covid-19 on world economies; (Dennis, 2020). Economies impact of Covid-19 includes:

- In May 2020, the Asian Development Bank released a statement estimating that the global economy could incur costs ranging from $5.8 trillion to $8.8 trillion due to the impact of COVID-19.

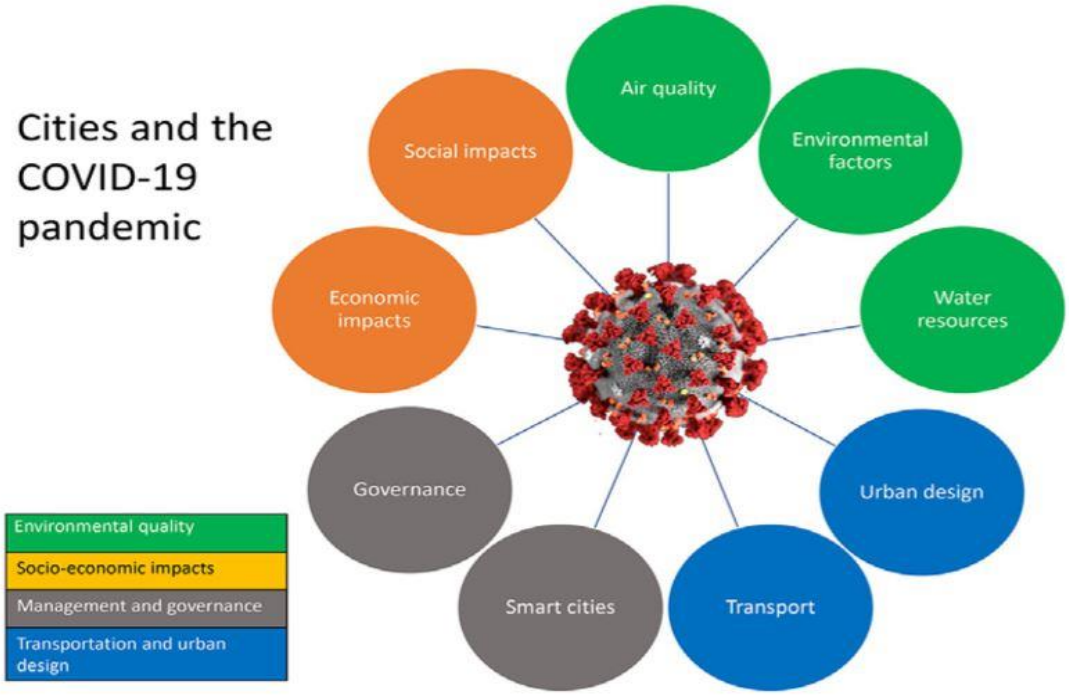


Figure 5 Cities and covid-19 Pandemic

- In April 2020, Christine Lagarde, President of the European Central Bank, expressed caution by stating that the Eurozone's economy could potentially contract by up to 12% in 2020. By August 2020, the European Union had witnessed a significant rise in unemployment, with 15 million individuals being unemployed, marking an increase of 700,000 since April 2020.
- the United States experienced a sharp decline in GDP during the first and second quarters of 2020. The GDP decreased at an annual rate of 48% in the first quarter and 32.9% in the second quarter. Additionally, consumer spending in the United States witnessed a

significant decrease of 10% in 2020 compared to the previous year, reflecting the impact of the COVID-19 pandemic on the economy (Bureau of Economic Analysis).

- Indeed, the United Kingdom's economy experienced a substantial contraction in the second quarter of 2020. The Office for National Statistics reported that the UK's GDP shrank by 20.4% during that period. This decline was primarily due to the impact of the COVID-19 pandemic and the subsequent lockdown measures implemented to control the spread of the virus.
- Australia, after nearly three decades of uninterrupted economic growth, entered into a recession in 2020. The country's economy contracted by 7% in the second quarter of the year. This decline was largely attributed to the COVID-19 pandemic and the subsequent restrictions and disruptions it caused to various sectors, including tourism, retail, and construction. The recession marked a significant turning point for Australia's economy after its prolonged period of growth.
- Japan's GDP experienced a substantial contraction in the second quarter of 2020. According to official data, the country's GDP shrank by 27.8% from April to June 2020. This marked the third consecutive quarterly decrease and the largest decline in postwar history for Japan. The significant downturn was primarily attributed to the impact of the COVID-19 pandemic, which resulted in decreased consumer spending, reduced exports, and disrupted supply chains. The decline in GDP reflected the challenges faced by Japan's economy during this period.
- South Korea officially entered into a recession in August 2020, the first in 17 years.
- According to projections, Latin American economies are expected to experience a decline of approximately 9.4% in 2020. This projection takes into account the impact of the COVID-19 pandemic, which has significantly affected the region's economies. The decline is primarily attributed to factors such as decreased consumer spending, reduced exports, disrupted supply chains, and the contraction of various sectors including tourism, manufacturing, and services. The projected decline reflects the challenges faced by Latin American countries in navigating the economic consequences of the pandemic.

2.1.1. Post-Pandemic Cities-Impact

Pandemics have always changed the lifestyles of people. People started adopting new strategies to cope with the pandemics and states adopted new policies to mitigate the impacts of the virus and slow down the spread of the virus. You are correct that past disease outbreaks have led to

significant improvements in public health and the establishment of various regulations and infrastructure to combat the spread of diseases. Zoning codes, health boards, sanitation regulations, and the development of modern infrastructure like sewer systems, water treatment facilities, hospitals, and clinics have all played crucial roles in creating healthier and safer urban environments. However, the COVID-19 pandemic has highlighted those cities, suburbs, and rural areas can still be vulnerable to airborne contagious diseases. Despite the advancements made in public health infrastructure, the highly contagious nature of COVID-19 has posed unique challenges. The virus spreads easily through respiratory droplets, making it difficult to contain in densely populated areas where people live and work in close proximity. The pandemic has emphasized the need for ongoing investments in public health infrastructure, improved disease surveillance, and effective response strategies. It has also highlighted the importance of personal hygiene practices, social distancing measures, and the use of face masks to limit the spread of airborne diseases in all types of communities. (Bereitschaft & Scheller, 2020). The following table depicts the cities and mitigation strategies they have implemented.

Table 1 Mitigation Strategies for Covid-19

Cities	Notable Mitigation Strategies
Auckland, New Zealand	• The central government's strategy includes t implementation of business closures and lockdowns as measures combat the COVID-19 outbreak.
Berlin, Germany	• A program for bikes that is subsidized
Chicago, USA	• Improved sanitation practices for public transportati vehicles
Guangzhou, China	• Passenger temperature checks and thermal imagi implemented. • Public transit systems have implemented a strategy organizing outdoor queues for passengers. • Lockdowns as part of central government strategies
Houston, USA	• The Slow Street program creates safer and more pedestria friendly neighborhoods by closing streets to through traff promoting walking, biking, and physical distancing.
Jakarta, Indonesia	• Affordable water containers and soap dispensers are bei distributed to improve access to hand hygiene facilities, promoti

	proper handwashing practices for disease prevention in resourc limited areas.
Kigali, Rwanda	• Sinks and hand washing stations at public locations.
Melbourne, Austral	• Allowing restaurants to expand seating areas into lanewa and sidewalks to reduce crowding of patrons. • Granting permits for restaurants to extend seating optio into laneways and sidewalks to promote social distancing amo customers
Milan, Italy	• Conversion of some streets into bicycle and pedestri paths.
New York City, US	• Enhanced sanitation of public transportation vehicl (electrostatic sprayers, • Research into antimicrobial materials and cleani strategies).
Oakland, USA	• Repurposing/closing streets into recreational areas (Slo Street program). • Making streets more pedestrian-friendly (Slow Stree Essential Places program).
Oslo, Norway	• Closing of schools and businesses as part of centr government strategy. • Restrictions on indoor recreation activities.
San Francisco, USA	• Slow Street program. • Shared Spaces program.
Seattle, USA	• Stay Healthy Streets program.
Seoul, South Korea	• Advanced contact tracing, surveillance, and notificati system. • National strategy. • Strict patient isolation as part of the national strategy.
Shenzhen, China	• Mobility restrictions. • Contact tracing and isolation.
Tokyo, Japan	• Increased teleworking. • Staggered work hours.

Recommendations for cities to successfully deal the COVID-19 and/or future risks include:

- Having public green spaces near residences is beneficial during lockdowns. This involves planning, promoting, funding, constructing, and maintaining parks and corridors for exercise and recreation. These spaces provide opportunities for physical activity, connection with nature, and overall well-being.
- During pandemics, expanding outdoor sidewalks and walk spaces near businesses and easing permitting processes can support de-densified business activities, particularly for restaurants. This allows businesses to utilize outdoor spaces for seating and operations, helping to maintain physical distancing and reduce indoor crowding. By facilitating the use of these spaces, businesses can adapt and continue operating while adhering to safety guidelines.
- Implementing increased and innovative public transportation sanitation practices is crucial for mitigating the spread of pandemic diseases and preventing the transmission of common viruses and bacteria. This includes enhanced cleaning protocols, hand hygiene facilities, improved ventilation, communication and education, and integrating technology for disinfection.

When designing strategic plans for future pandemics, key areas to prioritize include contact tracing, mitigation strategies, patient housing, resource allocation, information provision, and intergovernmental cooperation. This ensures an effective response, minimizes impact on public health and society.

Encouragingly, cities worldwide have taken proactive measures to mitigate the spread of the coronavirus, minimize economic and social hardships, and ensure public safety. These include implementing new regulations, and design changes to adapt to the challenges posed by the pandemic.

2.2. COVID-19 and shaping the urban resilience

In light of a pandemic, conventional land-use strategies in cities like Pakistan should be reevaluated, considering the impact on transportation and public health. Design aspects, such as wider sidewalks to facilitate social distancing, need to be considered. Higher densities can increase vulnerability and the spread of diseases, so careful planning is necessary. Additionally, land use

diversity should be strategically planned, ensuring critical services like grocery stores and medical facilities remain accessible during pandemics. It is also important to reevaluate transportation infrastructure to ensure resilience, sustainability, and social equity in the future (Zietsman, 2020). Over the past decade, urban resilience has seen significant innovation driven by the private sector, including vehicle automation, connected transportation, shared mobility, electrification, and dock less mobility. However, the COVID-19 pandemic has the potential to shift this dynamic, with the public sector emerging as a stronger partner. Lessons learned from the pandemic will drive new innovations, but it is crucial for the public sector to prioritize improving existing transportation systems and urban environments before focusing on new innovations. This includes enhancing sidewalks, bike lanes, and public transportation systems to ensure cleanliness and reduce crowding. While the importance of innovation should not be underestimated, it must be balanced with the immediate needs of improving the current infrastructure (Zietsman, 2020).

2.2.1. Measures on physical distancing

- To promote physical distancing and reduce crowding, it is recommended to reduce the capacity on individual services. This could involve limiting the number of passengers allowed on public transportation vehicles, such as buses or trains, to ensure adequate spacing between passengers. By implementing such measures, the risk of virus transmission can be minimized and public safety can be prioritized.

- Increasing service frequency during busier periods can help reduce rider density and promote physical distancing. By providing more frequent bus or train services, the number of passengers on each vehicle is reduced, allowing for better spacing and minimizing crowding.

- Encouraging continued home working and implementing staggered working hours can help reduce crowding on public transport services. By reducing the overall number of people traveling each day, especially during busy times, the risk of overcrowding can be minimized. This approach promotes physical distancing and ensures a safer commuting experience for those who do need to use public transportation.

- To facilitate physical distancing at bus stops and stations, a practical approach is to designate 2-meter spots for passengers to wait.

- Minimizing contact between transport staff and passengers is crucial for ensuring the safety of staff members and the uninterrupted operation of services. This is achieved by

implementing measures that limit physical interactions, allowing staff to maintain a safe environment while providing essential transportation services.

- To enhance passenger safety and confidence, it is important to provide handwashing facilities and hand sanitizer in transportation settings. By offering these amenities, passengers can practice proper hand hygiene, reducing the risk of transmission and promoting a safer travel experience.
- Promoting or requiring the use of face masks. Masks should be worn by both staff and passengers on public transport.
- To assist informal transport service providers, it is essential to create institutional, policy, and financial packages. These packages should offer targeted support, including funding, training, and regulatory frameworks, to help improve their operations and overcome challenges (Local Governments for Sustainability, 2020).

2.3. Strategies for travel patterns

Since public transport is the worst affected mode of travel during the COVID-19 pandemic, the evolving situation of the pandemic indicates three possible long-term scenarios:

1. COVID-19 has greatly affected public transportation, and its recovery may be hindered as people continue to avoid its use even after the pandemic.
2. In the long term, people generally show a preference for active modes of transportation and private cars over public transport.
3. Once the fear and threat of the pandemic diminish, individuals are more inclined to revert back to utilizing public transportation as a mode of travel (Abdullah M., 2020).

To attract users in the long term, it is recommended for transport authorities to focus on improving perceptions of the public transport system during the pandemic. Financial incentives can be used to encourage the recovery of public transport while considering user preferences. Work-from-home policies may impact long-term travel behavior, but certain sectors still require movement, making public transport necessary for society. Policies to attract people to public transport should be developed and implemented ethically, considering the potential spread of the virus. User preferences should be a key consideration in the development of policies to revive public transport (Abdullah M., 2020).

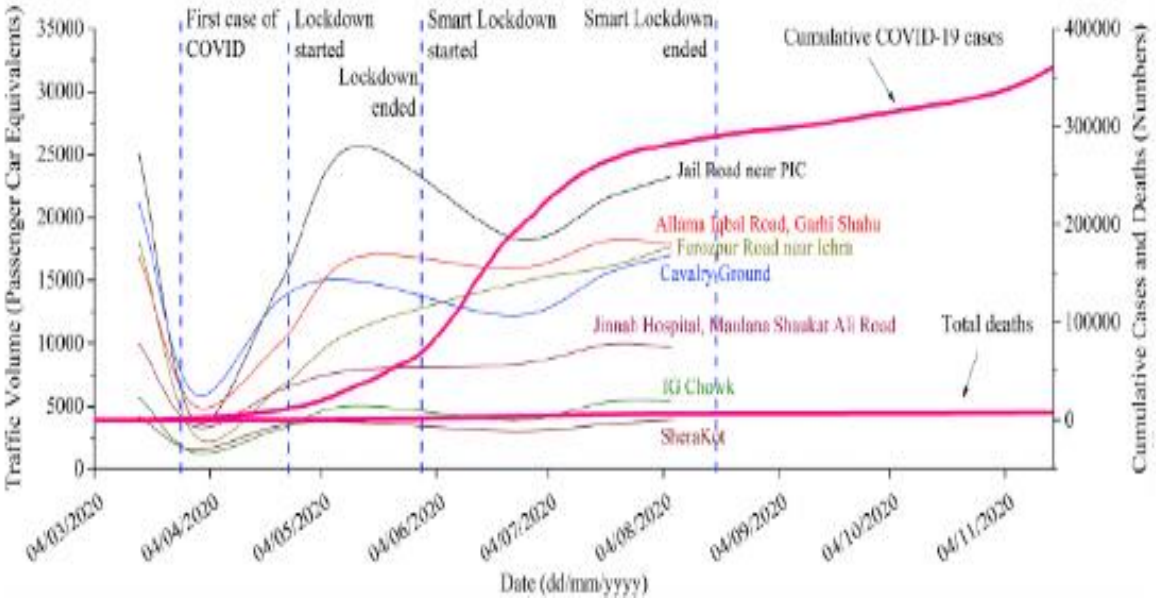


Figure 6 COVID-19 traffic levels at various major roads in Lahore, Punjab, Pakistan.

2.4. Case studies

2.4.1. California, USA

Innovation and Technology:

Public transportation operators should embrace innovative technologies to enhance their services and foster collaboration between public and private operators. This can be achieved through the implementation of pilot projects, forming partnerships with shared mobility providers, and utilizing MOD/Maas platforms. These measures aim to address service gaps, expand mobility options, integrate fare payment systems, provide real-time information, and promote social equity by ensuring equal access to reliable transportation for marginalized populations. To facilitate this innovation, regulatory flexibility is necessary to support pilot projects, partnerships, new business models, and the adoption of advanced technologies (Smith, 2021).

Planning and Operations:

Public transit agencies should prioritize implementing planning and operational reforms that prioritize the needs of marginalized populations. These reforms aim to promote social equity by ensuring that transportation services are accessible and inclusive for all individuals, regardless of their background or socioeconomic status. This can be achieved through various key actions. Firstly, agencies should focus on developing more frequent service and stabilizing funding sources. By improving the frequency of service, transportation becomes more reliable and

accessible for all individuals, including marginalized communities. Stabilizing funding sources ensures long-term sustainability and enables agencies to provide consistent and reliable transit options. Secondly, managing passenger capacity on public transit vehicles is crucial, especially in light of social distancing restrictions. Implementing measures to ensure compliance with these restrictions helps to prioritize the safety and well-being of passengers, particularly those who rely on public transit as their primary mode of transportation. Thirdly, agencies should explore new mechanisms for generating revenue. This may involve seeking out innovative funding models and partnerships to supplement existing funding sources. By diversifying revenue streams, agencies can ensure the availability and quality of transit services for marginalized populations. Fourthly, investing in the maintenance and repair of vehicles and infrastructure is essential. By bringing vehicles and infrastructure up to good repair, agencies can provide a reliable and efficient transportation system that meets the needs of all passengers. In addition to these actions, adopting a multimodal approach to transportation infrastructure and services is beneficial. This involves facilitating access across multiple modes of transportation and integrating different modes seamlessly. Furthermore, implementing land-use policies that promote affordable and dense housing can enhance transportation equity by reducing the need for long commutes and providing affordable housing options near transit hubs. By implementing these planning and operational reforms, public transit agencies can work towards building social equity and ensuring that transportation services are accessible to all, particularly marginalized populations.

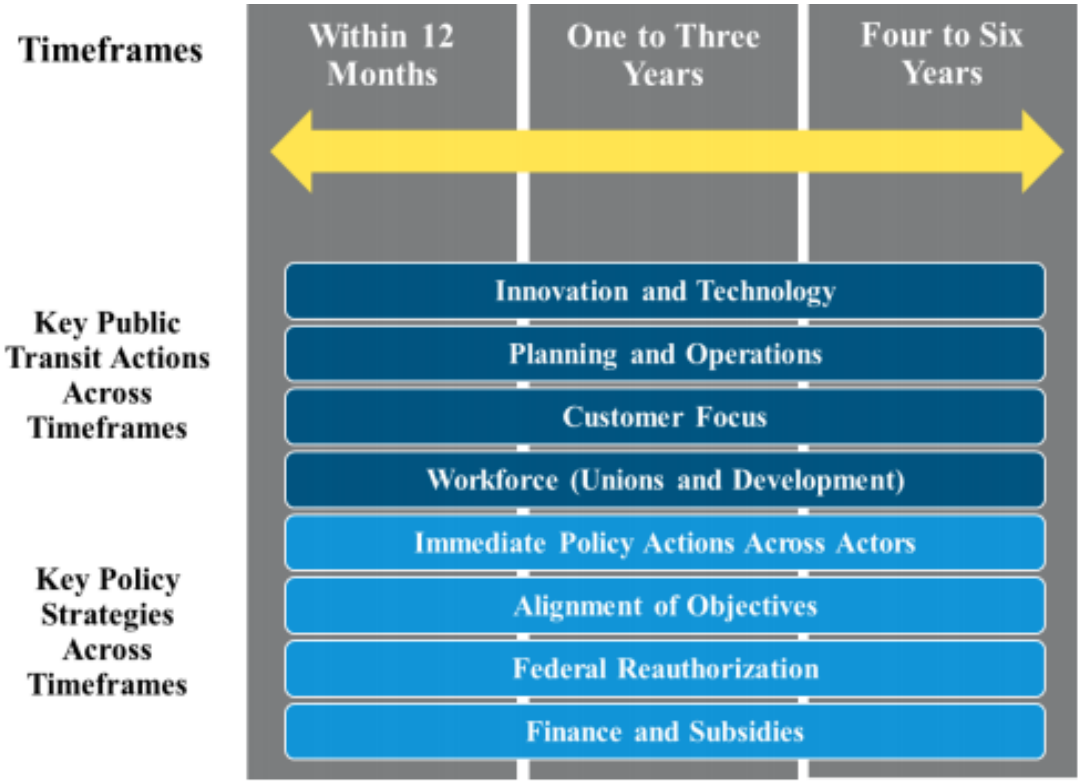


Figure 7 public transport and policy actions

Customer Focus:

Public transit organizations should embrace a customer-centric business model that places a strong emphasis on providing safe, healthy, and high-quality service. This approach prioritizes the needs of public transit-dependent and marginalized communities, promoting social equity and inclusivity. It also involves actively engaging with communities and garnering support for public transportation as an essential service and a basic right for all. By adopting this approach, public transit agencies can better meet the diverse needs of their customers and ensure a positive and equitable transportation experience.

Workforce Development:

Early actions for public transit agencies should focus on ensuring the safety of workers during the COVID-19 recovery, including providing personal protective equipment and implementing measures to separate riders from drivers. Longer-term strategies should include building training programs to retain and attract drivers, considering the future effects of automation, and restructuring agencies to be more flexible, adaptive, and multimodal (Stephen, 2021).

2.4.2. Australia

The Covid-19 pandemic underscores the importance for transport planners to be prepared for unexpected events. The sector was already facing uncertainty due to technological innovations like electric and connected autonomous vehicles, as well as changing socio-economic trends such as reduced driving among young people and the popularity of shared mobility. It is crucial for planners to adapt to these changes and ensure resilience in the face of future uncertainties.

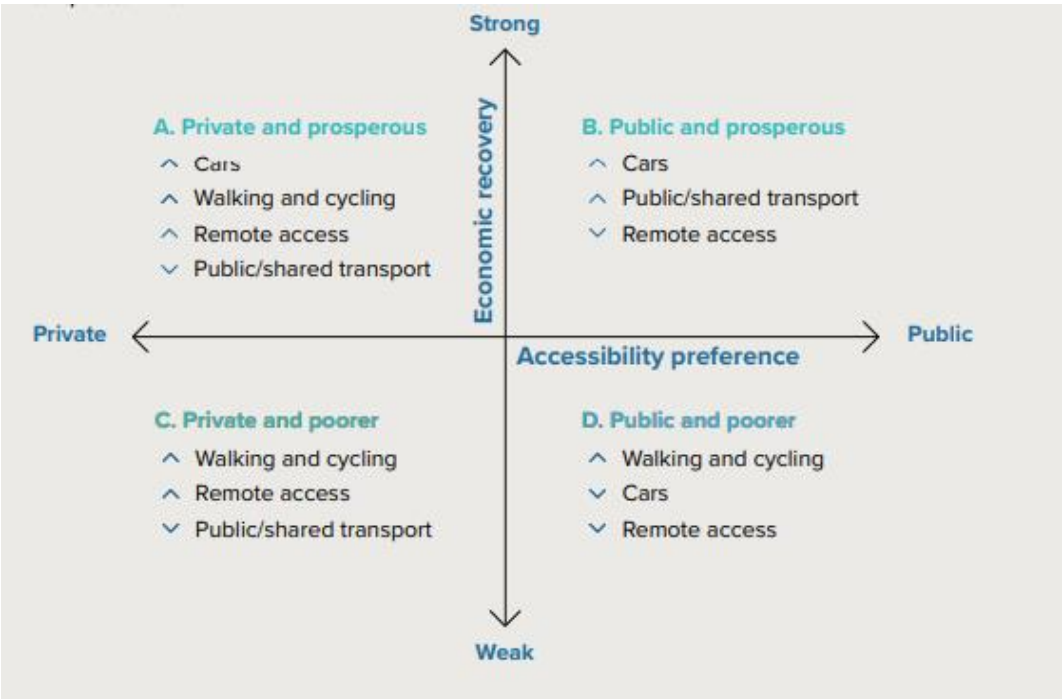


Figure 8 Covid 19 future scenario

To support the recovery of public transport, national and regional governments should invest in infrastructure and communicate safety measures effectively. On the demand side, measures like congestion charging and prioritizing walking and cycling through filtered permeability schemes can help constrain car demand and promote sustainable modes of transportation (Smith, 2021).

