ADBInstitute

RETHINKING CITIES FOR RESILIENCE AND GROWTH IN THE POST-COVID-19 WORLD

Edited by Kyoko Takahashi, Shreyas Bharule, Shogo Kudo, and KE Seetha Ram

ASIAN DEVELOPMENT BANK INSTITUTE

ADBInstitute

Rethinking Cities for Resilience and Growth in the Post-COVID-19 World

Edited by
Kyoko Takahashi, Shreyas Bharule,
Shogo Kudo, and KE Seetha Ram

ASIAN DEVELOPMENT BANK INSTITUTE

ISBN 978-4-89974-283-8 (Print)
ISBN 978-4-89974-284-5 (PDF)
DOI: https://doi.org/10.56506/RXLB2366

Asian Development Bank Institute
Kasumigaseki Building 8F
3-2-5, Kasumigaseki, Chiyoda-ku
Tokyo 100-6008, Japan
www.adbi.org

CONTENTS

TABLES AND FIGURES

TABLES

FIGURES

ABBREVIATIONS

ADBI	Asian Development Bank Institute
API	application programming interface
CIPR	carbon intensity of poverty reduction
DRRM	disaster risk reduction and management
FGD	focus group discussion
GDP	gross domestic product
GIS	geographic information system
HTA	health technology assessment
IATF	Inter-Agency Task Force (Philippines)
ICS	incident command system
ICT	information and communication technology
JSON	JavaScript Object Notation
KII	key informant interview
kWh	kilowatt-hour
LGU	local government unit
MBBS	bachelor of medicine and bachelor of surgery
MCGM	Municipal Corporation of Greater Mumbai
MMRDA	Mumbai Metropolitan Regional Development Authority
MoHFW	Ministry of Health and Family Welfare (India)
MSMEs	micro, small, and medium-sized enterprises
MUDRA	Micro Units Development and Refinance Agency
NGO	nongovernment organization
NLTK	Natural Language Toolkit
NOAH	Nationwide Operational Assessment of Hazards (Philippines)
POI	point of interest
PPOGS	public parks and open and green spaces
SNS	simple notification service
SWOT	strengths, weaknesses, opportunities, and threats
TOWS	threats, opportunities, weaknesses, and strengths
TReDS	Trade Receivables Discounting System
UGS	urban green space
UR Agency	Urban Renaissance Agency
WHO	World Health Organization

CONTRIBUTORS

Mukul Asher is a retired professorial fellow at the Lee Kuan Yew School of Public Policy, National University of Singapore, Singapore.

Julemer Ann Aying is a development communication specialist at Ateneo de Zamboanga University, Zamboanga City, Philippines.

Akane Bessho is an assistant professor at the Department of Urban Engineering, The University of Tokyo, Japan.

Shreyas Bharule is an assistant professor at the Department of Architecture and Regional Planning, Indian Institute of Technology Kharagpur, West Bengal, India.

Atsushi Deguchi is a professor at the Graduate School of Frontier Sciences, The University of Tokyo, Kashiwa City, Japan.

Bidur Devkota is an assistant professor at the Department of Electronics and Computer Engineering, Pashchimanchal Campus, Institute of Engineering, Tribhuvan University, Pokhara, Nepal.

Tsuyoshi Hashimoto is the founding chairman of RECS International Inc. based in Tokyo, Japan.

Tomohiko Ihara is an associate professor at the Graduate School of Frontier Sciences (Kashiwa City) and the Faculty of Engineering (Tokyo) of The University of Tokyo, Japan.

Dheeraj Joshi is a deputy secretary at the National Mission for Clean Ganga in New Delhi, India.

Shogo Kudo is an associate professor in the Global Studies Program, Akita International University, Japan.

G. Asok Kumar is a director general at the National Mission for Clean Ganga in New Delhi, India.

Klaribelle Anne Languayan is an alumna of the University of the Philippines Diliman, Quezon City, Philippines.

Nikita Madan is a senior environment specialist at the National Institute of Urban Affairs in New Delhi, India.

Karl Sam M. Maquiling is an associate member of the National Research Council of the Philippines.

Hiroyuki Miyazaki is a project assistant professor at the Center for Spatial Information Science, The University of Tokyo, Japan, and a visiting assistant professor at the School of Engineering and Technology, Asian Institute of Technology, Pathum Thani, Thailand.

Satoshi Miyazawa is a product manager in the xPop Division at LocationMind Inc., Tokyo, Japan.

Jun Okada is a doctoral candidate at the Graduate School of Frontier Sciences, The University of Tokyo, Kashiwa City, Japan.

Sakshi Pandey is a capacity building and training associate at the Asian Development Bank Institute, Tokyo, Japan.

Lorenz Ray Payonga is a doctoral student at the School of Industrial Engineering and Management, KTH Royal Institute of Technology, Stockholm, Sweden.

Leah M. Punongbayan-Dela Rosa is an associate professor at the University of Santo Tomas, Manila, Philippines.

Sushil K. Rai is an associate professor at the School of Business, University of Petroleum and Energy Studies, Dehradun, India.

Nimisha Samadhiya is a research associate at Nagrika in Dehradun, India.

KE Seetha Ram is a senior capacity building and training specialist at the ADBI and a visiting professor at The University of Tokyo, Japan.

Akhilesh K. Sharma is an assistant professor at the Institute for Studies in Industrial Development in New Delhi, India.

Tarun Sharma is a director at Nagrika in Dehradun, India.

Victor R. Shinde is the head of the Climate Centre for Cities at the National Institute of Urban Affairs in New Delhi, India.

Kala S. Sridhar is a professor at the Institute for Social and Economic Change, Bengaluru, India.

Kyoko Takahashi is a postdoctoral researcher at the Graduate School of Frontier Sciences, The University of Tokyo, Kashiwa City, Japan.

Piyush Tiwari is professor of property at the University of Melbourne, Australia.