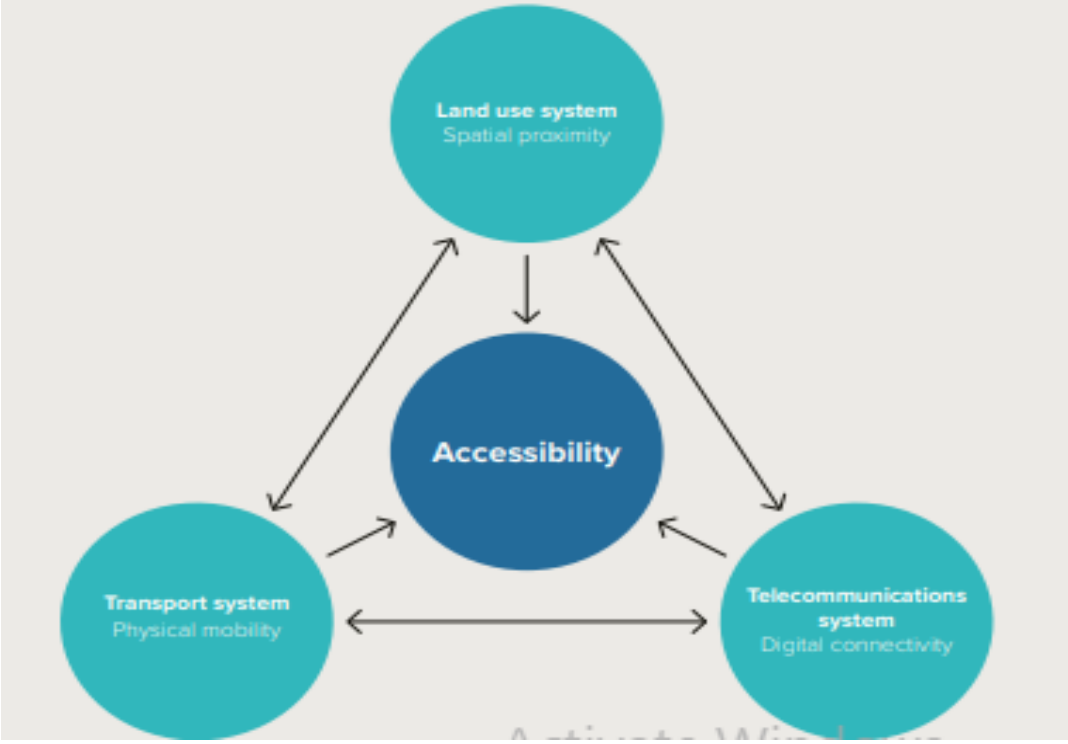


Figure 9 The triple access system

2.5. COVID-19 Pakistan socio-economic impact

2.5.1. Switching to the emergency mode

By incorporating a sufficient and effective plan, focused on saving lives, and a relief plan that includes financial packages, national governments can address the consequence of the COVID-19. These plans should be integrated into the COVID-19 National Action Plan and annual development plans to ensure comprehensive and coordinated responses to the crisis.

a) Maintaining essential health services and focusing on health system recovery and strengthening, particularly in primary health care, are essential in addressing the impact of the COVID-19 pandemic.

b) To address the impact of the COVID-19 pandemic, it is important to scale up and expand resilient and pro-poor social protection systems. This entails offering vital services such as food and nutrition, access to clean water. Special attention should be given to infants, children, women, and other vulnerable populations to ensure their well-being and support their recovery (Hasan, 2020).

2.5.2. Developing a resilient economy

To protect jobs and support micro, small, and medium-sized enterprises (MSMEs) and vulnerable actors, governments should implement public sector development policies and regulatory measures. This includes providing financial assistance, business support services, and regulatory flexibility to ensure economic stability and inclusivity.

a) An effective approach is to increase public-sector investment in labor-intensive development programs, such as cash-for-work initiatives. These schemes create short-term job opportunities in sectors like agriculture and rural infrastructure development, addressing unemployment and promoting economic growth; and
b) To protect private-sector jobs, enterprises, and domestic production, it is important to introduce incentives for vulnerable sectors and SMEs. This can be achieved through policy measures, regulatory support, and financial packages like subsidies, interest-free loans, and tariff rebates. Such initiatives aim to sustain businesses and promote exports.

2.5.3. Managing a Fiscal and financial surge

Efficient financial and resource planning, management, and mobilization are essential for addressing COVID-19 challenges and other development priorities. This approach optimizes resource allocation and promotes sustainable development.

a) To estimate the impact and financial implications of the COVID-19 response, it is important to identify macroeconomic policy options, administrative measures, and allocate resources efficiently. Prioritizing response efforts and creating fiscal space will help address immediate and long-term challenges posed by the pandemic;

b) it is crucial to promote global partnerships, engage the private sector, and foster development cooperation. This involves introducing measures to mobilize and leverage financial, technical, and advisory support. By actively engaging various stakeholders, including the private sector, and leveraging their resources and expertise, it becomes possible to effectively implement development plans and address the challenges posed by the pandemic; and

c) To promote efficiency and save costs during the COVID-19 response, implementing measures like austerity measures, debt rescheduling negotiations, and deferring debt servicing can be beneficial.

2.5.4. Inculcating Principles of Social Cohesion

Establishing systems and processes that enable citizens and communities to actively participate in and benefit from public sector development programs, particularly in response to COVID-19. This can be achieved through mechanisms such as participatory planning, consultation, and feedback mechanisms. By involving citizens and communities in decision-making, their needs and perspectives can be better understood and integrated into development programs, ensuring that the response to COVID-19 is inclusive and responsive to the specific needs of different groups. Additionally, providing opportunities for communities to benefit from these programs can help promote social cohesion, empowerment, and sustainable development:

a) In order to foster inclusivity, transparency, and accountability in public sector development planning and the response to COVID-19, it is crucial to incorporate social dialogue and political engagement that uphold fundamental human rights. This entails upholding the rights to peaceful assembly, freedom of association, collective bargaining, freedom of expression, access to information, gender equality, non-discrimination, and inclusion. By involving a diverse range of stakeholders in decision-making processes, we can guarantee a response that is both more inclusive and effective (PAKISTAN Socio-economic Impact Assessment & Response Plan, 2020).

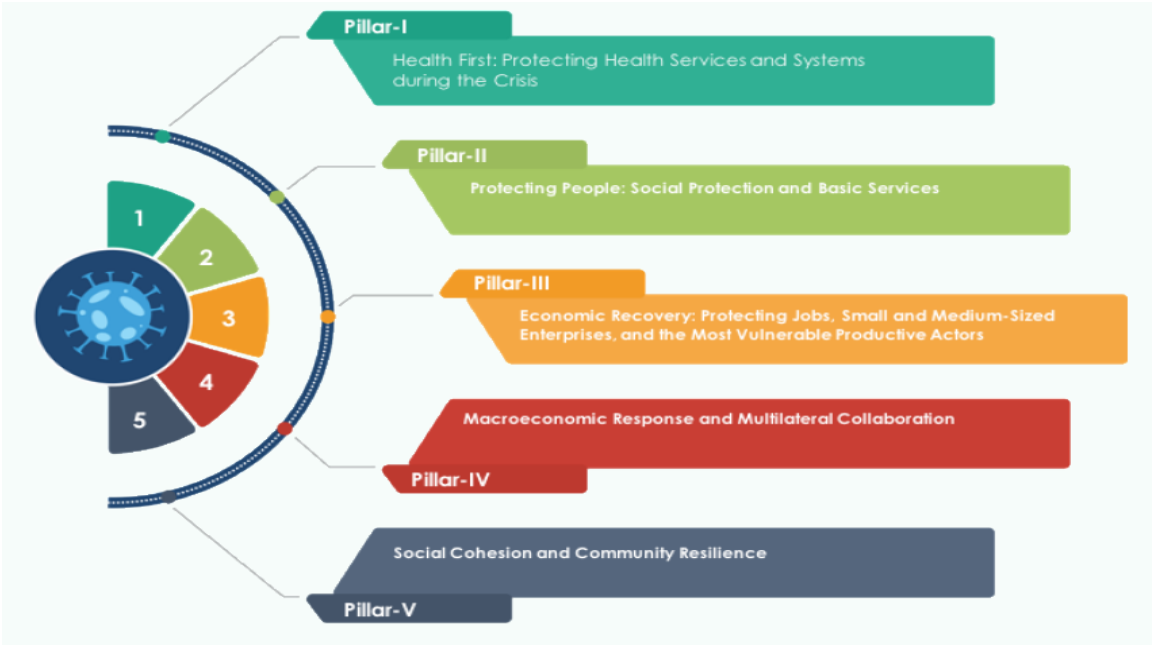


Figure 10 Plan requires adapting to the situation that has emerged as a result of COVID-19

2.6. Case studies

2.6.1. Korea

Social economy organizations have played a crucial role in mitigating the effects of the pandemic. They have supported governments in addressing COVID-19 related issues and have efficiently allocated resources for essential goods and services. To ensure their survival and contribute to a sustainable and inclusive society, a mix of policy measures is needed. Governments should include social economy organizations in their shared vision for the future and "build back better". An action plan can be developed to set a roadmap in which these organizations actively participate. Policies promoting social innovation and cooperation can help scale up their impact. To achieve this, social economy organizations require diversified financial resources and support for professionalization and digitalization. Utilizing relevant tools like open source and cooperative platforms is crucial. Additionally, the development of shared data and information on impact will help track progress and redirect efforts towards areas with fruitful results (Duforestel, 2020).

To help the social economy play its transformational role, policymakers could consider the following policy options:

- Provide financial resources for social economy organizations to promote social innovation and adapt their business models and operations. This support will help them navigate the challenges of the pandemic and contribute to building a resilient and sustainable sector.
- To promote positive social and environmental impacts, governments should prioritize sustainable and inclusive social procurement by increasing public procurement schemes that support social economy organizations.
- To promote collaboration and a shared vision, governments should actively engage with the social economy sector and develop partnerships. By working together, both parties can leverage resources and find innovative solutions to address social and economic challenges, leading to a more inclusive and sustainable society.
- To increase the visibility of the social economy, governments should develop tools for organizations to evaluate their impacts and share data and best practices. This will promote knowledge exchange and improve the performance of social economy organizations.
- The Korean government has taken steps to facilitate access to information and support for social enterprises during the COVID-19 pandemic. They have developed leaflets addressing health-related issues and available economic support packages for enterprises, including social enterprises. Additionally, Korea has implemented an action plan to address the potential impact of COVID-19 on social economy employees (Duforestel, 2020).

2.6.2. Bangladesh

The One-UN plan in Bangladesh supports economic stimulus and social protection packages to promote inclusive and sustainable development post-COVID. It addresses climate change challenges and aims to reduce vulnerabilities for all. The Integrated Socio-Economic Response Plan (ISERP) focuses on enhancing response programs to decrease multidimensional vulnerabilities in Bangladesh. The plan will be integrated with the current United Nations Development Cooperation Framework (UNDCF) 2017-2020, which has been extended to 2021. It will align with the Government of Bangladesh's Eighth Five Year Plan and the Sustainable Development Goals (SDGs). The ISERP is based on a whole-of-society approach, emphasizing the principles of leaving no one behind and building back better.

To effectively address the impacts of COVID-19 and facilitate a robust recovery, it is essential to adopt an integrated, multisectoral approach that encompasses all elements of the ISERP's five pillars. The pandemic has highlighted how vulnerabilities in one area can directly contribute to vulnerabilities in other areas. For instance, limited access to water, sanitation, and hygiene services or inadequate social protection schemes among urban poor communities can increase their exposure to infectious diseases and deepen economic shocks, resulting in higher poverty rates. Moreover, COVID-19 has amplified people's susceptibility to climate change and disasters, not only due to the occurrence of multiple disasters during the pandemic but also because of the erosion of their ability to cope with simultaneous shocks and disruptions. The five-pillar approach aims to ensure a cohesive and effective response by leveraging the expertise and resources of United Nations agencies, funds, and programs across various sectors (Rohingya, 2020).

2.7. Sustainable building infrastructure

Infrastructure investment decisions made at present will have a significant impact on how we address challenges like climate change, promoting inclusive societies, and achieving sustainable and balanced growth. This note highlights key considerations for supporting infrastructure investment that builds long-term resilience to future shocks, risks, and threats. It emphasizes the importance of aligning investments with infrastructure that is both robust and adaptable to changing circumstances and complexities. The note also takes into account recent observations in light of the COVID-19 pandemic, emphasizing the need to enhance the resilience of infrastructure

assets and systems. By doing so, we can facilitate the smooth flow of goods, people, data, energy, water, and support the resilience of communities as a whole. These considerations aim to guide decision-makers in making infrastructure investments that contribute to a more resilient and adaptable future. A key aspect of the process of rebuilding and improving is the necessity for a recovery centered around the well-being of individuals, with a strong focus on inclusivity and the reduction of inequality.

Figure 11 Adopted building back better

The COVID-19 pandemic has underscored the crucial role of infrastructure systems and services in sustaining economic and social activities and responding to unexpected threats and challenges. However, it has also revealed that infrastructure can be a potential source of vulnerability. It is crucial to acknowledge that the impact on infrastructure has not been entirely negative. Some services have actually witnessed an increase in demand or positive effects, underscoring the diverse nature of infrastructure and the intricate ripple effects of significant shocks. For instance, in cities like Lahore, Gujranwala, and Sialkot, construction or maintenance projects on roads may have progressed during periods of confinement as reduced traffic provided an opportunity for

construction crews to work without hindrance. This variation in impacts emphasizes the need for a nuanced understanding of infrastructure and its interconnectedness with different sectors and communities. It also highlights the importance of adopting a comprehensive approach to infrastructure planning and investment that considers both the potential vulnerabilities and opportunities that arise during times of crisis.

2.8. Build resilience capability

Although it is necessary to engage in preplanning considering the uncertainty and complexity of the situation, it may not be enough. Therefore, enterprises need to continuously assess the situation on a daily basis and respond accordingly. To do so, firms must possess the capability to bounce back and demonstrate resilience. The resilience capability refers to

a) the ability to remain resilient and adapt positively in the face of challenging conditions.
b) the skill to overcome and recover from unexpected setbacks.
c) the aptitude for preserving favorable functioning and results in the face of adversity.

Cities can build resilience by preparing for supply chain disruptions, learning from past experiences, and leveraging social capital. This involves evaluating weak points, gaining insights from previous incidents, and utilizing networks for resource access and information diffusion (Mohsin, 2020).

2.9. Case studies

2.9.1. Philippine

Building safer and more resilient

COVID-19 is a global pandemic with the potential to impact entire metropolitan areas. Hotspots within a specific barangay can increase the threat to the surrounding areas. This crisis has underscored the importance of equitable urban management. Efficient and effective service delivery is essential, particularly in ensuring that all citizens have equal access to swift and coordinated response efforts during crises and disasters.

Redesigning our cities

Cities across the world are embracing a shift in urban design, moving away from conventional materials like concrete and glass to incorporate more environmentally-friendly solutions such as vertical gardens. In addition, public parks are being designed with multipurpose infrastructure that

can capture and utilize stormwater for recreational purposes. Open spaces, like the libraries in Medellin, Colombia, are being developed as safe havens for people of all ages. As we look to the future, it is crucial to consider access to healthcare services during epidemics and integrate them with innovative mobility solutions. The use of digital tools like the Internet of Things and artificial intelligence is playing a significant role in supporting evidence-based planning. Moreover, in the context of the economic recovery from the COVID-19 pandemic, geospatial tools can be employed for effective infrastructure planning. This presents a unique opportunity for cities in the Philippines to connect with one another and actively engage in proactive urban planning. Given that cities are centers of talent, innovation, and creativity, it is vital to prioritize the creation of a high-quality living environment and sustainable practices in planning discussions. Mayors and local governments, who are at the forefront of response and recovery efforts, must acknowledge and address the fact that our cities will undergo significant transformations (Raghunath, 2020).

2.10. COVID-19 urban public spaces Planning

The Covid-19 pandemic should serve as a pressing wake-up call for urban planners, bureaucrats, and policymakers in Pakistan. It is crucial for them to invest significantly and purposefully in addressing the glaring disparities in access to urban infrastructure services. The existence of fragmented governance and a lack of accountability at various levels of government has impeded inclusive planning endeavors for many years. Policymakers must no longer overlook residents of informal settlements, as they are integral to the functioning of the city. Moreover, as some of the most vulnerable individuals, they deserve the utmost attention and support from policymakers. The long-term effects of Covid-19 combined with the impacts of climate change will take place in sites and at scales that involve populations that have never been accounted for in previous planning efforts. Here is a list of both urgent and long-term recommendations:

- Implement a comprehensive restoration of the local government system across Pakistan.
- Swiftly create a collaborative coordination committee comprising individuals from provincial and local governments, NGOs, and community leaders.
- Take into consideration the needs of a large population with healthcare requirements.
- Accurately document and regularly update population figures, while generating spatial data specifically for each ward, with a particular emphasis on informal settlements.

- Allocate emergency funding towards the improvement of existing water infrastructure and implementing measures to provide affordable and clean water in informal settlements (Abdullah, 2020).

2.10.1. Maximizing soft landscaping

The addition of "Maximize soft landscaping" as an object-related process in the model acknowledges the importance of garden beds and hedges as design elements that contribute to movement guidance and structural organization. At this level, it aligns with and connects to various functions such as "separation," "provide visual sensory experience," "maximize local character," "allow social (passive) interaction," "protect the travel way," and "maximize wayfinding." By maximizing the use of soft landscaping, urban design can enhance visual aesthetics, create a sense of place, facilitate social interaction, ensure safety, and improve wayfinding for pedestrians and users of the space.

Indeed, utilizing greenery as a directional infrastructure not only prioritizes its importance but also establishes connections to buffers and wayfinding processes crucial for ensuring safety. Moreover, it enhances existing functions within the model. By strategically incorporating greenery, spaces can be shaped and separated, allowing users to maintain distance while still maintaining a visual connection. This approach provides a means of separation without impeding the overall visual experience, making it a valuable element in urban design.

2.10.2. The adaptive capacity of public spaces

The adaptive capacity of public spaces, particularly those with fewer rules and technical elements like green spaces, has been evident during the pandemic. Their flexibility allows for different uses and adaptations under changing conditions. This adaptability is also a result of considering humans as assets within the public space system and recognizing the importance of user participation in the design process. This socio-technical systems approach values the flexibility of users in shaping the design and function of public spaces. Future research can further explore the adaptive capacity of public spaces by using agent-based models. These models can simulate proposed designs, allocate properties to agents, introduce temporary infrastructure, and examine various scenarios. This modeling approach can help understand the impact of demographic and behavioral variables on the adaptive capacity of public spaces, enabling better design decisions and planning for future challenges. Overall, recognizing and leveraging the adaptive capacity of public spaces, and considering them as socio-technical systems, can lead to more resilient and responsive urban environments. (Nicholas, 2020).

2.11. Case studies

2.11.1. Turkey

Addressing the challenges posed by the coronavirus pandemic necessitates continuous engagement and collaboration between national and local authorities, with active involvement from urban citizens. Creating a sustainable and antivirus-built environment is crucial to meet these challenges, ensuring the provision of safe, healthy, and suitable spaces for people. To prevent the spread of infections and diseases, it is essential to enhance security measures within the modern built environment. This can involve implementing multiple layers of protection, such as improved ventilation systems, regular sanitization protocols, and the adoption of social distancing measures. These measures contribute to a safer environment and help minimize the risk of transmission. Moreover, prioritizing sustainability in the design and construction of the built environment is of utmost importance. A sustainable approach takes into account not only environmental considerations but also the well-being of individuals residing or working in these spaces. By providing adequate and appropriate places for people, we can promote their overall health and mitigate the risks associated with infectious diseases. Creating a resilient urban landscape requires a comprehensive approach that encompasses not only the physical aspects of the built environment but also the social and behavioral factors of its users. By focusing on sustainable and antivirus-built environments, we can foster healthier, safer, and more resilient cities. The study recommends that:

- Promoting the importance of safe water and a sustainable environment is crucial in the fight against viruses. To achieve this, it is necessary to incorporate green buildings, green interiors, and climate change adaptation strategies. However, it is important to note that Turkish cities currently lack supportive infrastructure for cycling, leading to a reliance on individual transportation systems. Municipalities should prioritize the development of bicycle-friendly transportation systems that also accommodate electric scooters, motorcycles, and other similar modes of transportation. Furthermore, existing climate mitigation and adaptation strategies, particularly those focused on clean and sustainable practices, should be continued and implemented. These strategies are vital in reducing the impact of climate change and promoting long-term sustainability. By encouraging and supporting such initiatives, Turkish cities can contribute to creating a healthier and more resilient urban environment.

- Creating a healthy community requires comprehensive planning that emphasizes public health considerations in zoning, design, and improvements. Integration of urban design, smart technologies, and disaster response approaches is necessary for effective urban planning and management, fostering resilience and prioritizing public health.

Designing the built environment with the aim of increasing social interaction and creating safe public spaces is essential to address social disparities in urban areas. Densification is necessary to accommodate population growth, but there is also a need to consider de-densification within buildings through physical distancing and the implementation of health measures. This approach can be seen as a solution for future building design, balancing the need for social interaction with the importance of preventing pandemics.

In conclusion, effective strategic and operational decision-making, along with their implementation, can reduce the spread of viruses and mitigate their negative impacts. This study focuses on the decisions and measures taken by the Turkish government in the urban built environment during the transition to the new normal period. It is important to learn from this experience in order to address current and future challenges effectively (Bakir, 2020).

2.12. Future Planning for the Cities of Pakistan

2.12.1. A case study of Karachi

A study analyzed COVID-19 cases in Karachi and projected outcomes under different vaccine scenarios. One year of vaccine distribution with a 70% efficacy and 2.5-year duration could prevent 0.9 million cases, 10.1 thousand deaths, and 70.1 thousand DALYs. The cost-effectiveness ratio was $27.9 per DALY averted. While giving priority to older populations can lead to a greater reduction in deaths, distributing resources more broadly has similar economic implications. Lower vaccine prices are crucial for cost-effectiveness. Overall, vaccination has a significant health impact and is likely cost-effective, especially with optimistic vaccine scenarios (Maryam, 2021).

2.13. Tourism in Pakistan after a Pandemic

To ensure sustainable tourism, it is crucial to establish and enforce rules and regulations that protect the environment and culture. In the current scenario, hotels and restaurants, which are significant players in the tourism sector, are not implementing certification and standards. In Pakistan, the key laws governing the tourism industry include the Pakistan Tourist Guides Act

1976, the Travel Agencies Act 1976, and the Pakistan Hotels and Restaurants Act 1976. However, there is a need for stronger implementation and adherence to these laws to promote sustainable practices in the tourism sector.

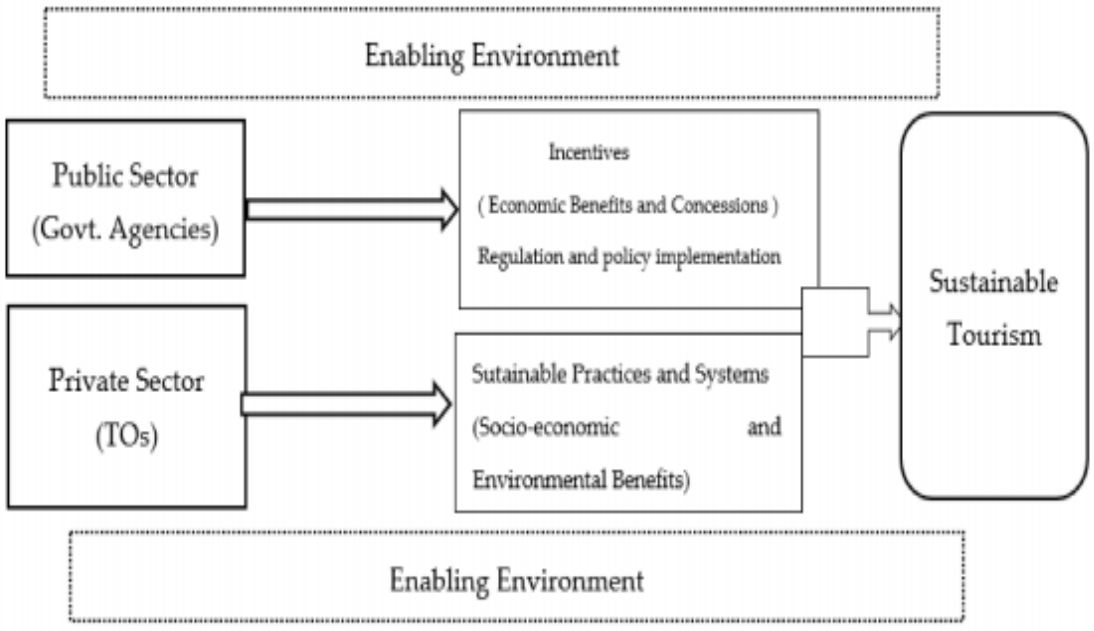


Figure 12 Development of sustainable tourism in Pakistan

Continued government support is crucial for the survival of businesses in the tourism sector. While initial actions have been taken, more coordinated efforts are needed. This includes financial assistance, tax incentives, and regulatory flexibility. Sustainable tourism practices should also be prioritized. Collaboration between government agencies, industry stakeholders, and international organizations is essential for an effective response. Key policy priorities include:

- To restore traveler confidence, implement strict health protocols, transparent communication, consider vaccine passports, offer flexible booking policies, collaborate with health authorities, and promote good hygiene practices.
- To support tourism businesses in adapting and surviving, it is crucial to provide financial aid, offer digital transformation training, and promote domestic tourism. These measures will help businesses adjust their operations, improve their online presence, and attract local visitors to sustain their livelihoods.
- To revive tourism, we must promote domestic travel and ensure the safe return of international tourism. This can be done through targeted marketing, implementing safety

measures, and building traveler confidence through collaboration with travel agencies and authorities

- Clear and timely communication is crucial in reducing uncertainty for travelers and businesses. Providing up-to-date information on travel restrictions, safety protocols, and regulatory changes helps to minimize uncertainty and allows for informed decision-making
- Adapting response measures is crucial to maintain capacity in the travel sector and address support gaps. By staying flexible and responsive, the industry can sustain its ability to meet the needs of travelers and businesses, while identifying and addressing any areas requiring additional support
- Strong cooperation within and between countries is vital for managing the travel industry effectively. By sharing best practices, coordinating efforts, and establishing common protocols, countries can ensure the safety and efficiency of travel, minimize disruptions, and foster trust among all stakeholders.
- Developing a resilient and sustainable tourism industry is essential. By adopting sustainable practices, preserving cultural heritage, and supporting local economies, the industry can minimize its environmental impact and ensure long-term benefits for travelers and destinations. This resilience allows the industry to withstand external shocks and remain viable in the face of challenges.

Flexible policies are crucial for the tourism industry to adapt to the current virus situation. However, it is equally important to learn from this crisis and address gaps in government and industry preparedness. Coordinated action between governments and the private sector is essential to improve crisis management, collaboration, and resilience for future challenges. The current crisis is an opportunity to reshape the future of tourism. Governments should prioritize digitalization, low-carbon practices, and structural transformation for a sustainable and resilient tourism economy. This includes investing in technology, promoting sustainability, and fostering innovation. (Naveed, 2020).

2.14. Case studies

2.14.1. Potential long-lasting tourism policy implications

- Sustainability is expected to play a more prominent role in tourism choices as awareness of climate change and its adverse impacts grows. The recovery of the tourism industry is

anticipated to be driven by natural areas, regional and local destinations. This shift towards shorter travel distances can lead to a lower environmental impact of tourism. Travelers are likely to prioritize destinations that offer sustainable practices, eco-friendly accommodations, and opportunities for nature-based experiences. This presents an opportunity for businesses to adopt sustainable practices and showcase their commitment to responsible tourism. By aligning with these trends, businesses can attract environmentally conscious travelers and contribute to the overall sustainability of the tourism industry.

- The preference for local travel within one's own country is expected to boost domestic tourism. Domestic tourists, who are often price-sensitive and have lower spending patterns, present an opportunity for businesses to cater to their needs and stimulate local economic growth.
- The crisis and ongoing uncertainty have greatly impacted traveler confidence, which may result in a prolonged decline in demand and tourism consumption. The lingering effects of the shock could continue to affect the willingness of individuals to travel, even after the initial crisis has subsided. It is important for businesses in the tourism industry to adapt and implement strategies to regain traveler confidence and encourage a recovery in demand.
- The changing crisis and long-term consumer trends will impact traveler behavior, leading to the emergence of new market segments and a greater emphasis on safety protocols and contactless experiences. Businesses must adapt to these shifts in order to regain traveler confidence and cater to evolving preferences.
- Travelers now prioritize safety and hygiene when choosing destinations and activities, opting for private options and avoiding large gatherings. However, this preference for privacy may have adverse environmental effects. Finding a balance between safety and sustainability is crucial for the tourism industry.
- The tourism industry is anticipated to undergo significant structural changes throughout its ecosystem. Not all businesses will be able to survive the crisis, resulting in a reduction in sector capacity. This limited capacity is expected to impact the recovery of the industry.
- The tourism sector may experience a worsening of skills shortages due to job losses and workers transitioning to other industries. This could result in a lack of qualified personnel within the tourism sector.

- Active measures and policies will be necessary to stimulate and restore investment in the tourism sector. These efforts are crucial to ensure the maintenance of high-quality tourism offerings and facilitate a sustainable recovery.
- Digitalization in tourism is expected to accelerate, with automation, contactless payments, virtual experiences, and real-time information delivery becoming more prevalent. These advancements will enhance customer experience and improve the efficiency and convenience of tourism services.
- Tourism policy will need to be more agile and adaptable, with a shift towards flexible systems that can quickly respond to changing policy priorities. Special attention will be given to crisis management, particularly in relation to safety, health, and other relevant policy considerations (COVID-19 policy responses, 2020).

2.15. COVID-19 Pakistan's Preparations and Response

2.15.1. Cooperation between Government Levels

Cooperation between government entities is impeded by a lack of coordination between federal and provincial levels, which hampers swift and efficient crisis response. While provinces have autonomy in decision-making for essential services like healthcare, the federal government's control over border control and aviation restricts the provinces' ability to enhance surveillance at airports. Moreover, in densely populated countries such as Pakistan, the involvement of local governments is vital for curbing disease transmission and improving healthcare access. Unfortunately, the absence of local government structures has resulted in delays in providing crucial services to communities (Shaikh, 2020).

2.15.2. Using Technology

Pakistan is actively adopting innovative smart solutions and exploring the utilization of technology to create awareness, mitigate risks, and effectively manage the impact of pandemics such as Covid-19. Through collaboration with the telecommunications industry, the government has replaced ringtones with awareness messages that educate callers about the dangers of the virus and provide guidance on safety measures. Regular SMS messages are also sent to the public, encouraging practices such as handwashing and social distancing. Furthermore, authorities are leveraging mobile tracking to reach out to individuals suspected of having confirmed cases, urging them to undergo testing.

2.15.3. Ensuring food security

Ensuring food security and access to a safety net are crucial objectives alongside a strong healthcare system. In Pakistan, the government has implemented various strategies to address these concerns. They have temporarily waived taxes on food items and significantly reduced oil prices. Additionally, households with utility bills below a certain threshold are eligible for a three-month deferral on payments. To ensure the availability of food and essential items, the government has allocated PKR 50 billion ($298.94 million) to government-operated utility stores. Moreover, PKR 280 billion ($1.68 billion) has been assigned to support wheat farmers and facilitate smooth wheat procurement. Logistical support funds have also been allocated to the National Disaster Management Authority (NDMA) to maintain a consistent food supply. Provincial governments, such as Sindh, are also taking proactive measures by providing relief in both monetary and non-monetary forms through a self-targeting mechanism that individuals in need can access via a designated hotline. The eligibility process for these relief measures is being refined as they are implemented.

2.15.4. Protecting businesses

Establishing a strong economic foundation is crucial for the government's efforts to revive the economy. The economic stimulus package comprises a comprehensive range of fiscal measures, including tax relief, financial support through subsidies for utilities, fuel, and transportation, as well as concessions and tax refunds. These measures are designed to protect exporters and businesses. Moreover, a separate package worth PKR 100 billion ($600.42 million) has been specifically allocated to support Small and Medium Enterprises (SMEs), which account for nearly 90% of all businesses in Pakistan and contribute 40% to non-agricultural employment. To incentivize new investments, the State Bank of Pakistan (SBP) has introduced the Temporary Economic Refinance Facility, which offers subsidized loans to the manufacturing sector. The SBP has also established a Refinance Facility that enables banks to access interest-free loans, which can then be extended to hospitals at an interest rate of 3% for a duration of five years. Additionally, the SBP has reduced the interest rate to 11%, although it remains higher compared to other countries that have implemented rate cuts, it is 150 basis points lower than the previous rate (Shaikh, 2020).

2.16. Spreading, death and recovery in Pakistan

Based on data from official reports in Pakistan and the World Health Organization (WHO), the development of COVID-19 cases in Pakistan can be summarized as follows. The first suspected case of coronavirus was identified on February 26, 2020, and later confirmed. The patient was a student at Karachi University and had recently traveled to Iran. Another suspected case was reported in Islamabad, also with a travel history to Iran. Prompt precautions were taken, including the closure of educational institutions. The initial two cases showed signs of recovery, leading to the identification of more cases. By early March 2020, the total number of confirmed COVID-19 cases reached 19, with the majority being in Sindh province. It was noted that some of the patients had recently traveled from Syria and London. Additionally, there was a rise in suspected cases from various districts in Punjab, but subsequent testing determined them to be COVID-negative. (Jawed, 2020).

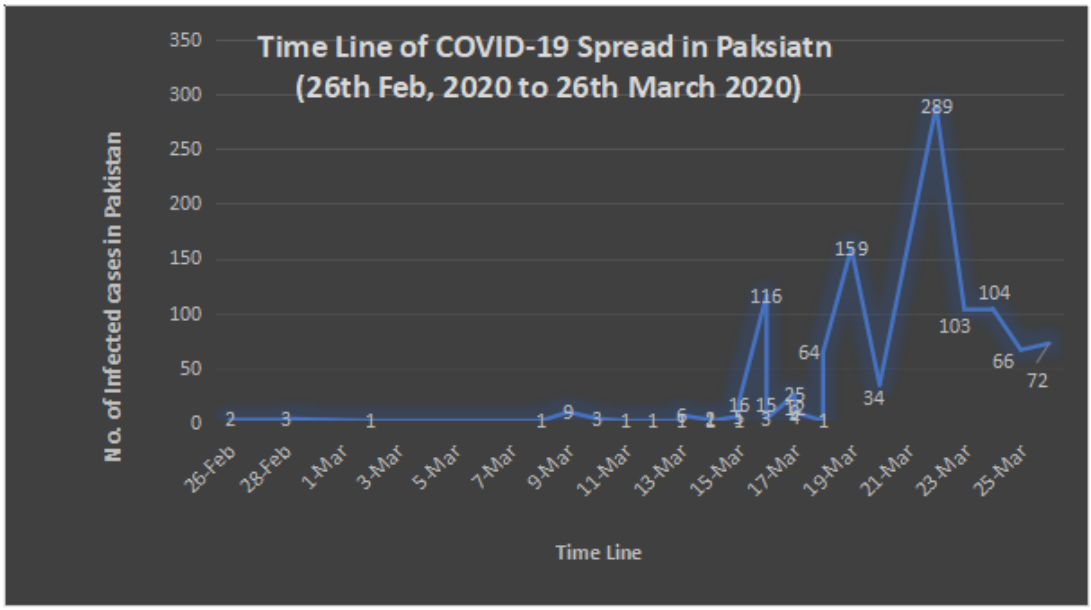


Figure 13 COVID-19 positive cases reported by the Government of Pakistan

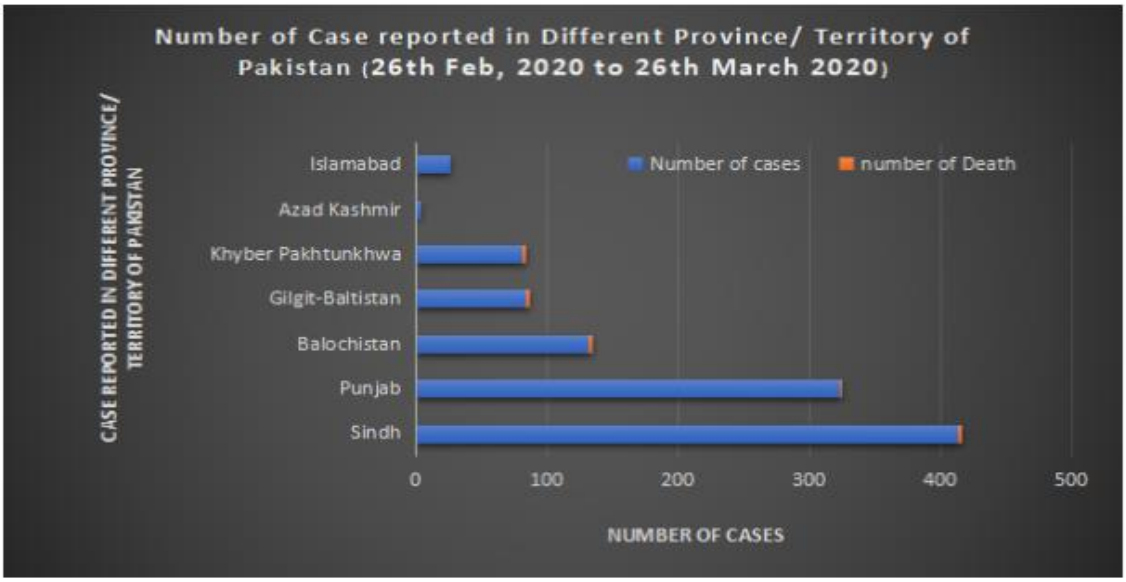


Figure 14 deaths in different areas of Pakistan reported by the Government of Pakistan.

Based on the analysis of available data and drawing from the patterns observed in previous epidemics, it is evident that immediate action must be taken to prevent the situation from deteriorating further. To curb the spread of the pandemic, it is imperative to interrupt the transmission of the disease, both locally and through travel. Additionally, applying successful treatment protocols used in previous coronavirus-related epidemics like SARS and MERS, as well as other respiratory infectious diseases, could prove beneficial in suppressing the spread of this pandemic and potentially eradicating the pathogen from the body. Implementing these preventive measures and effective treatment strategies are crucial in mitigating the impact of the pandemic (Jawed, 2020).

2.17. Pakistan & COVID-19 waves

A Pakistani government official has issued a warning, expressing concerns about the possibility of additional waves of COVID-19 in the country in the coming months. To mitigate this risk, the official has urged the public to adhere to safety measures and get vaccinated. The warning is based on an analysis that utilizes artificial intelligence disease modeling, indicating that without strict enforcement of standard operating procedures (SOPs) and a robust vaccination program, Pakistan could face a fourth wave of infections as early as July. Despite a decrease in infection rates and an accelerated vaccination campaign, there has been noticeable resistance to following health guidelines, such as wearing masks, and vaccine hesitancy among the population. As a result,

provincial governments are considering implementing measures like blocking cellphone connections and withholding salaries of unvaccinated government employees. It is important to note that the duration of protection provided by COVID-19 vaccines is still under investigation, as they are relatively new. However, available data suggests that individuals who have recovered from COVID-19 develop an immune response that offers some level of protection against reinfection. Ongoing research aims to determine the strength and duration of this protection (Sajid, 2021).

Several different types of potential vaccines for COVID-19 are in development, including:

- Vaccines that employ an inactivated or weakened virus utilize a modified form of the virus that is no longer capable of causing illness. However, it still prompts the immune system to generate a protective response.
- Vaccines based on proteins use harmless portions or shells of proteins that mimic the COVID-19 virus. By doing so, they effectively and safely trigger an immune response in the body.
- Viral vector vaccines employ a harmless virus that is incapable of causing disease. This virus acts as a platform to produce coronavirus proteins, thereby stimulating an immune response in the body.
- RNA and DNA vaccines represent a state-of-the-art method wherein genetically modified RNA or DNA is utilized to generate a protein that effectively triggers an immune response in a safe manner (Sajid, 2021).

CHAPTER 3

RESEARCH METHODOLOGY

3.1. Methodology

This illustrates what different techniques are used to collect the data required to conduct this study and how these techniques are applied. In order to conduct the study, two types of data are required such as primary as well as secondary data. That is why, methods that are used tocollect primary and secondary data are given below.

3.1.1. Introduction of Research Methodology

A research methodology serves as a guiding framework that outlines the nature of research activities, provides instructions on how to proceed, establishes criteria for measuring progress, and defines what constitutes success. It is a systematic approach employed to gather data and information in order to achieve our objectives. The methodology plays a crucial role in effectively accomplishing our tasks.

Similarly, a project methodology delineates the necessary steps to effectively manage projects from initiation to conclusion. It provides a detailed overview of each stage in the project life cycle, enabling individuals to precisely identify the tasks that need to be completed, when they should be accomplished, and how to approach them. Whether one is an expert or a novice, the project methodology facilitates the timely completion of tasks more efficiently than ever before.

3.1.2. Research Design

Research is based upon both qualitative and quantitative analysis based on field surveys and practices in developed as well as developing countries. Data has been gathered from both primary and secondary sources. Residents' opinions and surveys have been utilized to present the outcomes and discoveries regarding the development of urban resilience in response to the COVID-19 pandemic.

This study includes the identification of the research problem, formation of objectives, reviewing the literature from developed and developing countries, and also in the local context. A questionnaire was designed by keeping in mind the objectives of the research which helped in primary and secondary data collection and led to the processing and analysis of collected data.

Analysis was conducted to provide valuable insights, leading to the formulation of conclusions and recommendations. In support of the chosen methodology, Figure 3.1 illustrates the research activities and offers a rationale for its adoption. A framework of research design is prepared, (as shown in Figure 3.1).

The research method used for this research was hybrid as both the descriptive and exploratory methods were used to gather, study and analyze the data. Exploratory research was done to gather all the existing, nationally and internationally, shaping urban resilience in the wake of covid, their categories, their indicators, and their relevance and non-relevance to the conditions of Pakistan. To achieve this objective, a systematic approach was implemented, starting from a general-to-specific perspective. The specific steps followed are outlined below in sequential order:

- Literature Review
- Selection of Case Study Area
- Data Collection Primary Data Collection Secondary Data Collection
- Data Processing
- Data Analysis
- Conclusions and Recommendations
- Final Documentation and Report Writing.

3.1.3. Selection of Topic

Regarding the selection of the research topic, extensive discussions and consultations were held with teachers, professional planners, and senior individuals in the field. A comprehensive review of diverse literature was conducted, which ultimately guided the selection of a logical and relevant topic. Taking into account guidance from the supervisor, input from friends, and personal interests and capabilities, the following research thesis topic was chosen:

"SHAPING URBAN RESILIENCE IN THE WAKE OF COVID"

(The Case Study of Islamabad and Rawalpindi, the Twin Cities)

3.1.4. Selection of Case Study

The selection of a case study area should be suitable that is more accessible, economical, and also provide suitable information about the project. For our project, the selected case study area is "Rawalpindi and Islamabad". Because the study area selected for shaping urban resilience in the wake of covid is Islamabad and Rawalpindi city, The Islamabad-Rawalpindi metropolitan areas stand as one of the largest metropolitan regions in Pakistan. Primarily encompassing the twin cities of Islamabad

and Rawalpindi, this area boasts numerous gated suburbs, including DHA Islamabad and Bahria Town. Conveniently connected to Pakistan's national railway network operated by the Pakistan Railways, the region benefits from seamless transportation access. Facilitating travel, the well-equipped Islamabad International Airport, one of Pakistan's largest airports, has the capacity to accommodate up to 9 million passengers annually, with potential for expansion to 25 million. Anticipating future growth, the Civil Aviation Authority has plans to acquire additional land for the development of a third runway. Notably, this airport holds the distinction of being the sole landing site in Pakistan capable of accommodating the Airbus A380. Serving the twin cities and the broader metropolitan area, the Rawalpindi-Islamabad Metro bus system is an efficient 24 km (14.9 mi) bus rapid transit network. It operates on dedicated bus lanes and covers a total of 24 bus stations, ensuring swift and convenient transportation for residents and visitors alike.

3.1.5. The Literature Review:

The literature review holds paramount significance in any research endeavor as it elucidates the relationship between the proposed study and prior research. Moreover, it serves to validate the chosen methodology for conducting the research. Boote and Beile (2005) assert that conducting research without a comprehensive understanding of the literature poses challenges for researchers. The literature review serves various purposes, including:

- Demonstrating the research conducted on the topic prior to the current study. Reviewing the available literature pertaining to the research topic.
- Identifying the shortcomings in previous research efforts.
- Summarizing diverse methodologies and outcomes.
- Gaining insights from the work of other researchers.