Dang Huyen Trang is a PhD candidate at the School of Economics and Public Policy, University of Adelaide, Australia.

Ka Ying Wong is a capacity building and training associate at ADBI, Tokyo, Japan.

Makoto Yokohari is a professor in the Department of Urban Engineering, The University of Tokyo, Japan.

ACKNOWLEDGMENTS

This publication presents a series of concepts and case studies gathered through the Asian Development Bank Institute's call for papers on "Rethinking Cities for Resilience and Growth in the Post-COVID-19 World" and rigorously examined and refined through a series of paper development workshops.

We developed this edited volume with an additional step for developing the chapters. The Asian Development Bank Institute (ADBI) and the University of Tokyo organized a total of three learning workshops with the selected authors from the call for papers involving editors and invited discussants from Australia, India, Japan, the Philippines, and Viet Nam. These events enabled the authors of the chapters to present their preliminary findings and refine their contributions by incorporating the constructive discussions and comments that discussants and attendees provided at the workshops. We thank all the contributors for their cooperation, efforts, and precious time, which have helped finalize this edited volume. We deeply appreciate the contributors' illustrious submissions and continued patience in revising the chapters as well as providing valuable comments for the publication.

Our sincere gratitude goes out to all those who participated in the events, particularly all those who came from around the globe. We thank them for their active participation during the events and their feedback during the discussions, reflecting the project's success. We are also grateful to Professor Piyush Tiwari for kindly reviewing all the chapters and writing a succinct foreword to the book.

Our special appreciation to ADBI associates Sakshi Pandey, Veronica Ern Hui Wee and Ka Ying Wong, who brilliantly supported the entire process from design and development to completion, and support staff Akiko Hiraoka and Miho Sakamoto, who patiently assisted with all the administrative tasks. Without their untiring support and kind efforts, it would not have been possible to put together such a successful learning series and publication.

We are grateful to the ADBI Publications Committee and editing and production team, especially Adam Majoe, Jeongwon Seo, and David Hendrickson for coordinating the production and publication of this edited volume, Patricia Wada for her excellent and speedy work in editing the chapters, Aileen Magparangalan for typesetting, Ian Youngs for the cover design, and Josh Magtibay and Jay Valmon for their prompt and timely support in the webpage development related to this project.

Lastly, we are deeply indebted to Tetsushi Sonobe (Dean and CEO, ADBI Tokyo) and Seungiu Baek (Deputy Dean, ADBI Tokyo) for their guidance, encouragement, and participation in the events and this publication in 2023 as ADBI supports first as chair of Think7 (T7) during Japan's Group of 7 (G7) presidency and next the linkage between T7 and T20 during India's G20 presidency.

FOREWORD

The human population has been exposed to the risk of emergence and spread of infectious diseases with pandemic potential for thousands of years. Pandemics and epidemics that have affected humanity have included plague, cholera, flu, severe acute respiratory syndrome coronavirus (SARS-COV), and Middle East respiratory syndrome coronavirus (MERS-COV). The recent addition is the coronavirus disease (COVID-19), which engulfed the world in 2020 and after 3 years remains a concern. Cities have always been at the forefront of the battle with pandemics. The usual public health response has been isolation, quarantine, and border control to limit the spread of disease until pharmaceutical development catches up to address the disease. The response used during COVID-19 was similar, but this time the extent of impact has been different. Though cities are at the front line, the geographical expanse is larger, and the pandemic exposed global vulnerabilities and inequalities that have regional dimensions.

A city is a unique way of organizing space and activity to achieve a desirable purpose. A city is a place of social and individual interactions. As a marketplace, a city is a place where capital accumulates and where craftspeople congregate whose productive encounters lead to technological innovations. A city is a complex hierarchy of space from a very private, intimate, domestic world to the public for mass interactions. Density of built environment and humanity are key features of a city. Density produces economies of scale and scope but becomes problematic particularly when public health concerns arise. History has demonstrated that tension has always existed between attempts to plan a city and the on-ground spatial activities that transform the planned structures with the result that human engagements with space always outgrow the rigid structures of its planners.

The experiences of past pandemics reveal that cities respond to the challenges posed by a pandemic and reset by transforming the physical form through upgrades of water and sanitation infrastructure, housing regulations, street design, and public parks. These changes alter the way inhabitants live and interact with each other. The core components of cities are density, global interconnectedness, and mixed land use, which in the recent decades have contributed to phenomenal growth and prosperity. COVID-19 has not only challenged these foundational principles but has revealed other crevices that threaten the form of cities. Poverty and rising inequality are the two major problems that cities face. While there is no correlation between the density and the spread of disease, overcrowding and lack of access to services make certain segments of the population vulnerable. The poor face the adverse consequences of the pandemic as they lack resources and often live in overcrowded locations with inadequate services. When almost a quarter of the world's population lives in slums, which are concentrated in cities predominantly in developing countries, adverse living conditions are worsened by events like a pandemic. Informality alone is not necessarily a problem as it nurtures an informal productive economy that supports the formal economy in cities. The informal economy creates employment opportunities in self-employment sectors such as domestic help, vending, daily wage labor, and trading. The problem, however, is that these jobs are first to suffer when lockdowns affect cities. With insufficient cash reserves or access to formal sources of finance, the self-employed bear the brunt of losses that lockdowns impose. The frequent and prolonged COVID-19-related lockdowns during 2020–2021 caused the mass exodus of workers who had lost their sources of income and livelihood and had to return to the villages or cities they were from, causing reverse migration in many countries.

The formal sectors of the city economy were also not spared from the onslaught of lockdowns that followed the outbreak of COVID-19. City economies, which thrive on global networks for everything from sourcing and manufacturing to production and consumption—an arrangement that generates efficiency and growth—were disrupted as a consequence of border closures, work-from-home restrictions, and supply chain disruptions. The cumulative loss to the world economy was enormous. Working from home, teleworking, and online shopping created new structures. Downtown office towers resembled ghost towns. Homes became places of work and generated demand for home improvement.