For this particular research, a thorough review of literature has been conducted, focusing on prominent planning issues in both developed and developing countries. The literature predominantly comprises articles, newspapers, and case studies. Extensive literature review has been undertaken at two stages: initially, before finalizing the research topic, and subsequently, after the topic selection. During the first stage, literature review was conducted to reach a well-informed conclusion regarding the research topic. In the subsequent stage, the literature review focused on existing research related to the chosen topic. Both national and international studies were consulted to gather ample data concerning prevailing planning problems at the regional, city, and even national levels.

3.1.6. Methods of Collection of Data

The methods employed for data collection play a crucial role in ensuring the value and success of research. They directly impact the obtained results and the inferences drawn, thus serving as vital tools to evaluate and assess various phenomena within research theory. Effective data collection techniques are essential for quantifying complex research processes and inferences, discerning both visible and unseen factors, and ultimately yielding meaningful and significant results. Therefore, careful attention must be given to the design and implementation of accurate measurement techniques in order to capture the intricacies of the research subject.

3.1.7. Collection of Secondary Data

Data collection methods are instrumental in providing answers to the researcher's questions, and they can vary significantly. One common approach is secondary data collection, which refers to data that has been previously gathered and organized, or has undergone statistical treatment. The specific method employed for collecting secondary data will be described in the following section.

3.1.8. Desktop Survey

The first step taken on was the desktop survey. By taking advantage of modern technologyinternet was used to collect general information about conspicuous planning problems.Different web links and sites were searched in order to get information. The main focus was to select a case study that was economical to access and from which a maximum of the information can be gathered to enhance the knowledge.

3.1.9. Library Search

Everything is not available on the internet. The library was also searched to get data regarding the prominent planning problems of metropolitan cities, especially Lahore. The differentbooks and other materials were searched to understand the situation of the planning problems and their consequences in developed and developing countries. Other than this, different articles and already research thesis was also reviewed to get the appropriate information.

3.1.10. Collection of Primary Data

Primary data refers to information that is collected directly in the field and has not undergone any

statistical treatment. It is considered the most accurate and current form of data, providing valuable insights for research. However, gathering primary data can be time-consuming and costly compared to utilizing secondary data sources. Primary data collection is particularly necessary when the available secondary data is outdated, or there are concerns about the reliability and accuracy of the facts and figures provided. In such cases, primary data is collected to address gaps and ensure a more comprehensive and reliable dataset for analysis.

The primary data was collected in two ways

- Hybrid Research
- Indicators
- Sample size
- Expert Interviews

3.1.11. Hybrid Research

Hybrid research can be classified into two types: quantitative and qualitative. Quantitative data collection methods rely on numerical data and mathematical calculations, often utilizing closed-ended questionnaires. On the other hand, qualitative research methods do not involve numerical data or mathematical calculations; instead, they focus on words and discussions. In this research, various techniques were employed to gather primary information.

3.1.12. Sample Size

The selection of an appropriate sampling method is contingent upon the nature of the research. In this study, a simple random sampling technique was utilized to interview citizens regarding the shaping of urban resilience in the wake of COVID-19. Simple random sampling, also known as probability sampling, is a widely used method for selecting a sample from a population. It ensures that each member of the population has an equal likelihood of being chosen as part of the sample.

3.1.13. Expert Interviews

Following the finalization of the questionnaire and the adoption of a systematic approach to data collection, a survey was conducted with officials using a questionnaire comprised of both open-ended and closed-ended questions. This survey sought information from officials regarding the structured discourse on shaping urban resilience in response to the COVID-19 pandemic. The objective was to investigate the interplay between cities, health, and well-being by employing geospatial measures of the urban built environment, combined with quasi-longitudinal data on health and well-being.

3.1.14. Indicators

For shaping urban resilience in the wake of covid following indicators are assessed in detail:

Table 2 Indicators for shaping Urban Resilience

Thematic Category	
Environmental Quality	Lockdown's effects on Quality of Air
	Environmental factors and meteorological conditions' influences on effects
	Influence on water cycle of urban areas
Socio-economic effects	Social factors required for the provision of response as well as informed adaptation
Management and governan considerations	Governance maintenance
	The role of Smart Cities and intelligent solutions in facilitating response and recovery.
Transportation design	Issues related to urban mobility and transportation
	Urban Design issues
Resilience	Reliability
	Flexibility
	Robustness
	Vulnerability
	Survivability
	Risk Management

3.2. Data Analysis

This stage of data processing holds utmost significance in deriving meaningful results, as the efficacy of the collected data and its interpretation through systematic analysis are pivotal. Once the data is gathered, it undergoes various operations to organize and arrange it in a useful manner.

The data processing phase consists of two key stages: data preparation and analysis. During the first stage of data processing, attention is given to ensuring data precision, identifying any errors or omissions, and addressing potential gaps in the collected data. Verification of the data is also conducted, followed by its entry into computer systems. Subsequently, data analysis is performed utilizing different software tools such as MS Excel and SPSS, among others.

3.2.1. Factor Analysis

This analysis is done for better understanding and interpretation of the barrier as factor analysis helps in discovering and grouping the large set of data variables into comparatively small but meaningful factors to describe a certain perspective (Tucker, 1958). These small numbers of factors retrieved from factor analysis give the view of all the variables within these small factors. While in SPSS, the Principal components method was applied in the factor analysis as the principal component's method identifies and computes the composite scores for the under-study variables or factors (Neill, 2008).

3.2.2. Application of Chi-Square Test

The survey data was subjected to a chi-square test to assess its statistical significance. The chi-square test for independence is employed to examine the relationship between two variables in a contingency table, determining whether they are significantly associated with each other. The Chi-Square Test tells us whether the being compared variables have a relationship among them or not. The level of significance is measured by comparing the P-value with the significance of A (where $\alpha = 0.05$). In our study here, the P-value is more than α, then the respondents have the same opinion about one specific thing or question. But if the P-value is less than α, then it means that the respondents are not on the same page, and there is a difference of opinion among the respondents (KENT STATE UNIVERSITY, 2020).

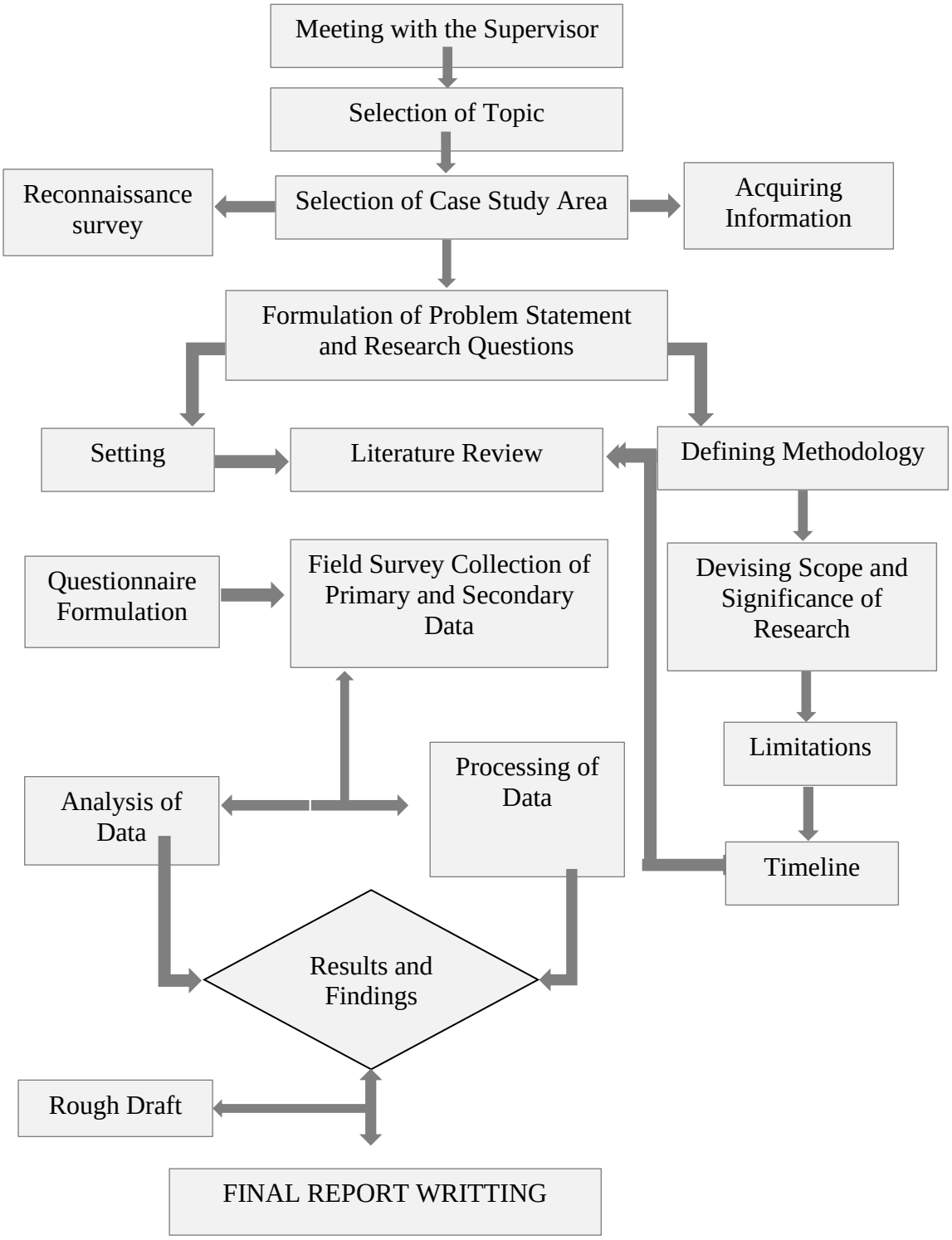
3.2.3. Results and Recommendations

Upon thorough analysis of the compiled data, significant conclusions were drawn. Additionally, recommendations were formulated to enhance the development of urban resilience in response to the COVID-19 pandemic, specifically within the chosen case study area.

3.2.4. Report Compilation

The final stage of the research process involves the creation of a comprehensive document. The format and structure of the report play a crucial role in effectively presenting the research work. With utmost care, the report is meticulously crafted to align with the research objectives. This step entails organizing the report by addressing the research problem, stating the objective and methodology, discussing the case study area selection, presenting the data collection and analysis methods, outlining the conclusions, and providing recommendations.

3.3. RESEARCH METHODOLOGY



CHAPTER 4

DATA ANALYSIS

4.1. Chi Square Test

The coronavirus pandemic has had significant impacts on the twin cities of Rawalpindi and Islamabad in Pakistan. In terms of the number of cases, both cities have seen a significant surge in COVID-19 cases since the start of the pandemic. As of my knowledge cutoff in September 2021, Rawalpindi had reported more than 100,000 cases and Islamabad had reported more than 86,000 cases. However, it's important to note that these numbers may have increased significantly since then.

The impact of the pandemic has been felt across many aspects of life in the twin cities, including:

1. **Health Care:** Hospitals in both cities have been overwhelmed by the number of COVID-19 patients requiring treatment. In addition, many other patients have been unable to receive medical care due to the focus on COVID-19 patients.
2. **Education:** Schools and universities in both cities were closed for long periods of time during the pandemic, with many schools shifting to online learning. This has had significant impacts on students' education and their ability to attend classes.
3. **Economy:** The pandemic has had significant impacts on the economy of the twin cities, with many businesses forced to close or reduce operations due to lockdowns and other restrictions. The tourism industry, in particular, has been hit hard.
4. **Public Safety:** The pandemic has led to increased safety measures, including the wearing of masks and social distancing, in both cities. However, compliance with these measures has been mixed, with many people still not following the guidelines.
5. **Mental Health:** The pandemic has had significant impacts on the mental health of people living in the twin cities. The stress and uncertainty of the pandemic, as well as the social isolation, have led to increased anxiety and depression in many people.
6. **Changes in transportation:** With more people working from home, there has been a significant decrease in traffic congestion in many cities. However, public transportation systems have been severely impacted by the pandemic, with many people avoiding them altogether due to concerns about the spread of the virus.
7. **Changes in public space use:** With many people staying at home, public spaces such as parks and playgrounds have become more important than ever as places for exercise and recreation.

However, the pandemic has also made it more difficult to gather in large groups, leading to restrictions on the use of public spaces.

8. **Increase in inequality:** The pandemic has had a disproportionate impact on low-income and marginalized communities, who are more likely to live in crowded housing conditions and have limited access to healthcare. This has highlighted existing inequalities in many cities and made it clear that more needs to be done to address them.

4.1.1. Institutional Indicators

Table 3 Impact on Institutions

Variables	Type of Area		p
	Planned Ar (%)	Unplanned Area (%)	
Opening of Government Institutes During Co lockdown			0.042
Yes	76.8%	87.3%	
No	23.2%	12.7%	
Maintenance of Standards of Operation			0.01
Yes	49.1%	65.8%	
No	50.9%	34.2%	
Social Distancing in Public			0.036
Yes	67.2%	79.7%	
No	32.8%	20.3%	
Reducing the prices of the basic utilities			0.000
Yes	16.2%	1.3%	
No	83.8%	98.7%	
Online documentations			0.134
Yes	34.7%	25.3%	
No	65.3%	74.7%	
Educate the public about Covid SOPs			0.000
Yes	93.0%	73.4%	
No	7.0%	26.6%	
Educating people about Covid			0.263
Yes	68.6%	75.9%	
No	31.4%	24.1%	
The trust of the public in institutions			0.000
Yes	25.8%	51.9%	
No	73.8%	48.1%	

Like many other cities in the world, Islamabad and Rawalpindi in Pakistan have been impacted by the COVID-19 pandemic. The local authorities have taken various measures to contain the spread of the virus and to provide medical care to those affected. Both cities have set up dedicated COVID-19 hospitals and quarantine centers to isolate and treat infected

individuals. The hospitals are equipped with necessary medical equipment, and the government has also arranged for additional ventilators to cater to the increasing number of patients. Furthermore, the government has implemented strict lockdowns and social distancing measures to minimize the spread of the virus. Schools, universities, and other public places have been closed, and people have been encouraged to stay at home and avoid unnecessary travel.

In addition, the government has also launched awareness campaigns to educate people about the importance of wearing masks, washing hands frequently, and maintaining social distancing. However, despite these efforts, the COVID-19 pandemic has continued to impact the region. The government has faced several challenges, including a shortage of medical supplies, inadequate testing facilities, and insufficient resources to cater to the growing number of patients. In conclusion, while Islamabad and Rawalpindi have taken measures to contain the spread of COVID-19, the pandemic has still had a significant impact on the region. The government and local authorities need to continue to work together to combat the virus and provide necessary medical care to those affected. The public doesn't trust a public institution during the wake of COVID-19. The administration, although, had only allowed grocery, dairy, fruit, and vegetable shops in the related areas to remain open.

Based on the given crosstabulation, it appears that the distance from the hospital to houses in the planned area is generally shorter than that in the unplanned area. Here's the breakdown: In the planned area, 139 people live within 1-10 km of the hospital, while 71 people live within 1-10 km in the unplanned area. In the planned area, 131 people live within 11-20 km of the hospital, while only 8 people live within 11-20 km in the unplanned area. Overall, out of the total 349 respondents, 270 people live within 1-10 km of the hospital and 79 people live within 11-20 km of the hospital. therefore, we can conclude that the majority

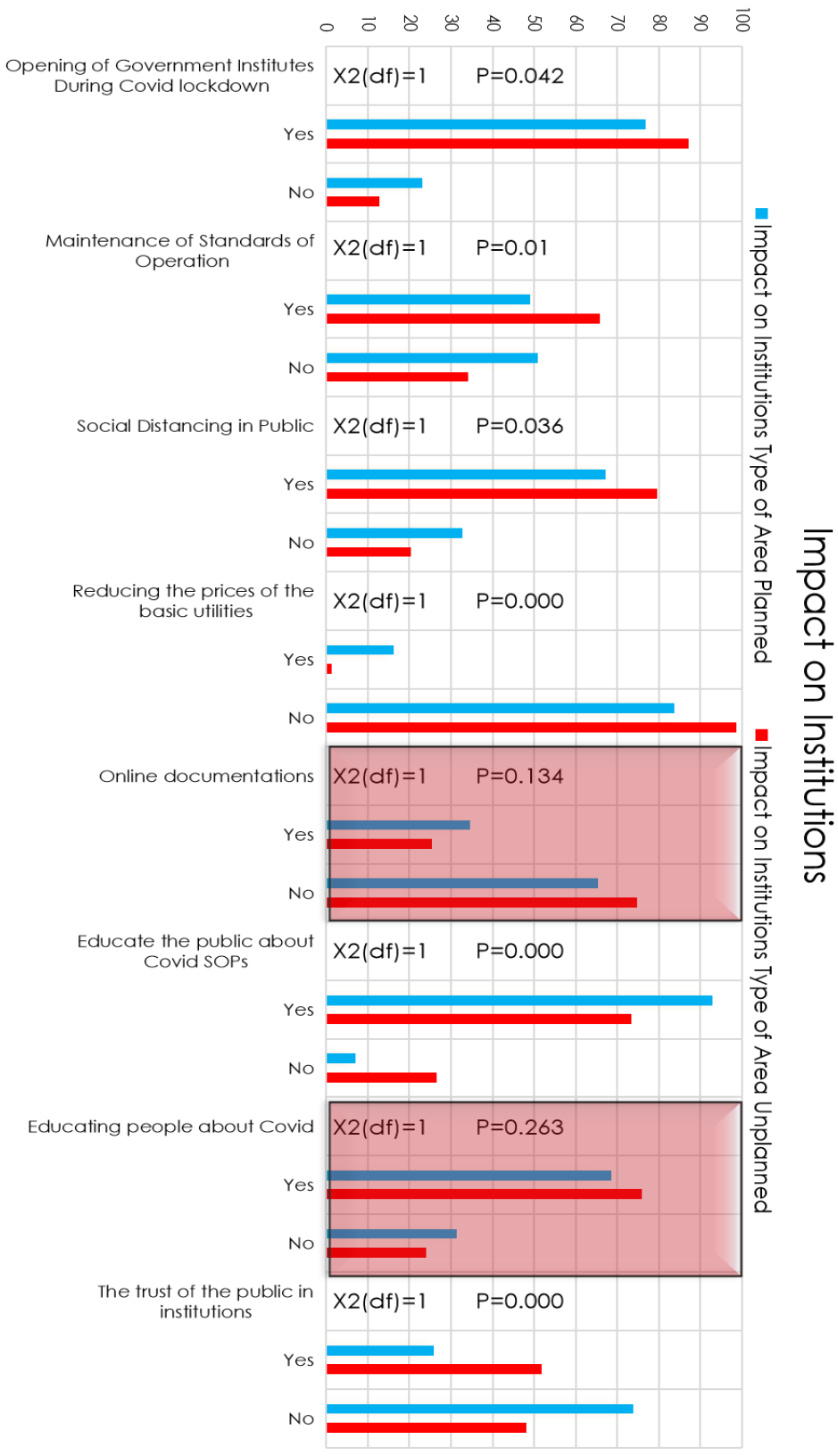
of people (210 out of 349) live within 1-10 km of the hospital, and most of them are in the planned area.

Based on the table, the survivability rate of Covid patients in the city varies by the type of area they live in. In the planned areas, 206 Covid patients had a high survivability rate, while 61 had a low survivability rate, out of a total of 267 Covid patients. This means that the survivability rate for Covid patients in planned areas was 77.1% (206/267) for high survivability and 22.9% (61/267) for low survivability. In the unplanned areas, 64 Covid patients had a high survivability rate, while 18 had a low survivability rate, out of a total of 82 Covid patients. This means that the survivability rate for Covid patients in unplanned areas was 78.0% (64/82) for high survivability and 22.0% (18/82) for low survivability. Overall, out of a total of 349 Covid patients in the city, 270 had a high survivability rate and 79 had a low survivability rate. This means that the overall survivability rate for Covid patients in the city was 77.4% (270/349) for high survivability and 22.6% (79/349) for low survivability.

The *p* value Sig = 1.000 this *p* value shows the similarity among the respondents because the *p* value is greater than 0.05. The death rate due to Covid-19 in Islamabad and Rawalpindi varied depending on the time period and the number of cases reported in the region. At that time, Islamabad and Rawalpindi were among the worst-hit cities in Pakistan by Covid-19. The death rate was constantly fluctuating due to the emergence of new cases and the effectiveness of containment measures.

In summary, the rate of Coronavirus cases in the area appears to be higher in unplanned areas with a low rate of Coronavirus cases, while planned areas with a high rate of Coronavirus cases had the lowest number of cases. It's important to note that this analysis is based solely on the data provided and may not represent the full picture of the Coronavirus situation in the area. The above Table shows the Chi-square test, this test gave the *p* value Sig = .017 this *p* value shows the Dis-similarity among the respondents because the *p* value is less than 0.05.

In terms of the management of the COVID-19 pandemic in Pakistan, there have been both positive and negative aspects. Overall, it can be said that the Pakistani government made efforts to manage the COVID-19 pandemic, but there were also areas for improvement. Based on the given crosstabulation table, it appears that the answer to the question "Do you think the Covid 19 pandemic was properly managed by the Government?" is strongly associated with the type of area (planned vs. unplanned). Out of the 97 respondents from the planned area, 69 answered "Yes" while 28 answered "No". On the other hand, out of the 252 respondents from the unplanned area, only 51 answered "Yes" while 201 answered "No". Therefore, it seems that people from planned areas were more likely to think that the Covid 19 pandemic was properly managed by the Government compared to those from unplanned areas. The *p* value Sig = .089 This *p* value shows the similarity among the respondents because the *p* value is greater than 0.089.



Graph 1 Impact on Institutions

4.1.2. Medical & Health Indicators

Table 4 Impact on Medical Health

Variables	Type of Area		p
	Planned Area	Unplanned Area	
	(%)	(%)	
Proper treatment			0.001
Yes	65.2%	44.3%	
No	34.8%	55.7%	
Sufficient equipment availability			0
Yes	41.1%	3.8%	
No	58.9%	96.2%	
Healthcare workers availability			0.009
Yes	56.7%	73.4%	
No	43.3%	26.6%	
Healthcare workers paid more durir Pandemic			0.114
Yes	45.2%	2.7%	
No	54.4%	73.4%	
Full attendance of hospital staff			0
Yes	77.4%	86.1%	
No	22.6%	13.9%	
Availability of medicines			0.000
Yes	34.1%	57.0%	
No	65.9%	43.0%	
Treatment of patients other than Covid			0
Yes	61.9%	83.5%	
No	38.1%	16.5%	
Provision of temporary hospital facilities			0.025
Yes	59.3%	73.4%	
No	40.7%	26.6%	
Provision of beds and ventilators			0.001
Yes	17.0%	36.7%	
No	83.0%	63.3%	

Table 5 Impact on Medical Health

Variables	Type of Area		p
	Planned Area	Unplanned Area	
	(%)	(%)	
The coping ability of the city			0.318
Yes	74.1%	68.4%	
No	25.9%	31.6%	
Conversion into Hospital			0
Yes	7.4%	45.6%	
No	92.6%	54.4%	
Facilitation for Covid patients			0
Yes	31.9%	75.9%	
No	68.1%	24.1%	
Distance of hospital from home			0.000
1-10km	51.5%	89.9%	
11-20 km	48.5%	10.1%	
Vulnerability of city			0.001
High	44.8%	65.8%	
Low	55.2%	34.2%	
Survivability rate of Covid patients			1.000
High	76.3%	77.2%	
Low	23.7%	22.8%	
Death rate			0
High	41.1%	10.1%	
Low	58.9%	89.9%	
Coronavirus cases rate			0.017
High	26.3%	40.5%	
Low	73.7%	59.5%	
Management of Covid 19 pandemic			0.089
Yes	25.6%	35.4%	
No	74.4%	64.6%	

It appears that more patients in planned areas (176) received proper treatment compared to those in unplanned areas (35) as they responded "Yes" to the question "Do you think the proper treatment was provided by Government hospitals?". On the other hand, a higher number of patients in unplanned areas (44) responded "No" compared to those in planned areas (94). The

p value Sig = .001 this *p* value shows the dis-similarity among the respondents because the *p* value is less than 0.05.