This was the first time when the potential of homes as places of work was tested. Teleworking and work from home improved work-life balance for some, but for others it blurred the boundaries between work and home, causing mental stress. The effect of lockdowns on women and children was immense as schools closed and the household work that falls largely on women increased. Lockdowns and the shift to online shopping reconfigured brick-and-mortar retailing, and shop floor unemployment rose. Restrictions on the sphere of movement revitalized neighborhood shopping. Whether these trends will persist in the future, only time will tell. It is, however, evident that cities adapted to the challenges posed by the pandemic, reconfigured economic structures, and established new linkages quickly.

The greatest challenge that the planet faces today relates to the climate crisis caused by human activities including unsustainable urban development. The stress that human activities have inflicted on natural processes and ecological systems is the primary cause for recent pandemics. Land use change, natural resource overexploitation, and migration have altered natural habitats and increased interactions between humans and wildlife. This has not only increased the chances of novel infectious diseases but has also increased the geographical spread.

Due to their proximity and accountability to people, the local or subnational governments were at the front line to manage the crisis that the pandemic posed. The crisis was sudden, and it caught many governments unaware. However, governments at different levels responded to manage the spread of the virus. Different countries have different health care models (from universal public health care at one end of the spectrum to non-universal insurance systems at the other end), and the responses varied. It became evident though that no one system comes out as the best fit model and the performance has been mixed. Subnational governments worked toward maintaining public services such as water and sanitation while protecting their own staff. Another tier of service delivery agencies emerged, organically in some cases and with support from subnational agencies in other cases. These are community organizations and self-help groups. Bound by common purpose, these organizations have long developed social capital, which they invested in providing services and other assistance that the overstretched formal system was unable to provide. Working in informal settlements, these organizations provided education to children, medical assistance, and temporary shelter, and in some cases delivered public services.

The world is still grappling with COVID-19 and the risk is far from over. These past 3 years have taught many lessons in providing health, social, and economic responses to the crisis. History has also taught us that this will not be the last event, so we need to learn and better prepare. Cities will retain their primacy, and by 2050 approximately 68% of the population will live in cities. The financial resources of governments will pose constraints. It is therefore important to rethink cities' resilience in the post-COVID-19 world. This book does precisely that. Experts from different countries examine the key questions that arose during the pandemic and debate the efficiency and efficacy of responses. Some of these responses manifest in changed public behavior, others in tools for better urban governance and service delivery. The lesson that emerges: to make cities resilient, we need a balance between the growth agenda and environmental sustainability underscored by inclusive planning that aims to reduce vulnerabilities and inequalities.

Piyush Tiwari
Professor of Property
University of Melbourne, Australia

PREFACE

Kyoko Takahashi, Shreyas Bharule, KE Seetha Ram, and Shogo Kudo

The coronavirus disease (COVID-19) pandemic has profoundly impacted the world's cities. Interestingly, if we look back on the history of city development, the roots of urban planning in the world's major cities can be traced back to the fight by people in cities against infectious diseases. For example, in the United Kingdom, during the industrial revolution in the late 18th century, the poor living conditions of the workers led to the spread of plague and cholera. At that time, planners realized the importance of open space settings within cities to mitigate the public health hazard of contagious diseases.

The rapid spread of COVID-19 has also highlighted various critical urban development issues. Urban localities have revealed the lack of basic medical facilities, limited governance capacity to ensure efficient use of resources, challenges due to dense settlement structures, and lack of public spaces to provide the required social distance. The COVID-19 pandemic has brought to us a central question: *how we should transform cities to be more resilient against the spread of a contagion?* Therefore, this book highlights the issues and challenges that arose in diverse urban conditions and brings new insights to enhance the resilience of cities in the post-COVID-19 world. Focusing on Asia, this book is a compilation of experiences and viewpoints of people involved in governance, economics, socioeconomic planning, spatial planning, urban environmental studies, and the study of urban resilience.

The process of creating this book began when the Asian Development Bank Institute (ADBI) editorial team issued an open call for papers in November 2021. The team also invited authors to present their draft papers, receive comments to improve the quality, and refine the results and conclusion. Experts in the field listened to the authors' presentations and reviewed and provided comments on the papers. Then, the ADBI editorial team coordinated with the authors, who incorporated the experts' comments. *Rethinking Cities for Resilience and Growth in the Post-COVID-19 World* is the culmination of this rigorous process.

In Part I, we begin with a chapter examining how the COVID-19 pandemic will affect the concept of urban resilience. The basic concept of resilience has been dominated by the idea of resilience to natural disasters, and this pandemic provides valuable insights on how to further develop that concept. The chapter by Lorenz Ray Payonga and Tomohiko Ihara shows how resilience could be viewed from the perspective of electricity as a complementary need in urban living. The chapter by Karl Sam M. Maquiling et al. discusses urban resilience from the perspective of local governance. By considering various perspectives on resilience in a post-COVID-19 world, this chapter provides insights into the future of urban resilience.

Part II examines the impact of the COVID-19 pandemic on cities' physical and intellectual assets. In particular, the lack of medical facilities stood out in many countries during the pandemic. The chapter by Tarun Sharma et al. examines how these medical facilities' effective and efficient use differed across cities. Leah M. Punongbayan-Dela Rosa discusses the importance of green spaces in the Philippines. Akane Bessho and Makoto Yokohari examine the role and potential of parks and green spaces in urban areas during the recent pandemic in Tokyo. These two cases highlight different approaches for urban green spaces between the two countries, although more people know about the importance of these spaces than before the COVID-19 pandemic began. In the area of urban intellectual property, Shreyas Bharule and Satoshi Miyazaki examine the social impact of the COVID-19 pandemic on big data and location-based information, which have garnered much attention in recent years. The chapter suggests how data could be used for policy making in the future.