It is also important to follow guidelines and protocols for COVID-19 prevention and treatment, such as wearing masks, maintaining social distancing, and getting vaccinated when possible. The *p* value Sig = .000, this *p* value shows the dis-similarity among the respondents because the *p* value is less than 0.05. According to the collective responses of the public in our case study areas we came to know 211 respondents gave a positive response and 138 respondents gave a negative response to a question mentioned above. The strength of negative responses is more as compared to the positive. gave the *p* value Sig = .009 this *p* value shows the dis-similarity among the respondents because the *p* value is less than 0.05.

Based on the crosstabulation table provided, it appears that not all hospital staff were able to keep their attendance full during the pandemic. Out of a total of 349 hospital staff, 277 were planned to attend and 209 of them were able to keep their attendance full, while 68 were unable to do so. On the other hand, out of the 72 unplanned staff, only 11 were able to keep their attendance full, while 61 were not able to do so. Therefore, it can be inferred that the pandemic had an impact on hospital staff attendance, with a significant number of planned and unplanned staff being unable to maintain full attendance.

Based on the given crosstabulation, it appears that the availability of medicines for mild symptoms during the pandemic varied depending on the type of area. In planned areas, 92 respondents reported that these medicines were available all the time during the pandemic, while 178 respondents reported that they were not. In unplanned areas, 45 respondents reported that these medicines were available all the time, while 34 respondents reported that they were not. Overall, out of the 349 respondents, 137 reported that these medicines were available all the time, while 212 reported that they were not.

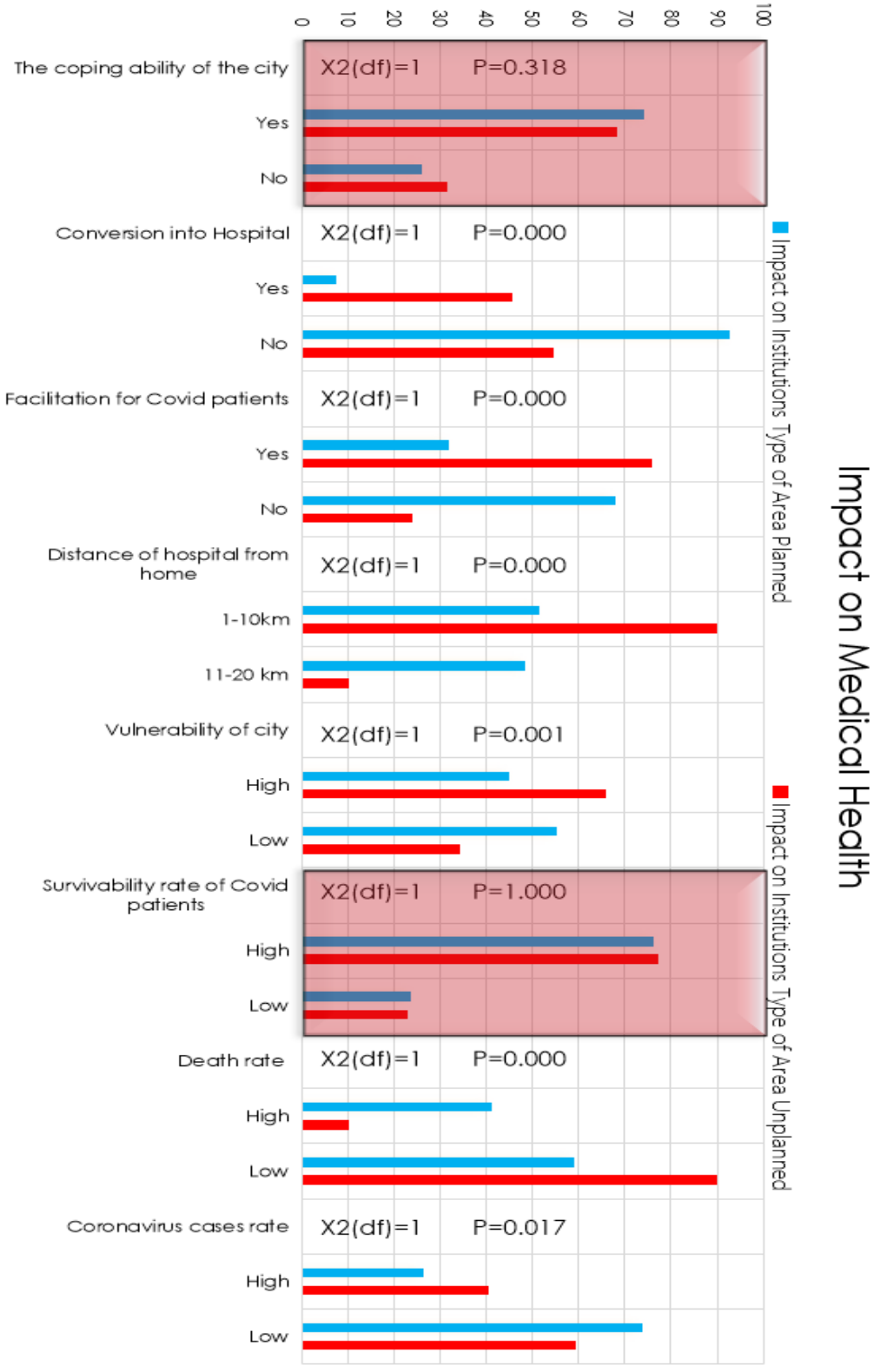
It's worth noting that this crosstabulation only provides a snapshot of respondents' experiences and perceptions regarding the availability of medicines for mild symptoms during the pandemic. It does not provide any information on the actual availability of these medicines or the factors that may have contributed to differences in availability between planned and unplanned areas. The *p* value Sig = .000 This *p* value shows the dis-similarity among the respondents because the *p* value is less than 0.05.

Based on the crosstabulation provided, it appears that some patients with other diseases were entertained in hospitals, as 233 out of 349 patients (or 66.8%) responded "Yes" to the question. However, 116 patients (or 33.2%) responded "No", indicating that not all patients with other diseases were entertained during their hospital stay. It is worth noting that the crosstabulation also shows a difference in the proportion of patients who were entertained based on the type of area they were in, with a higher percentage of patients in planned areas reporting being entertained compared to those in unplanned areas.

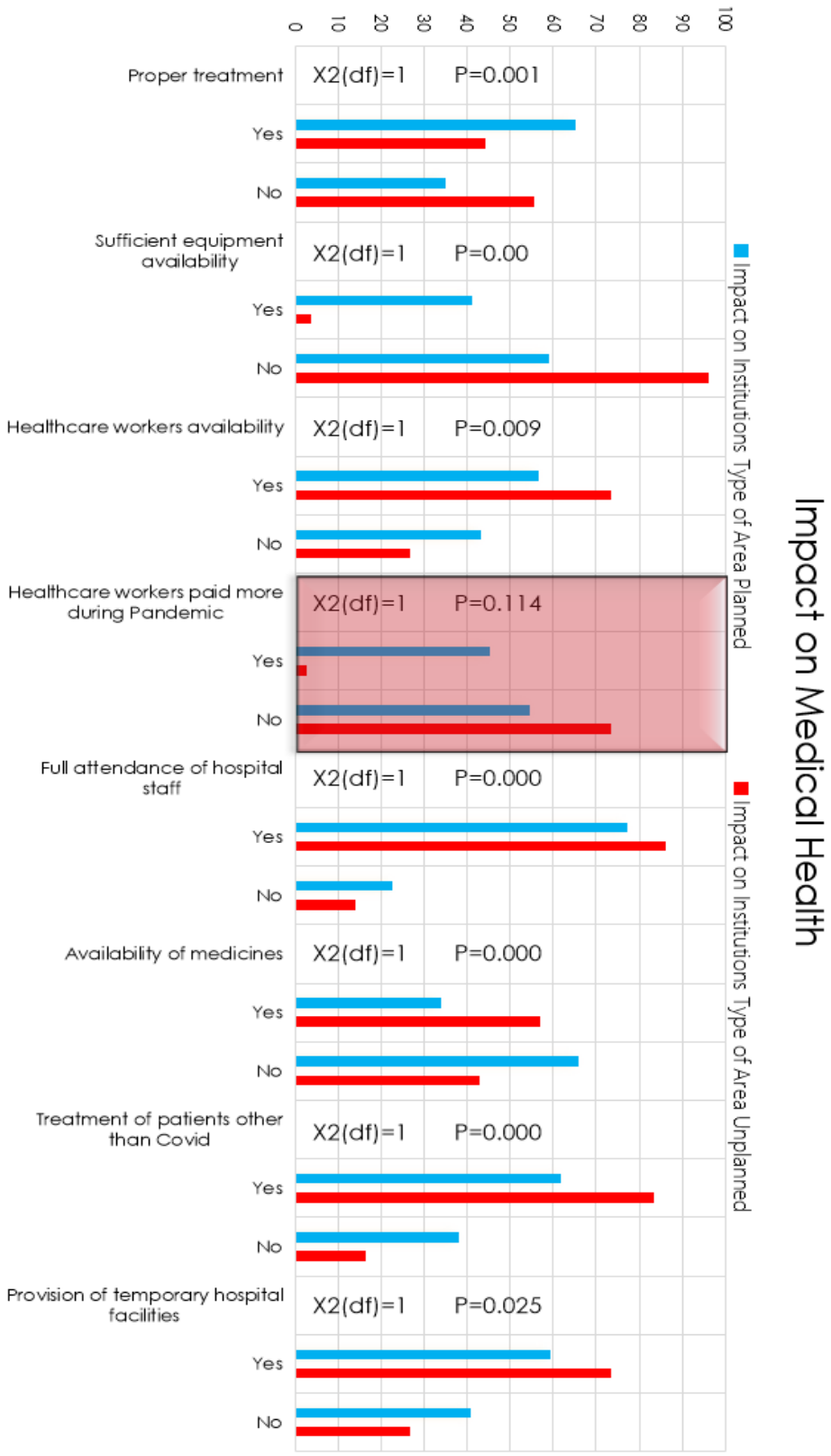
Overall, the goal of these temporary hospital facilities was to provide a safe and supportive environment for patients with mild symptoms of COVID-19. By taking pressure off of hospitals and medical centers, these facilities helped ensure that all patients received the care they needed during this challenging time. The Chi-square test gave the *p* value Sig = .025 this *p* value shows the dis-similarity among the respondents because the *p* value is less than 0.05.

Based on the given crosstabulation, it appears that beds and ventilators were not available for all patients in both planned and unplanned areas. Out of a total of 349 patients, only 75 patients reported that they had access to both beds and ventilators. On the other hand, 274 patients reported that they did not have access to both beds and ventilators. Looking at the breakdown by type of area, it appears that there were more patients in the unplanned area who reported that they did not have access to both beds and ventilators compared to the planned area. Specifically, out of 79 patients in the unplanned area, 50 reported that they did not have access

to both beds and ventilators, whereas in the planned area, out of 270 patients, 224 reported that they did not have access to both beds and ventilators. The table shows the Chi-square test, this test gave the *p* value Sig = .001 this *p* value shows the dis-similarity among the respondents because the *p* value is less than 0.05.



Graph 2 Impact on Medical Health



Graph 3 Impact on Medical Health

4.1.3. Infrastructural indicators

Table 6 Impact on Infrastructure

Variables	Type of Area		p
	Planned Ar	Unplanned Area	
	(%)	(%)	
Effect on water availability			0
Yes	18.1%	45.6%	
No	81.9%	54.4%	
Increase in Electricity load shedding			0.002
Yes	14.4%	2.5%	
No	85.6%	97.5%	
Increase in Gas load shedding			0
Yes	32.6%	0.0%	
No	67.4%	100.0%	
Increase in traffic volume			0.592
Yes	1.9%	0.0%	
No	98.1%	100.0%	
Increase in the number of trips			0
Yes			
No			
Public transport keeps operating			0.443
Yes	54.4%	59.5%	
No	45.6%	40.5%	
The ability of people to move privately			0
Yes	73.0%	46.8%	
No	27.0%	53.2%	
The decline in Internet facility			1.000
Yes	4.8%	5.1%	
No	95.2%	94.9%	

During the early days of COVID-19 people face issues regarding the availability of water. During the first lockdown, no of water boozers that supply water to twin cities was reduced. But this issue was resolved by the city government. They have issued new SOPs. All necessary

facilities were made available to the citizens. The rate per water boozer was increased, which was the main problem that citizens faced during COVID-19 regarding the availability of water. If we look at the above table, we may come to know that only 41 people answered “yes” out of 349 people, rest answered “No”. Moreover, this table depicts that only 79 people (Interviewee) were from unplanned areas whereas the rest 270 people out of 349 people were from planned areas. The above table was obtained by performing a Chi-Square test. This table gave the *p* value (Sig value) that is 0.002, which is less than 0.005, which means that there exists a significant difference between the opinions of two groups of people.

Approximately 88.3% of people responded that the load shedding of electricity didn’t increase during the COVID-19 pandemic. The *p* value (Sig Value) is 0.00, which is less than 0.005, which means that there exists a significant difference between the opinions of two groups of people. Approximately 88.3% of people responded that the load shedding of gas didn’t increase during the COVID-19 pandemic.

During the early days of covid-19 people were restricted to their homes which resulted in low traffic volume on the roads. If we look at the table attached below, we may come to know that only 5 people out of 349 answered “Yes” while the rest of the other people answered “No”. Moreover, this table depicts that only 270 people were living in planned urban communities and the rest 79 were living in unplanned urban areas. Only 5 people from the Planned area responded “Yes” and the rest responded “No”.

The above table gave us the *p* value (Sig Value) that is 0.592, which is greater than 0.005, which means that there exists a similarity between the opinions of two groups of people. Approximately 98.6% of people responded that the traffic volume didn’t increase during the COVID-19 pandemic. Government-issued SOPs for these transports and these SOP are strictly implemented by law enforcement agencies. If we look at the table attached below, we may come to know that 194 people out of 349 answered “Yes” while the rest of the other people

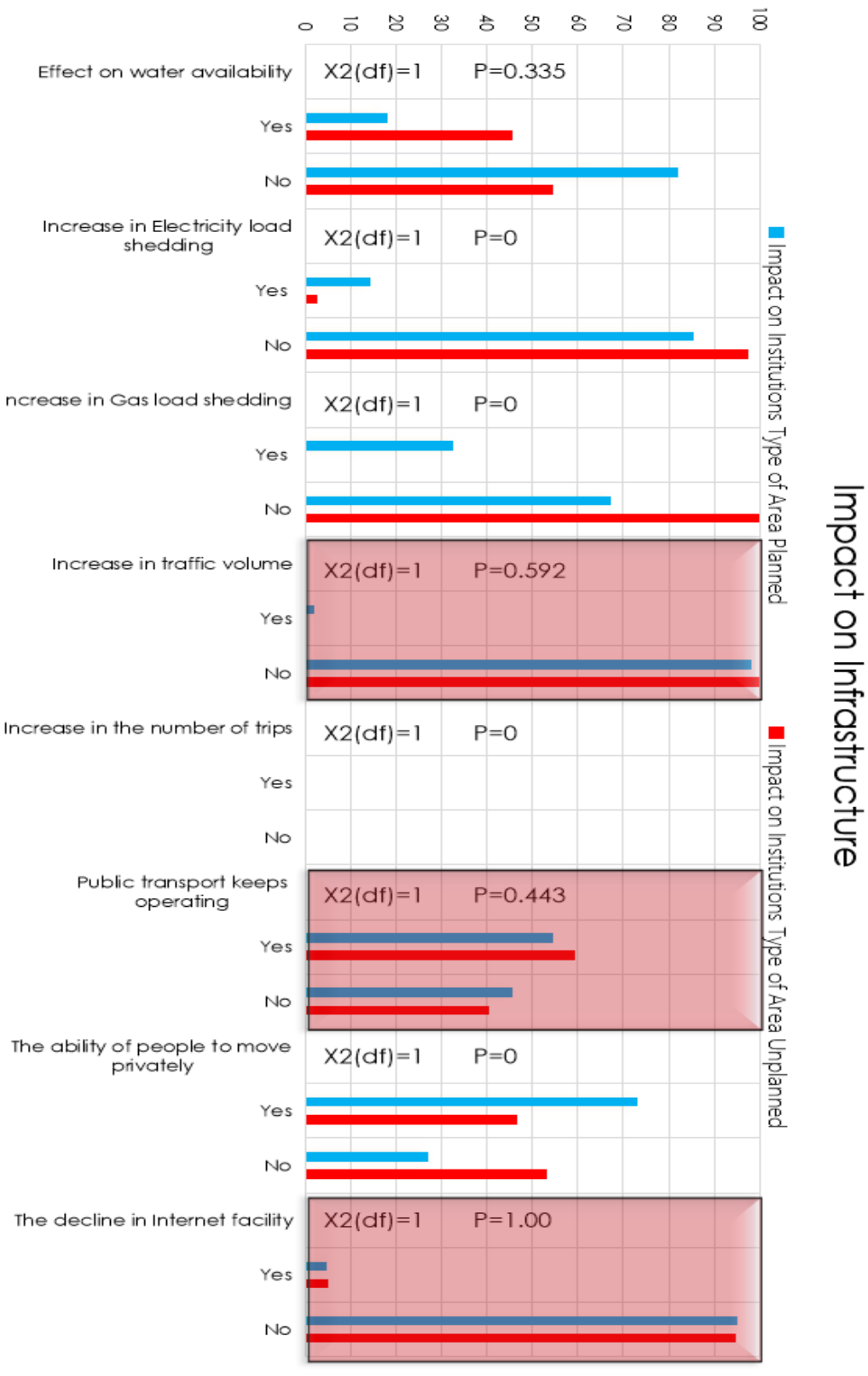
answered “No”. Moreover, this table depicts that only 270 people were living in planned urban communities and the rest 79 were living in unplanned urban areas. Only 147 people from the Planned area responded “Yes” and the rest responded “No”.

The above table gave us the *p* value (Sig Value) that is 0.443, which is greater than 0.005, which means that there exists a similarity between the opinions of two groups of people. Approximately 55.6% of people responded that public transport keeps operational during the COVID-19 pandemic. During the COVID-19 government imposed a lockdown on the whole country. People were restricted to their homes. All commercial and public activities were stopped or opened on alternate days because this trip generation was reduced.

After the first lockdown government issued rules and regulations which allowed people to move freely while fulfilling the SOPs that were prescribed by governments. If we look at the table attached below, we may come to know that 234 people out of 349 answered “Yes” while the rest of the other people answered “No”. This table gave us the *p* value (Sig Value) that is 0.000, which is less than 0.005, which means that there exists a significant difference between the opinions of two groups of people. Approximately 67% of people responded that people can use their personal/private vehicles for urgent tasks during the COVID-19 pandemic.

The internet facility did not decline during the Covid-19 lockdown. The table shows a crosstabulation between the type of area (planned or unplanned) and whether the internet facility declined during the Covid-19 lockdown. The data in the table represent the counts of the individuals who responded to the question about the internet facility during the lockdown. Out of a total of 349 respondents, 17 reported that the internet facility declined during the Covid-19 lockdown. Among those who reported a decline, 13 were from planned areas and 4 were from unplanned areas. On the other hand, 332 respondents reported that the internet facility did not decline during the lockdown. Among those who reported no decline, 257 were from planned areas and 75 were from unplanned areas. The table suggests that a relatively

small proportion of respondents experienced a decline in internet facilities during the Covid-19 lockdown, with the majority reporting no decline. Approximately 95.1% of people responded that internet facilities didn't decline during the COVID-19 pandemic.



Graph 4 Impact on Infrastructure

4.1.4. Economic Indicators

Table 7 Impact on Economy

Variables	Type of Area		p
	Planned Area	Unplanned Area	
	(%)	(%)	
Effect on monthly income			0.335
Yes	79.6%	84.8%	
No	20.4%	15.2%	
Increase in monthly income			0
Yes	25.9%	5.1%	
No	74.1%	94.9%	
Reduced salaries			0
Yes	47.0%	24.1%	
No	52.9%	75.9%	
Savings at time of a pandem			0.611
Yes	48.5%	51.9%	
No	51.5%	48.1%	
Fired from the job			0.218
Yes	3.3%	0.0%	
No	96.7%	100.0%	
Remained unemployed			0.199
Yes	25.6%	32.9%	
No	74.4%	67.1%	
Change in occupation			0
Yes	23.7%	5.1%	
No	76.3%	94.9%	

Table 8 Impact on Economy

Variables	Type of Area		p
	Planned Area	Unplanned Area	
	(%)	(%)	
Start any business			0
Yes	44.4%	20.3%	
No	55.6%	79.7%	
Work from Home			0
Yes	76.7%	7.6%	
No	23.3%	92.4%	
Distance from home to office			0
1-10 km	33.7%	65.8%	
11-20 km	48.1%	32.9%	
21-30 km	18.1%	1.3%	
Reduced attendance in office			0.675
Yes	71.1%	68.4%	
No	28.9%	31.6%	
Increase in online earning			0.324
Yes	96.7%	93.7%	
No	3.3%	6.3%	
Online shopping increase			0.251
Yes	50.7%	43.0%	
No	49.3%	57.0%	
Availability of online shoppin			0.008
Yes	81.5%	93.7%	
No	18.5%	6.3%	

Out of the 349 respondents, 74 reported an increase in monthly income during the Covid lockdown period, while 275 reported no increase. Furthermore, we can also see that the respondents are divided into two types of areas: Planned and Unplanned. Out of the 270 respondents from Planned areas, 70 reported an increase in monthly income, while 200

reported no increase. Out of the 79 respondents from Unplanned areas, 4 reported an increase in monthly income, while 75 reported no increase.

According to the chi-square test the *p* value is .000 this *p* value is less than .05 and this *p* value show the dissimilarity among the peoples of the case study area. There was a mixed response from the community. It came to know about the difference between positive and negative responses. This shows that the positive responses are less than negative. The monthly income does not increase during lockdown.

The respondents were also asked whether they received reduced salaries during the Covid lockdown, with a total of 146 respondents answering yes and 203 respondents answering no. Among respondents from Planned areas, 127 answered yes and 143 answered no regarding reduced salaries during Covid lockdown. Among respondents from Unplanned areas, 19 answered yes and 60 answered no regarding reduced salaries during Covid lockdown. Therefore, out of the total 270 respondents from Planned areas, 47.0% reported reduced salaries during Covid lockdown, while out of the total 79 respondents from Unplanned areas, 24.1% reported reduced salaries during Covid lockdown. According to chi square test the *p* value is .000 this *p* value is less than .05 and this *p* value show the dis similarity among the peoples of the case study area.

The question "Did you have any savings at the time of the pandemic?" was asked among individuals living in two types of areas: Planned and Unplanned. With the help of chi square test, we get to know about the *p* value which is .611 this *p* value is greater than .05 it shows the dis similarity among the peoples in our case study area.

People did not fire from their job during covid 19. According to the chi-square test the *p* value is .218 this *p* value is greater than .05 and this *p* value shows the similarity among the peoples of the case study area. Out of the 349 respondents, 95 individuals reported that they remained unemployed during Covid lockdown. Of these 95 individuals, 69 lived in planned areas while

26 lived in unplanned areas. According to chi square test the *p* value is .199 this *p* value is greater than .05 and this *p* value show the dis-similarity among the peoples of the case study area. It shows that the most of the respondents do not remain unemployed during covid lockdown. We can see that out of the 349 respondents, 68 had to change their occupation during Covid lockdown while 281 did not. The *p* value is .000 which is less than .05 it shows the similarity among the respondents in our case study area.

It appears that a higher proportion of individuals living in Planned areas had to start a business during Covid lockdown to support their earnings, compared to those living in Unplanned areas. The *p* value is p =.000 and it is less than .05 it shows the similarity among the respondents in our case study area. Work from home is more preferred in the planned area compared to the unplanned area. With the help of Chi square test, we get to know about the *p* value =.000 and it is less than .05 it shows the similarity among the respondents in our case study area.

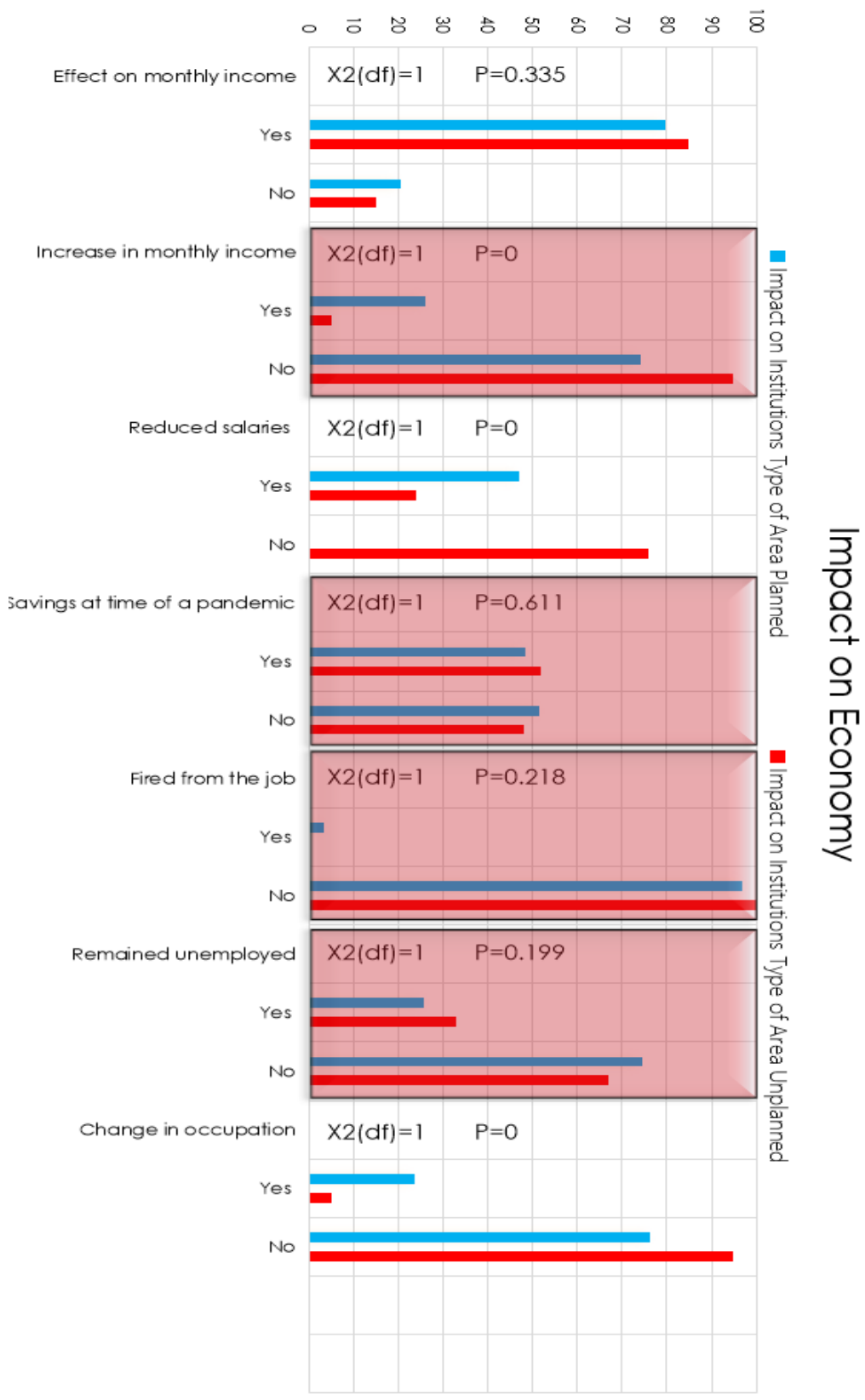
The distance from home to the office is categorized into three groups (1-10 km, 11-20 km, and 21-30 km) and the type of area is categorized as planned and unplanned. The total count of respondents is 349. The majority of the respondents (143) reported a distance of 1-10 km from their home to the office, regardless of the type of area. It appears that attendance in the office was reduced for some employees. Of the total 349 employees in the office, 246 employees responded "Yes" when asked if their attendance was reduced, while 103 employees responded "No". With the help of Chi square test, we get to know about the p =.675 and it is greater than .05 it shows the dis-similarity among the respondents in our case study area.

The online earnings increased during the COVID lockdown in Pakistan, as they did in many other countries. Based on the crosstabulation provided, it appears that online earning increased during the Covid lockdown. Out of the total sample of 349 respondents, 335 reported that their online earnings increased during the lockdown. Specifically, 261 of those respondents were

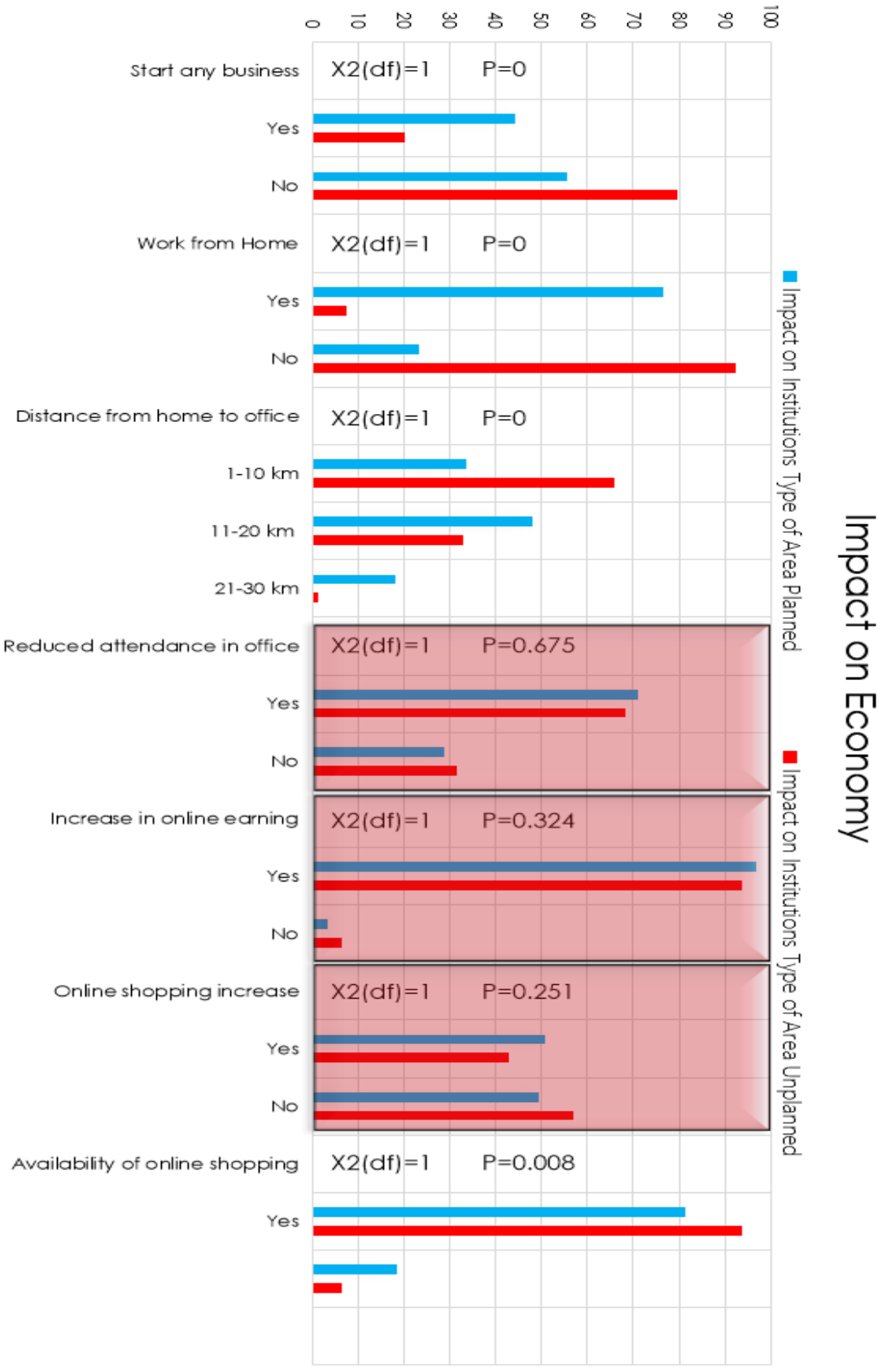
from planned areas, while 74 were from unplanned areas. With the help of Chi square test, we get to know about the p =.324 and it is greater than .05 it shows the dis-similarity among the respondents in our case study area. With the help of the result, the overall responses in case study area shows that online earning increased during covid lockdown.

Based on the provided crosstabulation table, we can see that out of a total of 349 respondents, 171 have started shopping for basic utilities through online mode, while 178 have not. Breaking down the responses by type of area, we can see that out of the 270 respondents from planned areas, 137 have started shopping for basic utilities through online mode, while 133 have not. Out of the 79 respondents from unplanned areas, 34 have started shopping for basic utilities through online mode, while 45 have not. With the help of overall responses, we came to know that most of the respondents start shop out for basic utilities through online mode.

It appears that the option of online shopping or by phone was available in the city. Out of the total 349 respondents, 294 indicated that online shopping or phone orders were available in their area. The p value is .008 which is less than .05 it shows the similarity among the respondents in our case study area. We came to know about the all responses. The positive responses are more as compared to the negative, so online shopping or by phone was available in our case study area.



Graph 5 Impact on Economy



Graph 6 Impact on Economy

4.1.5. Social Indicators

Table 9 Social Impacts

Variables	Type of Area		p
	Planned Area (%)	Unplanned Are (%)	
People were ready to help financial			0
Yes	37.8%	7.6%	
No	62.2%	92.4%	
people were available for listening you			0.021
Yes	84.8%	94.9%	
No	15.2%	5.1%	
Disturbance of social networking			1
Yes	61.5%	62.0%	
No	38.5%	38.0%	
Taking precautionary measures			1.000
Yes	54.1%	50.6%	
No	45.9%	49.4%	
Maintenance of distance of 6 feet			0
Yes	20.7%	48.1%	
No	79.3%	51.9%	
Application of face mask			0.000
Yes	94.1%	73.4%	
No	5.9%	26.6%	
Usage of sanitizer			0
Yes	50.4%	98.7%	
No	49.6%	1.3%	
Scaring of theft and robbing at hou			0.000
Yes	34.1%	57.0%	
No	65.9%	43.0%	
Remaining safe and secure in the wake of Covid			0.174
Yes	78.5%	70.9%	
No	21.5%	29.1%	

Table 10 Social Impacts

Variables	Type of Area		p
	Planned Area	Unplanned Area	
	(%)	(%)	
Stopping commercial activities			0
Yes	60.7%	92.4%	
No	35.2%	7.6%	
Ending of business			0
Yes	55.2%	91.1%	
No	44.8%	8.9%	
Stopping educational activities			0.006
Yes	91.9%	100.0%	
No	8.1%	0.0%	
Downsizing of industries			1.000
Yes	99.3%	100.0%	
No	0.7%	0.0%	
Closing of industries			0.337
Yes	67.4%	73.4%	
No	32.6%	26.6%	
Movement of people to another cit			0.001
Yes	31.9%	53.2%	
No	68.1%	46.8%	
People stayed in their hometown			0.265
Yes	78.1%	84.8%	
No	21.9%	15.2%	
Maintenance of social distance			0.512
Yes	61.5%	65.8%	
No	38.5%	34.2%	
Half attendance of people during prayer time			0.189
Yes	63.3%	54.4%	
No	36.7%	45.6%	

A total of 349 respondents were asked about the situation of willingness of people to help you financially amid Covid Lockdown in Islamabad/Rawalpindi. The 270 responses were recorded in Planned area while 79 responses were recorded from Unplanned area. As shown

in the table, the *p* value is 0.000 which means that there exists a significant difference between opinion of two groups. The result shows that, many people did not receive financial help during the Covid Lockdown. Only a small portion of people got the financial help during the Covid Lockdown. This is also evident from the Chi-Square test and the *p* value.

The question regarding availability of people to listen you over phone or face time in social isolation was asked from the respondents. The table shows the *p* value which is 0.21. The *p* value of .021 tells us that, there exists a significant difference in opinion of two group. In a nutshell, the responses of two groups are not look alike and they vary from one group to the other. The result tells us that, a significant portion of people had the opportunity to sharing their thoughts with others in the time of social isolation. While, only a small portion of people could not get the opportunity to find someone to share their thoughts over phone or face time.

The question about disturbance of social networking was asked about the respondent. The Chi-Square test gives the *p* value of 1.0 which means that the responses look alike and there is no significant difference exists between opinions of two groups. The result tells us that, majority of the respondents said that, social networking was disturbed amid covid lockdown.

Residents of Islamabad and Rawalpindi were asked about the situation of precautionary measures about social distancing. Here, the *p* value is .610 which depicts that, differences in opinion between two groups is not significant here. People were asked to follow the precautionary measures in the wake of Covid. Maintaining a distance of 6 feet was one of them. The *p* value which is .000. This *p* value indicates about the significant differences about the opinions of two groups.

A total of 349 people were asked about the question of sanitizer usage during the pandemic period. The Chi-Square test was performed to see the broader picture of this scenario. According to this test, the *p* value is .000 which tells the significant difference about the opinions of two groups. The major portion of the respondents said that, there was no fear of

theft and robbery at homes during the lockdown. While, the other group said yes about the existence of fear of theft and robbery at homes during the lockdown time. This result shows a positive sign somehow that, the residents of Islamabad and Rawalpindi felt quite safe from any type of robbery and crime during the lockdown time. The *p* value which is .174. This *p* value tells us that, the opinion difference between two groups is not significant here. The result tells the responses of respondents in a clear picture. Majority of the respondents said that, yes people remained safe and secure in the wake of Covid-19 lockdown.

Majority of people said yes, the commercial activities were stopped during the Covid lockdown. While, the other group said that, the commercial activities did not stop during the lockdown time. The respondents were asked about the adverse impact of Covid lockdown on the business activities. Here, the *p* value is .000 which depicts that, the opinion difference of two groups is significant here and they vary from each other. It is obvious from the result that, there exists a significant difference in opinions of two groups. Majority of the people said yes, the business of people ended quickly during the lockdown time. Whereas, the other group said that, the business of people did not end during the lockdown time.

The residents of Islamabad and Rawalpindi were asked about the management of educational activities during the lockdown time. This test gave the *p* value which is .006 which tells us that, there exists a significant difference in opinions of two groups. In a nutshell, their responses vary from each other. People were asked about the ending of educational activities during the Covid lockdown and majority of them said yes. While, a minor portion of people said no about the closing of educational activities. This result shows that, educational activities has seen a major decline in Covid lockdown.

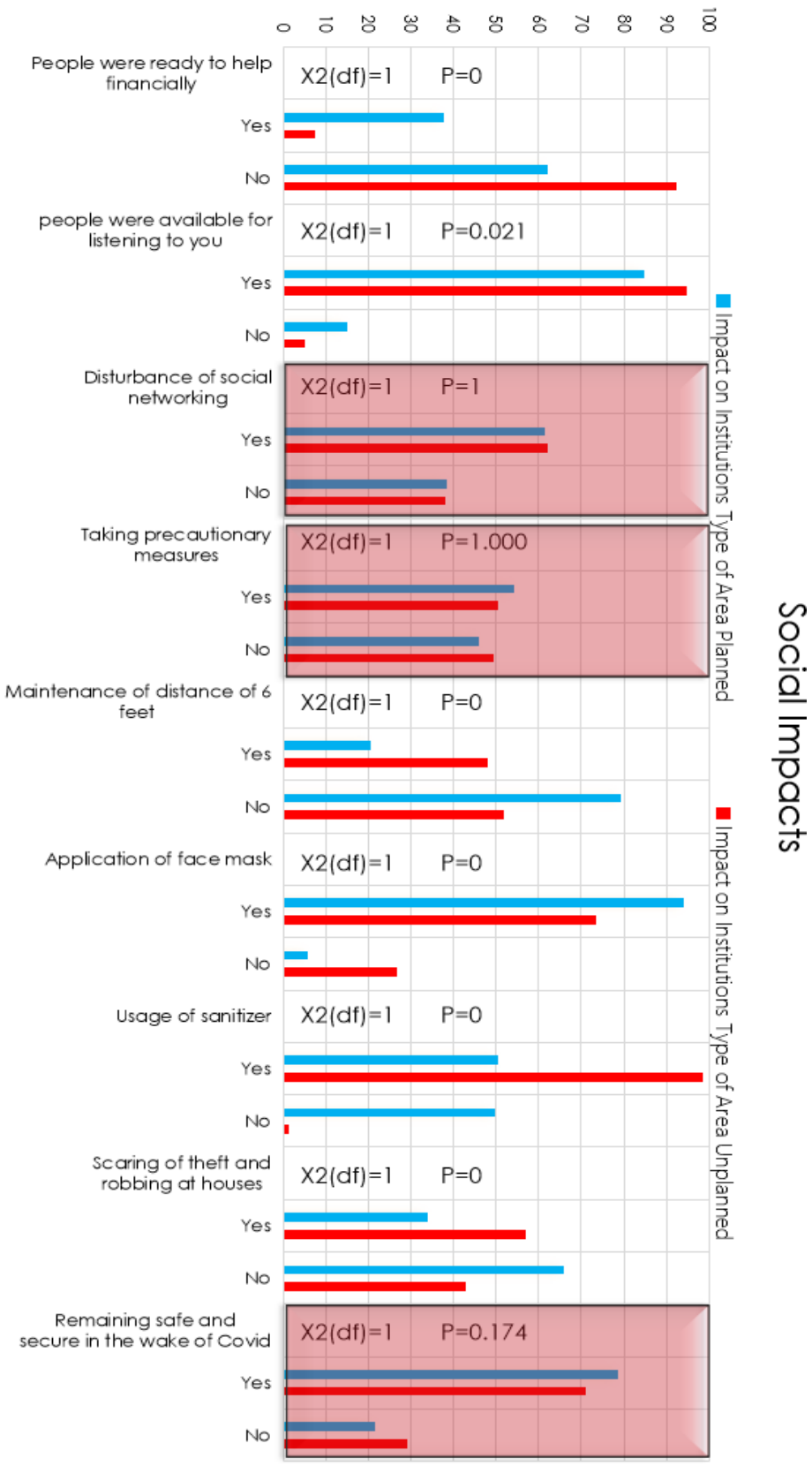
The residents of Islamabad and Rawalpindi were asked the same question about downsizing of industries in the Covid lockdown time. The *p* value here is 1.000 which depicts that, the opinion difference between two groups is not significant here. The result shows the results of

opinion difference of two groups. The residents of Islamabad and Rawalpindi were asked about the migration pattern in the time of Covid lockdown. Chi-Square test was performed here and its *p* value was examined. For this situation, the *p* value is .001 which shows a specific pattern. The *p* value lets us know that, the assessment contrast of two groups is significant here and it differs from one group to the other.

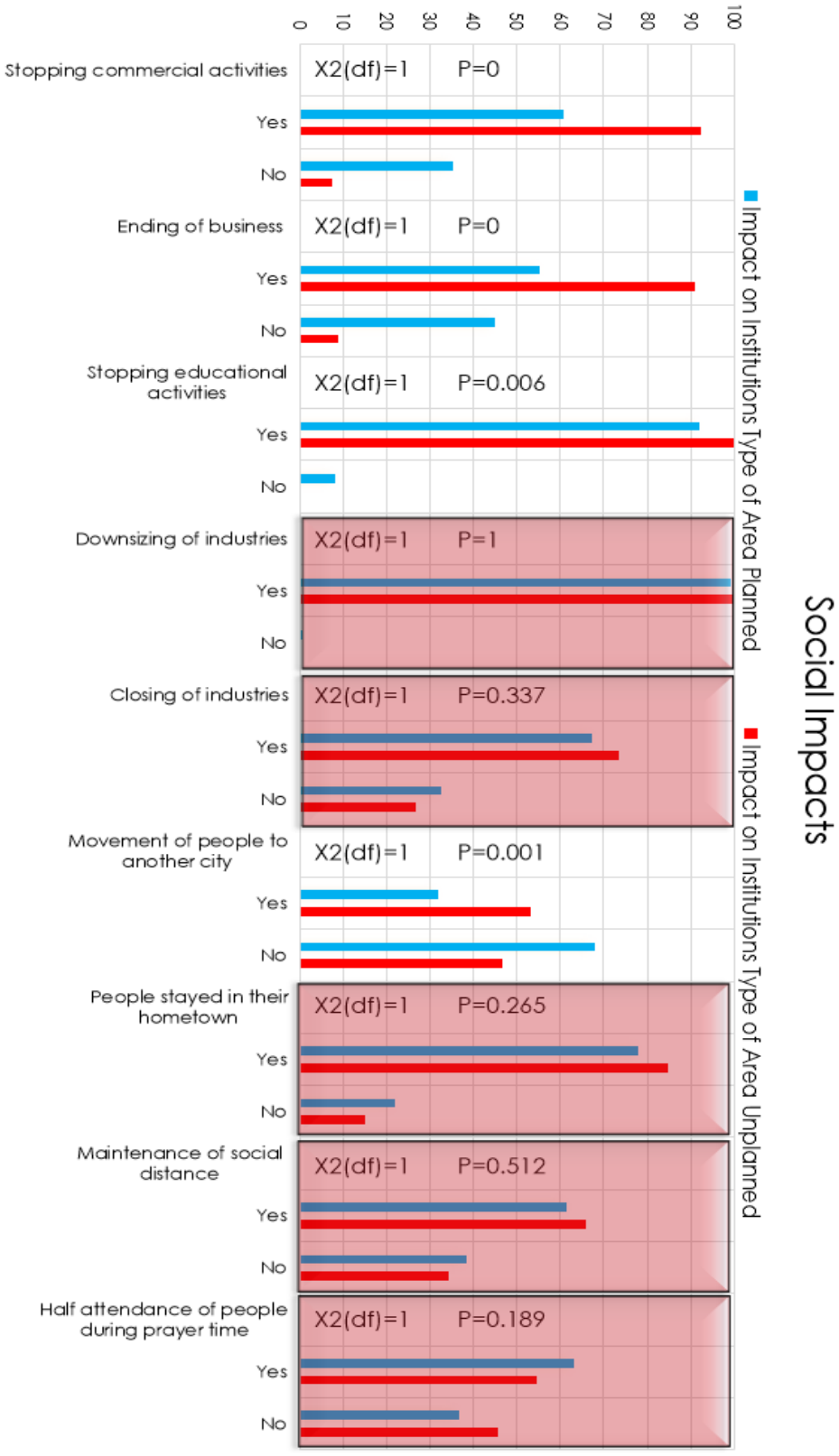
Since, the Covid lockdown has caused a serious wave of despair among people, so, people started moving to other cities. In this situation, many people preferred to stay in their hometown rather than doing migration. Here the *p* value is .265 which suggests that, the opinion difference of two groups is not significant here. The result shows us a clear picture about the responses of respondents. The majority of the respondents managed to stay in their hometowns rather than migrating to the other cities.