Part III explores special planning and coping strategies related to the planning. Victor R. Shinde et al. explore how river management should be further maintained by coping with pandemic-related stress. Akhilesh K. Sharma and Sushil K. Rai examine the impact of the spread of COVID-19 on the economic activities of micro, small, and medium-sized enterprises (MSMEs). MSMEs are vulnerable to sudden economic shocks, but they employ a large number of a country's workers and support the diversity of the country's industrial structure. The chapter suggests what kind of policy support is needed for MSMEs to remain viable. On the other hand, from a more micro perspective, Dang Huyen Trang presents the reality of the situation and the results of an interesting survey on how urban households developed strategies to overcome the pandemic. The chapter's findings offer practical policy implications for formulating specific household support policies.

In Part IV, we offer a collection of chapters that focus on the lifestyle changes caused by the spread of COVID-19. Kala S. Sridhar expounds on how India's carbon footprint may vary in post-pandemic city development. The chapter by Jun Okada et al. focuses on teleworking in Japan, noting the dramatic change in work styles due to the spread of COVID-19, and describes how teleworking was promoted during the pandemic and suggests issues to be addressed for teleworking to take hold in the future. Finally, Bidur Devkota and Hiroyuki Miyazaki focus on social media and its presence in our lifestyles. They discuss how social media is used in the wake of the pandemic and how it should be used effectively in society in the future concerning the possibilities and challenges.

In Part V, Tsuyoshi Hashimoto elaborates on the path to resilience. He suggests that future cities should pursue the urban model with dynamic and open characteristics, both spatially and temporally. Spatially, these cities would naturally encompass rural and agricultural areas and may extend as necessary beyond national boundaries. Temporally, they should accommodate not only growth and expansion of urbanized areas but also metabolism and changes in urban morphology and encompass relationships with rural areas. In designing such an urban model, city networking and the concept of a "resilient city" are important. Lastly, the editors summarize and comment in the epilogue on the diversity of paths in which we encounter "resilience" and develop ways to "rethink the city."

Observing the diverse impacts of COVID-19 on urban environments, the book attempts to answer what has changed, what we should remember when developing cities as the world recovers from the pandemic, and what enhancements are possible to urban living. Although COVID-19 has not fully waned, the views expressed here might bring about positive changes at this moment. With the information conveyed in *Rethinking Cities for Resilience and Growth in the Post-COVID-19 World*, we hope to contribute to more effective decision making, policy planning, and implementation processes for inclusive, innovative, and resilient cities.

PART I

Urban Risk Management

PART I SUMMARY

Ka Ying Wong

The coronavirus disease (COVID-19) has presented an unprecedented challenge to governments and individuals across the globe. Besides its direct impact on public health, the pandemic has also tremendously changed the way we think, act, and live. Threatening both the existing economy and the social fabric by the "new normal," the pandemic has called countries and cities to strengthen their capacity to minimize negative impacts brought by similar crises in the future. Part I of this book—Urban Risk Management—emphasizes the need for better hazard responses and presents referenceable solutions to cope with disasters like COVID-19.

Chapter 1 by Payonga and Ihara discusses the prospect of electricity policy given the changes in post-pandemic lifestyle and climate. The authors evaluate both formal and informal preparedness with the countermeasures used in Albay, Philippines, a province that has effective disaster management and has frequent climatic and geologic hazards. The case affirms the possibility for people to survive temporarily without electricity in the 21st century if there are stronger systematic interventions, household material countermeasures, and recognition of individual resilient needs.

To optimize electricity resilience, Chapter 1 gives specific directions for leaders to prepare for any sudden power disruptions happening in the future. The authors suggest that policy makers ensure unimpeded access to basic goods and services, promote landscape and building designs suited to a country's climate, and enact policies that strengthen communities and enhance well-being.

Chapter 2 by Maquiling et al. investigates the extent of disaster preparedness in the Philippines, highlighting the significance of urban resilience in the post-pandemic era. The authors evaluate the practices of local government units, specifically their implementations of disaster risk reduction and management protocols, by employing both quantitative and qualitative methodologies. Investigating knowledge, awareness, adherence, and attitude of barangay, municipal, and provincial governance units, the authors find the current implementation to be varied and self-directed to local weather hazards. While local governments competently manage natural hazards because of their familiarity with local risks, those same local units are inadequate in handling compounded risks resulting from hydrometeorological and health crises.

For improving future hazard response, Chapter 2 calls for local governments to incorporate into their responses the elements of constant monitoring, inter-agency coordination, resource mobilization, information communication, and grassroots organization. The authors also suggest localizing response mechanisms to offer higher flexibility and adaptability to achieve better urban risk management.

In summary, what we have witnessed during COVID-19 stresses the need for developing better emergency responses. In the post-pandemic era, resilient and sustainable electricity policy can be useful for curtailing the negative impacts brought by similar crises. To strengthen urban risk management, policy makers and leaders must improve local governance units' implementational capacity with the help of close monitoring, consistent data, and concerted efforts, and they must adjust response mechanisms based on the local contexts.

CHAPTER 1

Beyond Access to Electricity: Surviving a 21st Century Pandemic Without It

Lorenz Ray Payonga and Tomohiko Ihara

1.1 Introduction

Electricity is said to be the lifeblood of modern society. It is an important ingredient in improving the quality of life in developing communities and sustaining it in more developed ones. Its significance is emphasized by United Nations Sustainable Development Goal 7, which aims to achieve universal access to electricity by 2030 (Goal 7.1.1; United Nations Economic and Social Council 2022). Moreover, its accessibility and reliability indicate ease of doing business (World Bank 2020a). Modern society has become dependent on electricity because it powers necessary tools of trade, enables many services, and makes various opportunities available.