The question of maintenance of social distancing in mosque was asked to 349 residents of Islamabad and Rawalpindi. The Chi-Square test gave us the *p* value which basically examine the statistically difference among the opinions of two groups. In this case, the *p* value is .512 which means that, the opinion difference between two groups is not significant here.

Majority of the group said yes, the attendance of the worshippers was reduced to half during the Covid lockdown days. While, the other group said that, the attendance of the people did not reduce to half in Mosques during the Covid lockdown days. This shows a mixed response from the residents of Islamabad and Rawalpindi. Majority of people were of the view that, the social distancing was being followed by people in the Mosques which shows the positive attitude of the people.



Graph 7 Social Impacts



Graph 8 Social Impacts

4.2. Normalization

In order to evaluate the socioeconomic impacts of Covid-19 in twin cities, the following indices have been constructed:

- Infrastructure Urban Resilience Index
- Economy Urban Resilience Index
- Social Urban Resilience Index
- Utility Resilience Index

4.2.1. Sub-indices used in Infrastructure Resilience Index

Table 11 Selected Sub-indices for Infrastructure Resilience Indicator.

Sr. No.	Infrastructure Sub indicators
1	Management of Covid -19 Pandemic
2	Sufficient equipment availability
3	Availability of medicines
4	Provision of temporary hospital facilities
5	Provision of beds & Ventilators
6	Treatment of patients other than Covid -19

4.2.2. Sub-indices used in Economy Resilience Index

Table 12 Selected Sub-indices for Economy Resilience Indicator.

Sr. No.	Economic Sub indicators
1	Work from Home
2	Increase in online earning
3	Increase in online shopping
4	Reduced salaries
5	Remained unemployed
6	Change In occupation

4.2.3. Sub-indices used in Social Resilience Index

Table 13 Selected Sub-indices for Social Resilience Index

Sr. No.	Social Sub indicators
1	Disturbance of social networking
2	Taking precautionary measures
3	Maintenance of distance of 6 feet
4	Application of face mask
5	Usage of Sanitizer
6	Ending of business

4.2.4. Sub-indices used in Utility Resilience Index

Table 14 Selected Sub-indices for Utility Resilience Index

Sr. No.	Utility Sub indicators
1	Impact on water availability
2	Increase in electricity load shedding
3	The decline in Internet facility
4	Reducing the price of essential utilities
5	Opening of government institutions duri Covid -19
6	Increase in Gas load shedding

The three analysis steps in developing urban resilience indicators using a hybrid index-based approach are standardization, weighting, and Aggregation.

- Standardization ensures the comparability of data.
- Weighting assigns importance to indicators.
- Aggregation combines indicators into a composite index for measuring urban resilience.

Normalization

This study uses the Min-Max method to normalize the winsorized variables to rescale between 0 and 1. It is an essential step in data preprocessing, ensuring that variables with different scales and distributions have equal influence during analysis. The process involves subtracting the minimum

value from each data point and dividing by the range (the difference between the maximum and minimum values). This formula calculates the normalized value (X') of a data point (X):

$$\mathbf{X' = (X - min(X)) / (max(X) - min(X))}$$

The Infrastructure, Economy, Social, and Utility Resilience Index have been created simultaneously. Wi indicates the weights obtained through PCA, and $NXit$ means that specific indicator in normalized form. IRI means Infrastructure Resilience Index, ERI means Economy Resilience Index, SRI means Social Resilience Index, and URI means Utility Resilience Index. Ultimately, all four indicators are aggregated to achieve a composite index for urban resilience in planned and unplanned areas.

$$\mathrm{IR}I = {}_{i=1}\Sigma^{n}\, WiNxit$$

$$\mathrm{ER}I = {}_{i=1}\Sigma^{n}\, WiNxit$$

$$\mathrm{SR}I = {}_{i=1}\Sigma^{n}\, WiNxit$$

$$\mathrm{UR}I = {}_{i=1}\Sigma^{n}\, WiNxit$$

4.3. Results and Discussion

4.3.1. Infrastructure:

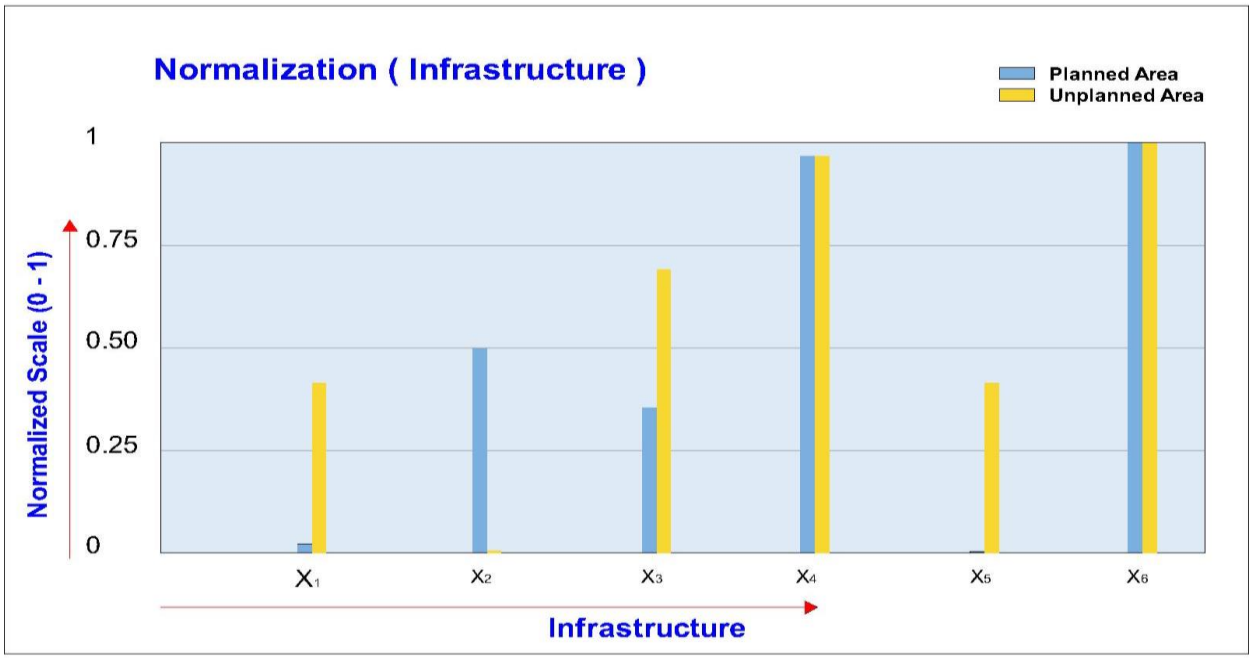


Figure 15 Normalization of Infrastructure

4.3.2. Economy:

The Normalized values of sub-indicators are being presented in planned and unplanned areas. The value of X_1 is 0.7 in planned while 0 in unplanned areas, so it is significant in planned areas. The value of X_2 tells us that this sub-indicator is significant in both areas. The value of X_3 is 0.7 in planned areas and 1 in unplanned areas, meaning it is more significant in unplanned areas. The value of X_4 is 0.3 in planned areas and 0.2 in unplanned areas, meaning it is more significant in planned areas. The X_5 is more significant in unplanned areas as its value is 0.3 and 0 in planned areas. The value of $X_{6 \text{ is } 0}$ in planned and unplanned areas, meaning it is less significant in both areas.

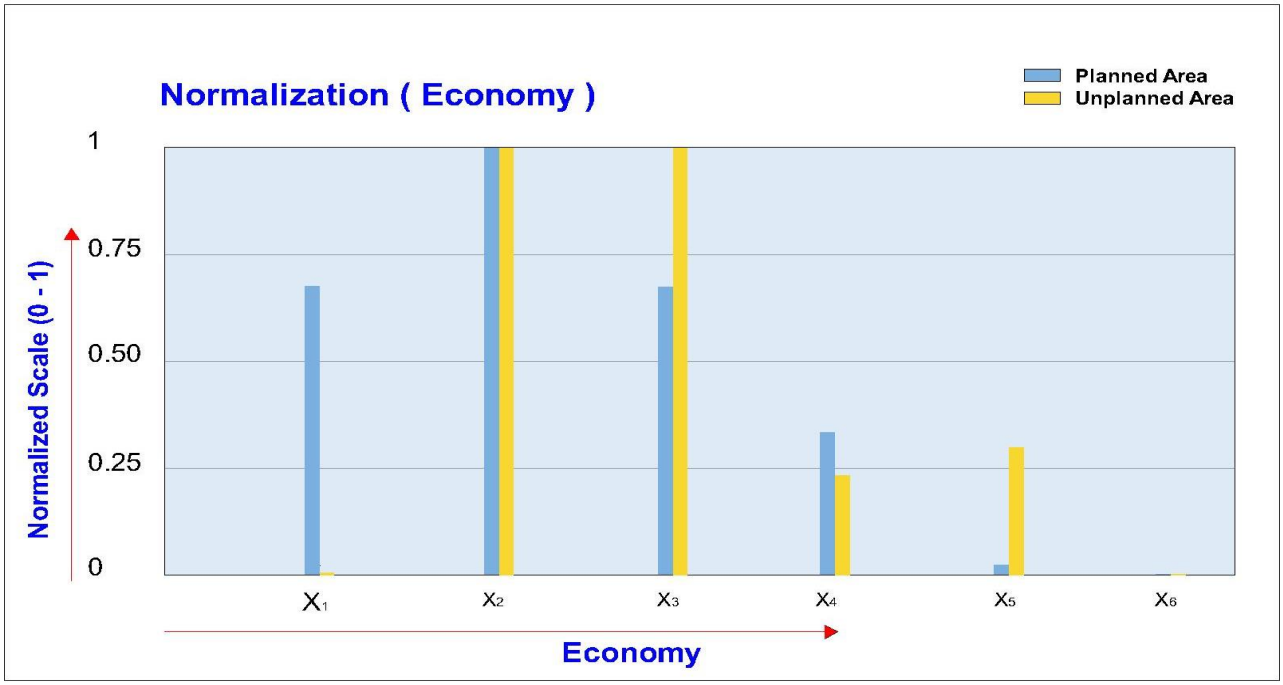


Figure 16 Normalization of Economy

4.3.3. Social

The Normalized values of sub-indicators are being presented in planned and unplanned areas. The value of X_1 is 0.5 in planned while 0.3 in unplanned areas, so it is significant in planned areas. The value of X_2 tells us that it is more significant in the planned area. The value of X_3 is 0 in the planned area and 0 in the unplanned area, which means it is less significant in both areas. The value of X_4 is 1 in planned areas and 0.5 in unplanned areas, meaning it is more significant in planned areas. The X_5 is more significant in unplanned areas as its value is 1 in unplanned and 0.4 in planned areas. The value of X_6 is 0.4 in planned and 0.9 in unplanned areas, meaning it is more significant in unplanned areas.

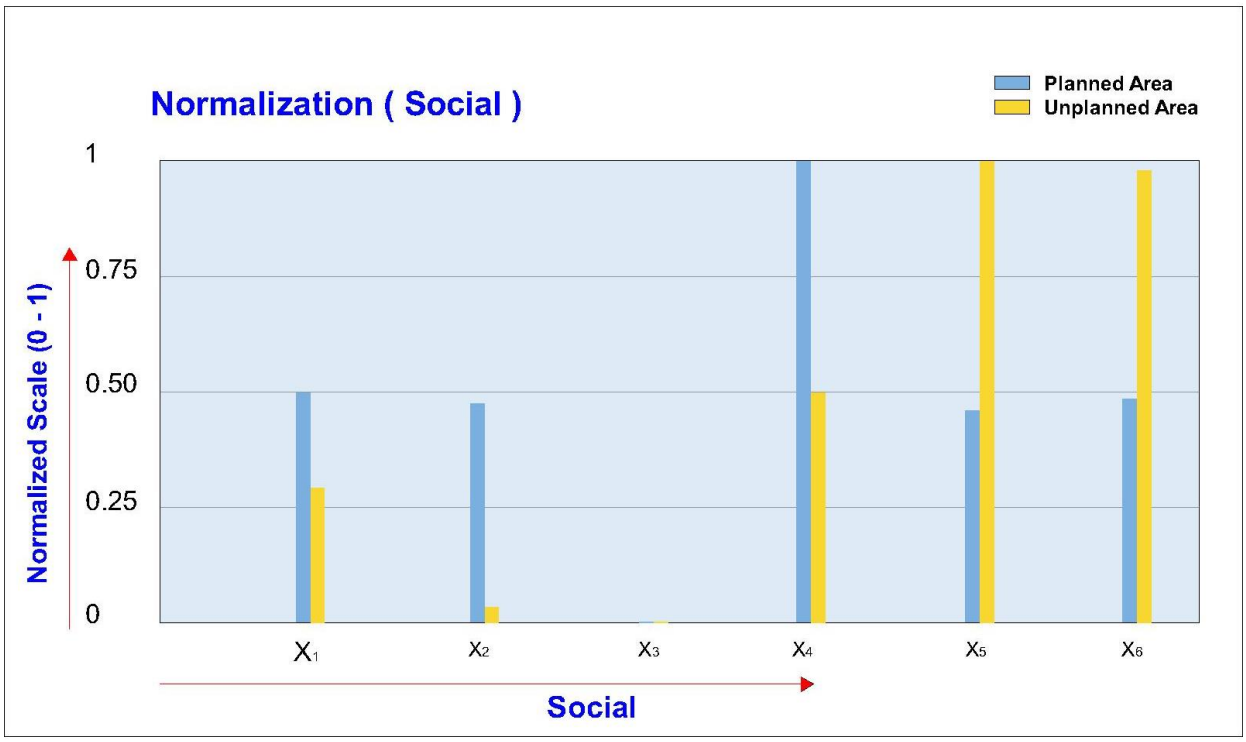


Figure 17 Normalization of Social

4.3.4. Utility

The Normalized values of sub-indicators are being presented in planned and unplanned areas. The value of X_1 is 0.2 in planned while 0.5 in unplanned areas, so it is significant in unplanned areas. The value of X_2 tells us that it is more significant in planned areas. The value of X_3 is 0 in the planned area and 0.1 in the unplanned area, which means it is less significant in both areas. The value of X_4 is 0.2 in planned areas and 1 in unplanned areas, meaning it is more significant in unplanned areas. The X_5 is more significant in both areas as its value is 1. The value of X_6 is 0.4 in planned and 0 in unplanned areas, meaning it is more significant in planned areas.

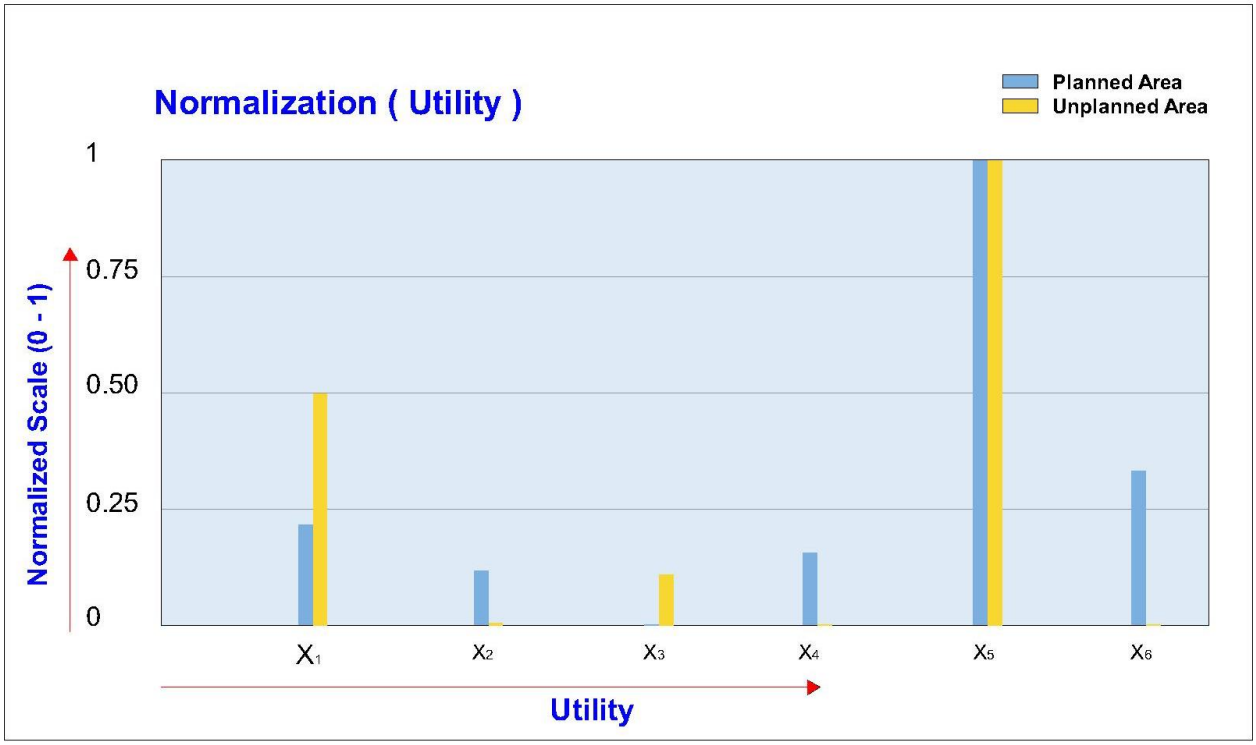


Figure 18 Normalization of Utility

4.3.5. Indicators-wise Ranking in the Context of the Urban Resilience Index

Assuming equal weights for the indicators, the rankings based on the provided data could be as follows (1 being the highest rank), Social, Infrastructure, Utility, and Economy. These rankings indicate that social factors have the highest importance in urban resilience, followed by Infrastructure, Utility, and Economy. However, it is essential to note that these rankings are subjective and should be determined based on the specific goals and context of the resilience assessment. The following table shows the overall condition of these four Urban Resilience Indicators in both planned and unplanned areas.

Table 15 Normalization

Normalization									
		Planned Area				Unplanned Area			
Sereno.	X	Infrastructure	Economy	Social	Utility	Infrastructure	Economy	Social	Utility
1	X_1	0.1	0.7	0.5	0.2	0.4	0	0.3	0.5
2	X_2	0.5	1	0.45	0.1	0	1	0.05	0.0
3	X_3	0.3	0.7	0	0	0.7	1	0	0.1
4	X_4	0.9	0.3	1	0.2	0.9	0.2	0.5	0.0
5	X_5	0	0.02	0.4	1	0.4	0.3	1	1
6	X_6	1	0	0.4	0.4	1	0	0.9	0.0
Final Values		**0.47**	**0.45**	**0.46**	**0.3**	**0.60**	**0.40**	**0.40**	**0.2**

A score of 0 means the lowest resilient or significant, and a value of 1 means the highest resilient or significant. In the planned area, the infrastructure sub-indicator X_6 is the most resilient, while the Economy sub-indicator X_2 is the most resilient, the Social sub-indicator X_4 is the most resilient, and the Utility sub-indicator X_5 is the most resilient. In unplanned areas, a score of 0 means the lowest resilient or significant, and a value of 1 means the highest resilient or significant. The infrastructure sub-indicator X_6 is the most resilient, the Economy sub-indicator X_2 is the most resilient, the Social sub-indicator X_5 is the most resilient, and the Utility sub-indicator X_5 is the most resilient.

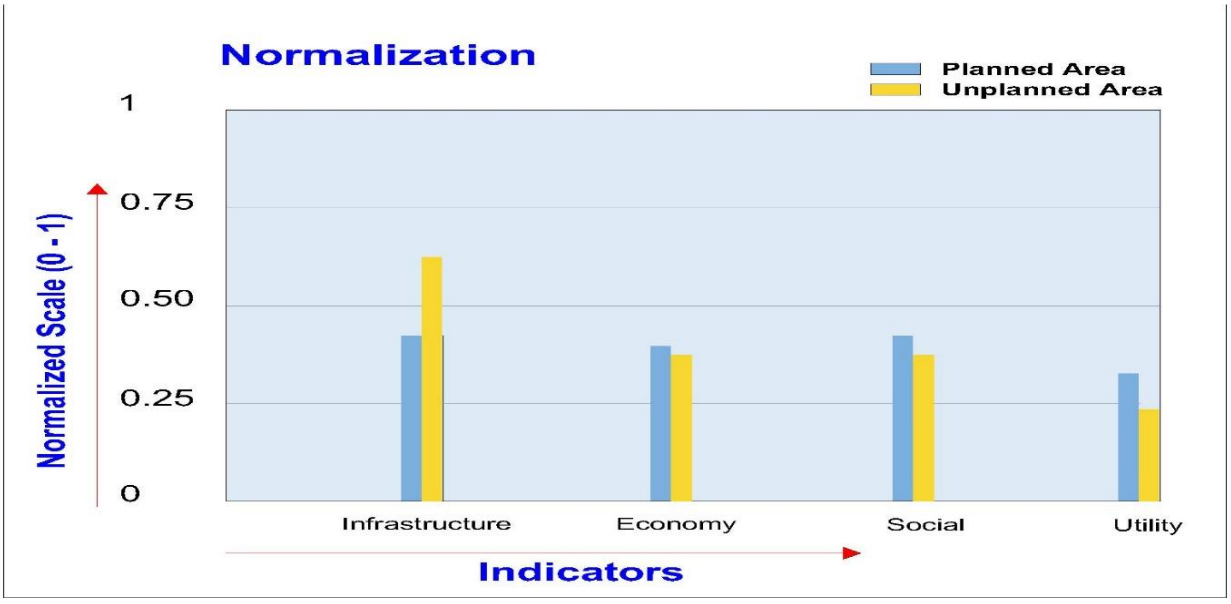


Figure 19 Normalization of all Indicators

The table above shows the final Normalized values of all four indicators in planned and unplanned areas. This value is obtained by using the Index based Approach. The value of Infrastructure in the Planned area is 0.47, which means it is more significant here. The value of the Economy in the Planned area is 0.45, which means that it is less significant here. The value of Social in the Planned area is 0.46, which means it is less significant here. The value of Utility in a Planned area is 0.3, which makes it the least significant and least resilient in a planned area. In a nutshell, Infrastructure is found to be most significant in the planned area of Islamabad and Rawalpindi, and Utility is found to be least significant here.

In terms of unplanned areas, the value of Infrastructure in Unplanned areas is 0.6, which means it is more significant here. The value of the Economy in the Unplanned area is 0.4, which means that it is less significant here. The value of Social in an Unplanned area is 0.4, which means it is less significant here. The value of Utility in an Unplanned area is 0.2, which makes it the least significant and least resilient in an Unplanned area. In a nutshell, Infrastructure is found to be most significant in the Unplanned area of Islamabad and Rawalpindi.

4.4. Priority Analysis

Table 16 Priority Analysis

Sr. No.	Priority Areas	Number
1	Reducing the prices of the basic utilities	305
2	Increase in monthly income	275
3	Provisions of beds and ventilators	274
4	Maintenance of distance of 6 feet	255
5	Management of Covid-19 pandemic	252
6	People were ready to help financially	241
7	Trust in Public institution	238
8	Capacity of Government for online documentation	236
9	Sufficient equipment availability	235
10	Ending of business	221
11	Disturbance of social networking	215
12	Availability of medicines	212
13	Healthcare workers paid more during pandemic	205
14	Facilitation for Covid patients	203
15	Savings at the time of pandemic	177

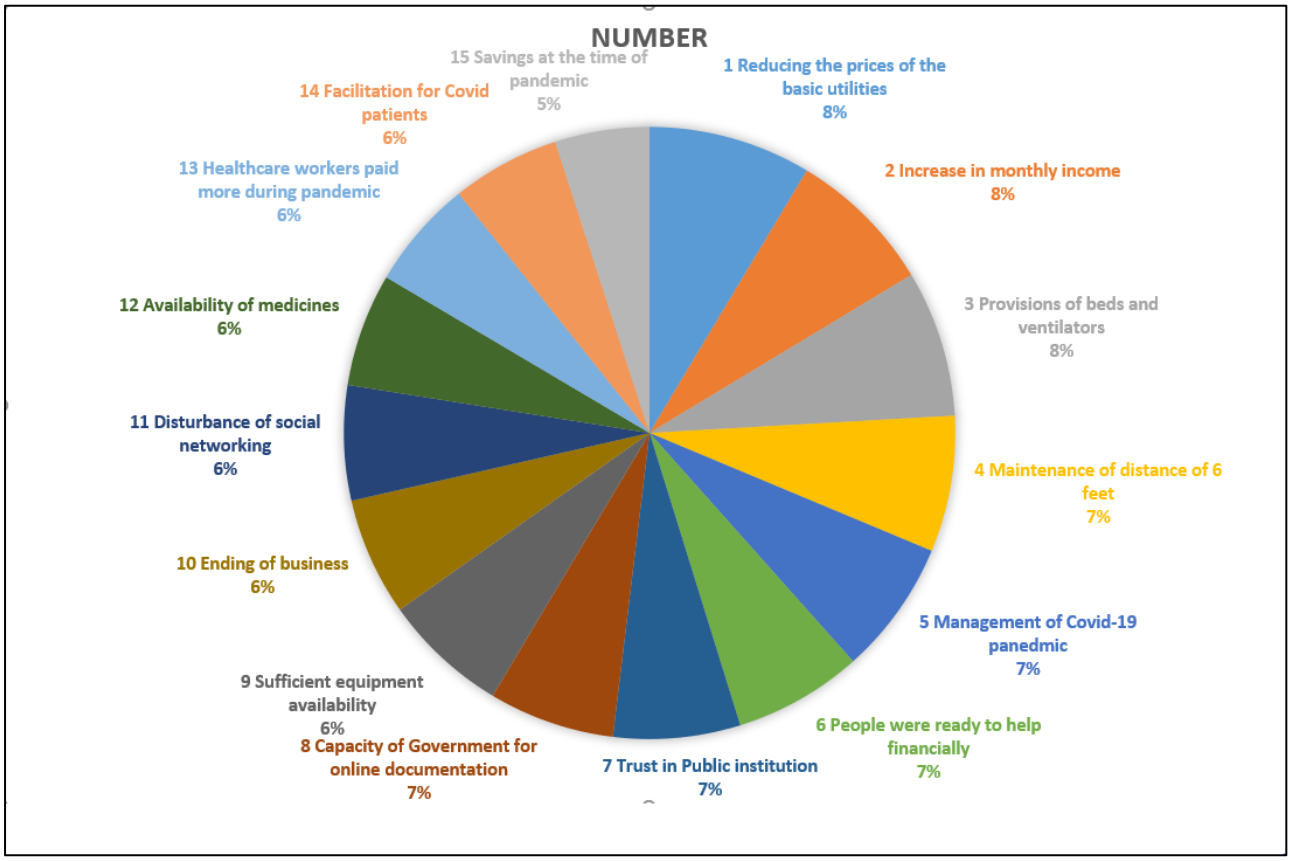


Figure 20 Priority Analysis

The questionnaires were filled from the planned and unplanned areas of Islamabad and Rawalpindi. The views of the respondents were recorded and analyzed in the spreadsheet and the Chi Square test was performed. The next step is to perform the priority analysis based on the respondent's input and viewpoint. A total of 305 people said that, the prices of basic utilities need to be reduced in the Covid lockdown time. This implies that, this comes to the top of priority list for further analysis to be done. The Covid-19 epidemic has disturbed the local economy and due to loss of employments, people were unable to buy necessary things. Prices of basic utilities must be reduced in order to facilitate the rural as well as urban poor. In most cases, businesses were shut down but the prices of utilities kept the same which caused a wave of depression among residents of Islamabad and Rawalpindi. In this critical time, the Local, Provincial and Federal Government should give a number of incentives for the welfare of the public. The utility bills and the prices of daily household things needs to be reduced at least to half.

Similarly, a total of 275 people said that, monthly income should be increased during Covid lockdown. One respondent was of the view that, he was unable to save a single penny during the

time span of Covid lockdown. However, a mixed response can be seen between respondents regarding the saving and struggling to make ends meet. However, only a few respondents were able to save from their income, otherwise, mostly found it difficult to survive. Government should have granted some special income support program for all the public regardless of their job description. The provision of saving funds and a financial plan was the need of the hour. The residents of Islamabad and Rawalpindi saw an immediate decline in stability between income and expenditure. One respondent was of the view that, this pandemic has impacted us by reminding the importance of budget in daily life.

The provision of basic infrastructure, medicines, technical staff and utilities was also a major task in the covid lockdown time. The residents of Islamabad and Rawalpindi were of the view that, they face a serious shortage of hospital beds during the Covid-19 time. One respondent was of the view that, he could not find a bed in the hospital during the Covid lockdown. The other respondent was of the view that, although, he was able to find a bed in isolation ward, but there was no ventilator available for him. There is no harm in admitting the fact that, the residents of Islamabad and Rawalpindi has seen the shortage of beds and services in the hospitals. The health system was weak and overburdened that, the demands of beds and ventilators exceeds the supply during the Covid lockdown days.

For this purpose, a total of 274 respondents highlighted the issue of shortage of beds and ventilators in the Covid-19 lockdown time. Healthcare workers were trying their best to serve the Covid affected patients well, but due to shortage of ventilators, it became a difficult task for them. Healthcare workers were also got positive tests for Covid-19, making the situation even worse. One respondent was of the view that, people tend to move to large city for their treatment for this pandemic. For this reason, the burden on cities like Islamabad and Rawalpindi becomes higher. The pandemic has impacted the Government ability to provide more hospital beds and ventilators in order to save more lives of the people.

A total of 255 respondents were of the view that, maintenance of distance of 6 feet was not followed by majority of the public. Social distancing was seen as the proactive measure for controlling the spread of Covid-19. Public awareness about the social distancing was given through a number of ways during the Covid-19 time, yet, the complete exercise of social distancing cannot be meet in Islamabad and Rawalpindi. Various factors can contribute towards this phenomenon such as the demographic profile of the people, the variation in socioeconomic status, misconceptions about the spread of Covid-19, lack of available resources and overpopulation. Lack of proper education can be seen a factor in not maintaining the distance of 6 feet in public gathering as well. Residents of

Islamabad and Rawalpindi needed more time to collect, analyze, implement as well as execute the basic policies regarding the control of spread of Covid-19. The people need to be aware well regarding the maintenance of social distancing of 6 feet in gatherings and public places. For this purpose, a managed media campaigns can be seen as a useful tool to educate people regarding the pros and cons of social distancing.

One respondent was of the view that, Pakistan's health system was overwhelmed and overcrowded during the first as well as second wave of Covid-19 pandemic. Some of the respondents did follow the proactive measures such as they maintained the distance of 6 feet in all the public places. But, majority of the residents of Islamabad and Rawalpindi did not follow the proactive measures to control the spread of Covid-19. The respondents were less compliant to preventive measures such as application of techniques of hand washing, maintenance of distance of 6 feet, application of face mask in the public as well as social distancing in a true spirit. Government has made several notifications regarding the social distancing in the public places ranging from hospitals, Mosques, Public transport and public gatherings.

A number of measures were introduced by the Government such as reducing the office staff to half and closing the educational activities as children are more vulnerable to this virus. In a nutshell, people themselves could not follow and obey the Government instructions. The closing of commercial activities was also an initiative from Government to reduce the public crowd from the shopping areas. The timings of the Market were reduced to half in day time by the Government to help maintaining the social distancing in Islamabad and Rawalpindi. Many of the respondents were of the view that, the social distancing was a difficult measure to apply in daily life specially in crowded places such as shopping areas and utility stores etc. It can be said that, proper compliance to the preventive measures is vital to control the spread of Covid-19 pandemic as a whole.

Management of Covid-19 pandemic was also a major task for the Government throughout the Covid lockdown time. A total of 252 respondents were of the view that, the management of Covid-19 was not done properly due to a number of reasons. First of all, the scarcity of the resources needed to cope with this devastating pandemic led to the mismanagement of Covid-19 pandemic. Secondly, the unavailability of hospital beds and ventilators has caused a wave of depression and despair among the residents of Islamabad and Rawalpindi. Thirdly, the lack of knowledge about application of preventive measures from the people was also a major factor in this regard. Lastly, the non-serious behavior and attitude of the general public towards application of various measures such as using hand sanitizers, face mask and social distancing.

Residents of Islamabad and Rawalpindi were of the view that, the Covid-19 has caused serious issues about managing the overall Covid patients due to resources limitation. The long-term sustainable healthcare program needs to implement to take good treatment of Covid-19 patients in the long run. Poor treatment control has led towards the increased death rate during the Covid-19 lockdown time. A total of 241 respondents said that, people were not ready to help them financially during the Covid-19 lockdown time. This can also be understood by the factors of economic instability as well as economic decline. Majority of the business were completely shut down during the Covid such as tourism industry. Daily wage earners lost their source of income due to closing of construction activities. The residents of Islamabad and Rawalpindi were unable to donate or receive any financial help from people during the Covid-19 lockdown time.

A total of 238 respondents said that, there was a lack of trust on public institutions during the Covid-19 pandemic times. Public trust will have help to have a greater compliance with the Government policies such as regulation system and health care policies. Similarly, a total of 236 respondents were of the view that, Government was not capable enough to shift towards online documentation during the Covid-19 lockdown. This shows the lack of capacity of Government to shift towards online platform due to social distancing and other measures in lockdown time. A total of 235 respondents were of the view that, the sufficient equipment was not available all the time in the hospitals of Islamabad and Rawalpindi.

A total of 221 respondents said that, their business was totally closed during the lockdown time. They were of the view that, they lost their means of living in the lockdown time which is a major issue. A total of 215 respondents has seen the evidence of disturbance of social networking in the lockdown time. A total of 212 people said that, there was shortage of medicine availability in hospitals during Covid-19 lockdown pandemic. A total of 205 respondents said that, the healthcare workers should have paid more during the pandemic lockdown time. A total of 203 respondents said that, there were inadequate facilities for Covid patients in Islamabad and Rawalpindi. A total of 177 respondents said that, there was no saving at the time of pandemic. This data helps us to determine the priority areas with the potential of implementing policies and resources in the areas.

CHAPTER 5

CONCLUSION

5.1. Conclusion

The study's findings indicate that the coronavirus cases rate is higher in unplanned areas with a low rate of cases, while planned areas with a high rate of cases have the lowest number of cases. The social resiliency outcomes are mixed. Based on the findings, the study suggests improvements in economic and Utility aspects related to COVID-19 while maintaining urban resilience standards. Using a composite index allows for a comprehensive evaluation of multiple indicators and dimensions to provide policymakers and urban planners with insights. The infrastructure was more resilient after the socioeconomic impacts of Covid-19 in both planned and unplanned areas. Then, the Economy and Social factors have achieved the resiliency to cope with the devastating socioeconomic impacts of Covid-19 in planned and unplanned areas of Islamabad and Rawalpindi.

5.2. Recommendations

This study recommends a need to make specific improvements in utility aspects. The findings indicate that the infrastructure indicator demonstrates the highest resilience, while the utility indicator exhibits the least resilience. Based on these observations, the following recommendations and conclusions can be drawn; Strengthening Utility Resilience: Given the lower resilience of the utility indicator, it is crucial to focus on enhancing the reliability and accessibility of essential services such as water supply, electricity, sanitation, and waste management. Investments in infrastructure and technology improvements, along with effective governance and planning, can help mitigate the vulnerabilities in utility services. Collaborative efforts should be undertaken between government agencies, private sector entities, and communities to ensure a robust and resilient utility infrastructure. Enhancing Social Support Systems: COVID-19 has significantly impacted the social fabric of communities.
It is imperative to strengthen social support systems to address the socioeconomic consequences. This includes ensuring access to healthcare, education, and social services for all population segments. Initiatives such as expanding healthcare facilities, promoting inclusive education, and providing social safety nets can enhance the social resilience of Islamabad and Rawalpindi.

Prioritizing Infrastructure Development: The higher resilience of the infrastructure indicator suggests that Islamabad and Rawalpindi have a solid foundation in terms of roads, bridges, hospitals, schools, and other essential facilities (United Nations Development Programme, 2020). However, it is essential to continue prioritizing infrastructure development to meet the evolving needs of the cities. Investment in intelligent Infrastructure, sustainable transportation systems, and disaster-resilient structures can further enhance the cities' overall resilience.

Economic Recovery and Diversification: The region's economic resilience is crucial for the post-COVID recovery. It is recommended to focus on revitalizing economic activities, promoting entrepreneurship, and attracting investments. Diversification of industries and strengthening the local economy can mitigate the impacts of future shocks. Furthermore, facilitating job creation, skill development, and fostering innovation can contribute to a more resilient and inclusive economic ecosystem.

Integrated Approach to Urban Resilience: To effectively address the socioeconomic impacts of COVID-19 and build resilience, an integrated approach is essential (United Nations Development Programme, 2020). Collaboration between government bodies, private sector entities, academic institutions, and communities is critical. A coordinated effort encompassing urban planning, policy development, infrastructure investments, social welfare programs, and disaster management can lead to holistic resilience-building measures.

5.3. Limitations

The COVID-19 pandemic has highlighted the need for greater data availability and coordination in urban resilience efforts. Timely and accurate data is critical for decision-making, risk assessment, and planning interventions. However, data gaps, inconsistencies, and limited information-sharing between different sectors can hinder effective urban resilience strategies.

Lastly, the pandemic has revealed the interconnectedness of cities with global networks, making resilience efforts vulnerable to external shocks and systemic risks. Disruptions in global supply chains, travel restrictions, and international cooperation challenges have impacted cities worldwide. Each city has its unique characteristics, dynamics, and challenges, which may greatly influence the results of the case study. As a result, it becomes difficult to extrapolate the findings to different cities around the world. Furthermore, case studies are often reliant on qualitative data, which may be subjective and vary in quality. This subjectivity can introduce biases and limit the objectivity of the findings. Additionally, case studies may not provide a comprehensive understanding of the complex

and multi-faceted nature of urban resilience in the context of a global pandemic like COVID-19. It is essential to consider these limitations when interpreting the results of a case study on urban resilience during the COVID-19 pandemic.

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ANNEXURE – 1

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School of Civil and Environmental Engineering (SCEE)
Department of Urban & Regional Planning (URP)

Shaping Urban Resilience in the wake of Covid 19

*The Questionnaire is designed for interviewing the local people to know the resilience of their city during Coronavirus pandemic. It will be helpful in completing MS research thesis on "***ShapingUrban Resilience in the wake of Covid 19**

". This information will be kept anonymous and used only for study purposes. Your cooperation in this regard will be acknowledged and appreciated.

a) Gender: _____

b) Education: _____

c) Age: _____

d) What is your occupation?

i. Private Business, Type of Business _____

ii. Government employee, Scale _____

iii. Unemployed

iv. Student

e) Location: _____

f) Area:

a. Planned

b. Unplanned

g) Are you native of Islamabad/Rwalpindi?

a.Yes b. No

h) The scheme you are living in a. Govt. Housing Society

b. Private Housing Scheme

i) Ownership of House:

a. Own

b. Rented

j) House size a. 5 Marla b. 10 Marla c. 1 Kanal

d. 2 kanal

k) Household Size: _____

l) Number of years of living:

a. Less than 5 years b. 5 years

c. 10 years d. 15 years e. 20 years

f. More than 20 years

m) Monthly income:

a. Less than 20 thousand

b. Between 20 to 50 thousand c. Up to 1 lac

d. Up to 2 lacs

n) Monthly Expenditures:

a. Up to 50 thousand

b. Up to 1 lacs

c. Up to 2 lacs

o) Number of earning members:

Sr. No.	Questions	Response	
1.	Were Government Institutes open to serve public during Covid lockdown?	Yes	No
2.	Was the city Government able to maintain the Standards of Operations of Covid 19?	Yes	No
3.	Was the city Government able to keep the social distancing in public pla during Covid lockdown?	Yes	No
4.	Was City Government able to low down the prices of the basic utili during Covid lockdown?	Yes	No
5.	Did the Government institutions have the capacity for	Yes	No

	documentations to be done online at the time of pandemic?		
6.	Was the city Government able to educate the public sufficient eno about Covid SOPs?	Yes	No
7.	Was city Government able to educate the public about Covid disease and its treatment?	Yes	No
8.	Did people have their trust in public institutions during the wake of Covid 19?	Yes	No
9.	Was your city able to cope with this pandemic?	Yes	No
10.	Did any of the historic building was converted into hospital during Co 19 lockdown?	Yes	No
11.	Did any of the hospitals was facilitated for Covid patients which specific for eye or heart diseases.	Yes	No
12.	How long is the distance of hospital form your house?		
13.	How much your city was vulnerable to the Covid 19 as compare to ot cities?	High	Low
14.	What was the survivability rate of Covid patients in your city?	High	Low

15.	What was the death rate due to Covid 19 in your city?	High	Low
16	What was the rate of Corona virus cases in your area?	High	Low
17.	Do you think the Covid 19 pandemic was properly managed by the Government?	Yes	No
18.	Do you think proper treatment was provided by Government hospitals?	Yes	No
19.	Do you think sufficient equipment to cope up Covid 19 was available hospitals?	Yes	No
20.	Do you think healthcare workers were provided with full saf equipment?	Yes	No

21.	Do you think healthcare workers were paid more at the time of pandem	Yes	No
22.	Did full staff of hospitals keep their attendance full during pandemic?	Yes	No
23.	Were the medicines for mild symptoms available all the time dur pandemic?	Yes	No
24.	Did water availability affected during Covid lockdown?	Yes	No
25.	Did load shedding of electricity increase during Covid lockdown?	Yes	No
26.	Did load shedding of Gas increase during Covid lockdown?	Yes	No
27.	Did traffic volume increased during Covid lockdown?	Yes	No
28.	Did number of traffic trips increase during Covid lockdown?	Yes	No
29.	Did public transport keep operational during Covid lockdown?	Yes	No
30.	Did people of the city have the capacity to move privately for th private/urgent tasks?	Yes	No
31.	Did internet facility decline during Covid lockdown?	Yes	No
32.	Did online earning increased during Covid lockdown?	Yes	No

33.	Did people start shop out for basic utilities through online mode?	Yes	No
34.	Did the option of online shopping or by phone was available in your ci	Yes	No
35.	Did the patients of other diseases get entertained in hospitals?	Yes	No
36.	Did temporary hospital facilities build for the people having n symptoms?	Yes	No
37.	Were beds and ventilators available for all the patients?	Yes	No
38.	Did your monthly income get affected amid Covid lockdown?	Yes	No
39.	Did the monthly income Increased during covid lockdown?	Yes	No

40.	Did you receive reduced salaries during Covid lockdown?	Yes	No
41.	Did you have any savings at the time of pandemic?	Yes	No
42.	Did you were fired from your job from the company during Co lockdown?	Yes	No
43.	Did you remain unemployed during Covid lockdown?	Yes	No
44.	Did you have to change your occupation during Covid lockdown?	Yes	No
45.	Did you have to start any business during Covid lockdown to support y earning?	Yes	No
46.	Did work from home preferred in your company?	Yes	No
47.	How long is the distance from your home to your office?		
48.	Did attendance in your office was reduced?	Yes	No
49.	Did people were ready to help you financially amid Covid Lockdown?	Yes	No
50.	Did people were available for to listen you by talking over phone or f time in the timeof isolation?	Yes	No
51.	Was social networking disturbed amid Covid lockdown?	Yes	No

52.	Did people take precautionary measures about social distancing?	Yes	No
53.	Did people maintain the distance of 6 feet in public places?	Yes	No
54.	Did people strictly apply face mask during pandemic period?	Yes	No
55.	Did people use the sanitizers during the pandemic period?	Yes	No
56.	Did people get scare of theft and robbing in their homes i lockdown?	Yes	No
57.	Did people remain safe and secure in the wake of Covid19 lockdown?	Yes	No

58.	Did commercial activities stop during Covid lockdown?	Yes	No
59.	Did business of people, you know someone, ended during lockdown?	Yes	No
60.	Did educational activities stop during Covid lockdown?	Yes	No
61.	Did industries start downsizing during Covid lockdown?	Yes	No
62.	Did some industries get closed during lockdown?	Yes	No
63.	Did people move to other city during Covid lockdown?	Yes	No
64.	Did people stay in their hometowns during Covid lockdown?	Yes	No
65.	Did people maintain the social distance in mosques?	Yes	No
66.	Was attendance of people in offices reduced to half?	Yes	No