The dependence of people on electricity has made them oblivious to its existence. Thrift (2004) calls this phenomenon "technological unconscious," that is, the better the infrastructure, the easier it escapes notice. Ironically, the more reliable the infrastructure (e.g., power system) is, the harder any disruption can hit it; but because of its perceived reliability, people will tend to use more of it and become more dependent on it, creating a "double vulnerability paradox" (Steetskamp and van Wijk 1994), which is also termed by de Nooij, Koopmans, and Bijvoet (2007) as a "vulnerability conflict." During the coronavirus disease (COVID-19) pandemic, with community lockdowns and stay-at-home orders, electricity demand shifted to the residential sector (Asian Development Bank 2021). With work and personal/family life intertwined in the same space, electricity dependence at home has never been more pronounced. While the COVID-19 pandemic appears to already be abating and electricity demand elsewhere is shifting back to pre-pandemic levels, changes brought by the pandemic such as remote and hybrid work are likely to stay (Alexander et al. 2021), and climate change has heightened the risk of the next pandemic happening (Carlson et al. 2022).

Although the world is getting closer to achieving universal access to electricity (United Nations Economic and Social Council 2022), such an achievement must not obscure the risks and threats modern power systems are and will be facing. The International Energy Agency (IEA) (2020) has pointed out key challenges in the areas of electricity security during energy transitions (e.g., supply and demand variability, outdated power grids), cyber resilience (e.g., digitalization and cyberattacks), and climate resilience (e.g., rising global temperatures and sea levels, more extreme and variable weather events and patterns). The World Energy Outlook (IEA 2021) further notes that there is insufficient investment to meet future energy needs, and that uncertainties over policies and demand trajectories increase the risk of volatility for energy markets.

Should another COVID-19-like public health emergency happen again within this century, it might be under worse environmental and energy conditions. In such a scenario, cities and communities must be prepared to adapt to a pandemic with power interruptions at the peak of summer, amid a freezing winter, or in the aftermath of a super typhoon—times when people are most vulnerable. While it is expected that residential energy demand will shoot up as it did in the recent pandemic, prevailing load shedding procedures (e.g., in the Philippines and Australia) give the residential segment the lowest priority in the dispatch of electricity (Powercor and CitiPower 2019; Wholesale Electricity Spot

Market 2014).[1] That is, should power supply be strained for whatever reason, households will be the first ones to be disconnected from the grid and the last to be reconnected. Thus, there is a need to rethink the notion of electricity being the lifeblood of modern society. Electricity-dependent cities and communities must imagine and be ready for a life without it albeit temporarily.

It could be easy to reduce the readiness for power interruption events to governmental or personal responsibility, akin to what Heidenstrøm and Kvarnlöf (2018) call "formal" and "informal" preparedness. Formal preparedness refers to typically top-down oriented checklist-like criteria such as emergency supplies, emergency plans, and awareness, while informal preparedness pertains to practices embedded in everyday lives and culture that bear elements of preparedness—like knowing how to store food longer in case a blackout occurs—such that coping with power outages becomes second nature. Informal preparedness, they assert, comes as a consequence of previous experiences of power outages that nurture embodied "blackout competence" among individuals and households. This view of readiness for power interruptions under any circumstance may still be extended and be embedded into building more resilient cities and communities, especially post-pandemic.

In this chapter, we describe a study performed among households in Albay, a Philippine province where power interruptions are part of daily life. In 2018, this province had the third-highest number of power interruptions in the country, the most unreliable power among provinces in the Luzon mainland, and the highest number of momentary (i.e., shorter than 5 minutes) interruptions nationwide. That year, an average subscriber in Albay experienced almost 200 interruptions totaling 133 hours. These power interruptions occurred in a province that has been constantly exposed to climatic and geologic hazards such as typhoons, droughts, and volcanic eruptions but has also been recognized for effective disaster management (Naz et al. 2021). Presuming that Albay residents have a high degree of "blackout competence," their countermeasures reveal essential needs that can make power interruptions more bearable and less disruptive sans electricity. As Wallenborn and Wilhite (2014) assert, disruptions like blackouts can reveal what people really need and can do without in terms of electricity consumption—bringing opportunities to explore new "configurations." Strengthening these essential needs and/or making them easily accessible to the public will contribute to the resilience and well-being of communities post-pandemic and amid a changing climate.

This chapter attempts to answer the following questions:

(i) How have residents in Albay adapted to the perennial power interruption problem?
(ii) What is needed to make power interruptions more bearable, especially during a pandemic?
(iii) What "new configurations" can be explored for cities and communities to strengthen resilience to power outages with or without a pandemic?
(iv) How can electricity be rethought in the context of a post-pandemic world?

Since the study on which this chapter is based was designed to elicit responses assuming pre-pandemic conditions, significant changes in vulnerabilities and electricity consumption behavior caused by the pandemic are briefly discussed to put things in perspective. The revealed essential needs are respectively elaborated and the status quo in the Philippine setting assessed based on secondary data

[1] Load shedding procedures may be dictated by the grid/market operator or local distribution utility. In an electric cooperative in Texas (Big County Electric Cooperative Inc. n.d.), for example, the residential segment is one of the last sectors to be subjected to forced outages. In Europe, some jurisdictions use the value of lost load to identify priority customer segments (de Nooij, Koopmans, and Bijvoet 2007). There are also efforts to address the "fair load shedding problem" (Oluwasuji et al. 2020).

like government statistics and other relevant literature to find resilience improvement opportunities for cities and communities. By highlighting the lessons we can learn from electricity users instead of the usual supply- and infrastructure-centered approach on this topic, we then conclude with a reflection on how electricity policy can be rethought in the context of a post-pandemic world. We also offer recommendations for future study.

1.2 Case Study: Albay, Philippines

1.2.1 Methodology

As part of a broader study on power interruptions and quality of life in the province of Albay, Philippines, this chapter focuses on the results of one open-ended question: "When there is a power interruption, what do you do to lessen its impacts on you?" Respondents were free to write as many as five answers in any of the languages they spoke (i.e., Bikol, Tagalog, and English), without a set of choices.

Answers were elicited through a group-administered field survey that ran for seven days in October 2019 (n = 151) and an online survey from 24 March to 9 May 2020 (n = 207). The field survey covered the 10 most populous cities and towns of Albay, and the online survey covered 15 of the 18 most populous cities and towns in the province. Respondents for the field survey were sampled randomly, although it was difficult to ascertain the randomness of the online survey aside from trusting the "boost post" feature of Facebook. In the combined sample (n = 358), the demographic characteristics more closely resembled government statistics. For instance, the field and online samples had an average household electricity consumption of 72 kilowatt-hours (kWh) and 146 kWh per month, respectively, while the average recorded by the electric utility in 2018 was 98.4 kWh. The combined dataset yielded an average electricity consumption of 113 kWh. Studies like those from the United Kingdom (Anderson et al. 2017), Brazil (de Rezende Francisco et al. 2006), and the Republic of Korea (Jo, Jang, and Kim 2020) have found electricity consumption as a predictor of household characteristics like income, number of residents, presence of children, employment status of the head of household, and age distribution.

The survey obtained 940 raw countermeasures, which we translated into English. We then extracted common countermeasure categories and implied complementary necessities using thematic analysis. For example, a raw response like "chatting with people outside" would fall under the "socialization" category and imply the need for a friendly neighborhood. In the following subsections, we briefly discuss the resulting countermeasure categories and implied needs, including the formal and informal preparedness classifications by Heidenstrøm and Kvarnlöf (2018).

1.2.2 Countermeasures

Table 1.1 shows the 17 countermeasure categories noted in the study. Rankings for the field and online survey components are in parentheses.

We tallied the number of responses per theme of countermeasures but did not perform any further quantitative analyses; we did not consider the order in which respondents answered. The leading countermeasure, i.e., finding ways to stay cool and ventilated, implies the environmental context being in a tropical country. However, the differences between the rankings of countermeasures thereafter for field and online survey respondents leave room for speculation. For instance, field survey respondents seem to gravitate toward socialization more than engaging in hobbies, which is the second most frequent activity for online survey respondents. While emergency lighting is often top of mind (third

Table 1.1: Countermeasure Categories Extracted from Survey Responses

Countermeasures	Field	Online	Combined
Finding ways to stay cool and ventilated	65 (1)	140 (1)	205
Engaging in hobbies/Enjoying oneself	25 (7)	57 (2)	82
Socialization	41 (2)	39 (7)	80
Doing household responsibilities	33 (5)	45 (4)	78
Spending time elsewhere	37 (4)	39 (7)	76
Resting	20 (8)	43 (5)	63
Finding ways to keep house well-lit	39 (3)	22 (12)	61
Using battery-operated devices	27 (6)	27 (9)	54
Doing/Planning other activities not requiring electricity	9 (10)	40 (6)	49
Employing preemptive measures		46 (3)	46
Being indifferent	12 (9)	32 (8)	44
Buying/Using backup power sources	7 (11)	23 (11)	30
Taking electrical safety measures		24 (10)	24
Eating/Drinking	6 (12)	16 (13)	22
Others	6 (13)	12 (14)	18
Managing electricity consumption	2 (14)	2 (16)	4
Improvising		4 (15)	4

Note: Rankings for the field and online survey components are in parentheses.

Source: Authors.

most frequent) for field survey respondents, it comes as a weak 12th in the ranking among those who took the online survey. On the contrary, employing preemptive measures such as charging electronic devices, making sure there is always water on hand, and rescheduling activities are much more common among online survey respondents (3rd) than those who took the field survey (no mention). Surely, demographic and electricity consumption characteristics are at play, and it would be worthwhile to delve deeper and find these relationships and nuances. However, that is beyond the scope of this chapter.

1.2.3 Formal Preparedness

From 2016 to 2018, only 9% of power interruption events in Albay—corresponding to 20% of the aggregate duration—were scheduled. For these interruption events, residents were informed ahead of time often through the Facebook pages of the electric distribution utility, local officials, and media, and through announcements via local radio and television networks. It is only for these interruptions, and for occasional typhoons (0.3% of all interruption events, 26% of total duration), that households could prepare in advance. At the household level, there is no official government guidance as regards formal responses or preparations for power outages aside from a provision in the *Magna Carta for Residential Electricity Consumers* (Energy Regulatory Commission 2004) that mandates electric distribution utilities to announce any scheduled power interruption at least 2 days in advance through print or other mass or interactive media.

In terms of material preparation, several households reported having alternative lighting materials and devices such as flashlights, candles, emergency lamps, gas and paraffin lamps (Petromax), and solar-powered lamps. A few households mentioned owning backup power sources like standby

generator sets, solar power systems, and uninterruptible power supplies. While having battery-operated devices such as mobile phones and radio, coupled with power banks, is a form of material preparation, they are also used in daily life—which makes them more appropriately categorized under informal preparedness.

1.2.4 Informal Preparedness

Albay residents are clearly adept at dealing with power interruptions, practicing a considerable degree of informal preparedness in their daily lives. Knowing what to do immediately is evidence of strong informal preparedness and blackout competence, whether residents report engaging in hobbies like exercising, playing mobile or board games, reading books, or doing art; socializing with family and friends; knowing where to go to pass time, like malls or parks; keeping or planning backup activities to do if power goes out unexpectedly; or employing other preemptive measures such as keeping tabs on perishable items in the refrigerator, ensuring a sufficient supply of water and ice, making sure devices are always fully charged, and ironing clothes all at once.

1.2.5 Revealed Complementary Necessities

Based on the noted countermeasures, we identified a necessity for systemic interventions, strengthening household material countermeasures, and recognizing individual resiliency needs. The resulting seven categories of implied needs are grouped into these three classes, as elaborated in Figure 1.1 with respective examples from survey responses.

Figure 1.1: Implied Needs for Improved Preparedness

Systemic Interventions	Household Material Countermeasures	Individual needs
Utilities • Water • Gas • Internet • Transportation **Community and public spaces** • Well-ventilated/refreshing public spaces • Friendly neighborhood • Restaurants and shopping malls • Sports facilities **Landscape and architecture** • Proper ventilation • Lawns/Farms • Trees and greenery	**Contingency equipment/Tools** • Alternative lighting materials/ Devices • Alternative power sources/ Backup devices • Battery-operated devices (e.g., mobile phone, radio) • Refrigerator (prolonged storage) • Sturdy electrical equipment **Emergency supplies** • Food, drinks, ice • Money • Firewood • Comfortable clothing • Fan • Stationery materials	**Interpersonal relationships** • Family • Friends • Neighbors **Other specific needs** • Cleaning tools and cookware • Hobby items (e.g., books, board games) • Relaxation items

Source: Authors.

We define systemic interventions as those that may require government push, policy assistance, private sector support, and community participation. Household material countermeasures are those we deem to be common and tangible household-level preparations to soften the impact of and/or adapt to power interruption events. Lastly, individual needs are those that may vary by person or household; for instance, some people may find it easier to cope by themselves while others may not.

1.3 COVID-19 and the Exposure of Vulnerabilities

Although we posit that the need for making cities and communities more resilient against power interruptions would be similar whether or not there is a pandemic, some of the impacts would certainly be more pronounced in some sectors of the population amid a pandemic. This difference is due to shifts in electricity consumption behavior and vulnerabilities further exposed by pandemic-related circumstances. Precautionary measures moved many activities to households. Thus, they became the primary physical space, with virtual spaces becoming the "way out," if available. Moreover, with the health care system being strained by COVID-19 cases and apprehensions about getting infected by the virus, those with non-COVID health conditions were exposed to greater risk.

1.3.1 Households as the Primary Physical Space

The first COVID-19 household survey of the World Bank (2020b) in the Philippines showed that one in four household heads lost their job due to the pandemic. About 52% of those working in August 2020 were not able to work as usual. Of those who were able to work as usual, only knowledge workers, among a few others, were able to predominantly shift to home-based work. Aside from income and livelihood problems, households also faced concerns about food security, health care, and education. Thus, although electricity consumption shifted toward the residential sector, households would have encountered varying issues with the new setup depending mostly on financial capacity. Economically, this might have meant not being able to pay for utilities, basic needs, and emergency supplies. Family dynamics, relationships, and personal routines have also been profoundly affected (Weeland, Keijsers, and Branje 2021), especially in economically vulnerable households (Kalil, Mayer, and Shah 2020). Socioeconomic and psychological stressors like these certainly weaken households' resilience to power outages despite their usual blackout competence.

1.3.2 Virtual Spaces as the Way Out

Before the pandemic, spending time outside the household or socializing with others were typical countermeasures of Albay residents during power interruptions. However, these kinds of activities were generally discouraged during the pandemic. During community quarantine periods, the internet was one of the few ways left available to socialize outside of the household unit. While the internet provided a social outlet, problematic internet usage was associated with lower levels of psychological well-being of young people in countries like the Philippines and Turkey (Fernandes et al. 2021). If a widespread power outage affecting internet access would occur during a pandemic lockdown, individuals with weak or strained ties with family or housemates could face a challenging situation.

1.3.3 Strained Health Care System

Since 2020, health care systems worldwide have been heavily strained especially at the height of COVID-19 waves. The priority in addressing the pandemic has led to a decrease in the utilization of non-COVID-19 health care services. In the Philippines, for instance, researchers found a significant drop in admissions for non-urgent and respiratory diseases (e.g., dengue, asthma, pneumonia) and diseases requiring regular follow-up (e.g., tuberculosis, hypertension, ischemic heart disease; Uy et al. 2022). Among the possible reasons were fears of getting infected in hospitals, travel restrictions and lack of public transport, and reduced household purchasing power. Given that staying cool and ventilated is the primary countermeasure reported by Albay residents against power interruptions, individuals with heat- and ventilation-related health conditions living in similar environments would be more vulnerable to power outages in a pandemic. It could be worse if it lasts for hours, especially during dry spells. Financially disadvantaged households would be doubly vulnerable.

1.4 Assessment of Revealed Complementary Necessities

Sections 1.2 and 1.3 laid out the results of the Albay case study and presented how the COVID-19 pandemic has affected household conditions vis-à-vis suggested resiliency measures against power interruptions. Respondents' declared countermeasures imply that they have access to what they need albeit possibly in a less structured or less developed state. Therefore, we take from their experience, assess the prevailing conditions of these implied necessities on a national level, and offer some ways forward. We place particular attention on systemic interventions because of the greater stake policy makers have in them.

1.4.1 Systemic Interventions

Essential utilities. The case of Albay revealed four complementary utilities necessary to keep life bearable despite a power interruption. They are water, gas, internet, and transportation.

Water is needed to keep people cool and hydrated amid sweltering temperatures. A common practice has been to store extra drinking water in jugs and gallons, and general-purpose non-drinking water in buckets, drums, and water tanks. For households with refrigerators, it is also common to make and stock up on ice. Although water supply is often decoupled from electricity supply at the household level, 47.8% of Philippine households rely on water refilling stations—which use electricity for their equipment—for drinking water (Philippine Statistics Authority 2021). Private water companies and local water districts also use electricity for their facilities like pumping stations and water and wastewater treatment plants. As of 2021, Metro Manila's private water utility concessionaires Manila Water and Maynilad are still primarily dependent on grid power, save for less than 10% of power consumption sourced from their own renewable energy sources (Manila Water Company 2021; Maynilad Water Services 2021).

For cooking, liquefied petroleum gas remains the dominant fuel used in over 40% of Philippine households, while electricity usage for cooking is 12% at most; all the rest use charcoal, wood, and other biomass and traditional fuels (Sustainable Energy for All and Advisors 2019). This low use of electricity for cooking indicates that food preparation will less likely be affected by a widespread power interruption.

Despite the ubiquity of internet access in the Philippines, only 14.6% of households have broadband/fiber/DSL internet connections at home (Philippine Statistics Authority 2021). However, 90.5% have cellular phones. This means that most of the 76 million estimated internet users in the country (Kemp 2022) likely use mobile data to go online. More often than not, telecommunications cell sites have their own backup power equipment and are prioritized for power restoration, especially after extreme weather events. Some run off-grid on diesel generators or renewable energy.

Transportation is also an essential utility during power interruptions because it enables people to pass time elsewhere or access government, financial, health care, and other services. Aside from the rapid transit systems in Metro Manila, the transportation sector in the Philippines is still predominantly unelectrified (Vergel et al. 2022). This allows for transportation services to continue despite power outages, unlike in megacities like Tokyo or New York where major power interruptions can cripple people's mobility (Japan Today 2011; Kennedy 2003). Even so, compared to water, gas, and internet, transportation would be the essential utility most directly hit in a pandemic. Such a scenario would limit people's access to activities and services that could help lessen the impacts of power outages.

With regard to the availability of essential complementary utilities, the Philippines appears to be generally resilient to temporary disruptions in electricity service. However, for areas like Metro Manila, whose water services are mostly coupled to grid electricity supply, any unforeseen wide-area power outage (e.g., cascading power outage) will also severely disrupt the water supply. Although backup equipment, mechanisms, and long-term plans are in place, the government and policy makers must be cognizant of this risk. Climate change and resource issues may exacerbate this risk, for example, during dry spells when electricity demand is high and reserve supply is thin. The same phenomena can put a strain on water supply, even for water systems decoupled from the grid. Despite the availability of other utilities mentioned, coping with power interruptions in a tropical country like the Philippines would be more difficult as soon as the water supply falls short, especially amid a pandemic.

In line with global efforts toward decarbonization and electrification of the transport sector, there has been a strong push for electric vehicles and mass transit systems in the Philippines. While these are steps in the right direction, the entire transport system must be made resilient to shocks like power outages by providing for alternative and affordable modes of transport, including designing cities conducive to active mobility like walking and cycling. The COVID-19 pandemic and the advocacy efforts of various civil society groups have accelerated the adoption of active transport modes in the country. Since July 2020, the government has started implementing policies and allocating enormous resources for relevant infrastructure like protected cycling lanes and wider walkways (Abante and Bendaña 2021).

Assuming these complementary utilities are available, access to them still depends upon households' financial capacity. In situations like the COVID-19 pandemic, when many households lose significant income, all the more should governments help cushion the impact and implement systemic interventions to make these complementary utilities accessible to all.

Community and public spaces. Community and public spaces often provide refuge for Albay residents during power interruptions to escape boredom, kill time, socialize, engage in hobbies, spend quality time with loved ones, or simply stay cool. Among places frequently mentioned were malls, parks (including town "plazas"), restaurants, sports facilities like community basketball courts, anywhere with air conditioning, or simply "outside." At the height of the pandemic, however, going to enclosed spaces like malls and restaurants was discouraged. Meanwhile, there has been a severe deficiency in public parks and open and green spaces (PPOGS) nationwide (ASSURE Inc. 2019).

Dubbed as the country's "de facto public parks" (Venzon 2020), the 865 malls in the Philippines—often air-conditioned—have assumed the social functions of public spaces. However, in the event of a power outage and lack of backup power and air conditioning, most malls transform into a suffocating giant enclosure. On a positive note, some mall developers like Ayala Land have endeavored to design their commercial spaces with outdoor open and green spaces that double as local parks (Chung 2015). The pandemic has also made alfresco dining appealing to restaurant-goers so much so that formerly busy streets like Rada Street in Makati City's central business district have been partially closed to vehicle traffic and become outdoor dining attractions.

Functioning primarily as magnets for consumer activity, malls serve a social function only as a secondary if not unintended consequence. They cannot substitute for the unique health, aesthetic, ecological, economic, and security benefits PPOGS could provide (ASSURE Inc. 2019). Aside from malls' dependence on electricity, they also tend to concentrate people in one location rather than decentralize. Focused on a segment of the population with economic capital, they are naturally islands of gentrification, which are thus inaccessible to those who are far both in terms of financial capability and physical proximity.

In a pandemic scenario, transportation capacities would be reduced, incomes would fall, and mobility would be restricted. Should a widespread power outage occur, as much as people would want to spend time outside their homes, they cannot congregate in large numbers and, in the case of lockdowns, cannot go too far away from home. Therefore, the availability of PPOGS down to the community level is of great import. The Alliance for Safe, Sustainable, and Resilient Environments (2019), together with national associations of landscape architects and environmental planners, recommends the development of well-distributed neighborhood public open and green spaces that include local parks within 400 meters' walking distance of at least 95% of all dwellings and an active open space within 1 kilometer of the same. They also suggest adding local parks, plazas, or public squares in activity centers and higher-density residential areas. Unfortunately, there have been policy challenges, especially in the formulation and enforcement of government-mandated comprehensive land use plans at the city/municipal levels. If unaddressed, these challenges can hamper the development of PPOGS at the expense of cities' and communities' resilience to future shocks like power outages, pandemics, and climate change.

Landscape and architecture. Aside from keeping themselves hydrated and going elsewhere, Albay residents mentioned landscape and architectural elements that also keep them cool and ventilated during a power interruption. Getting "fresh air" was a frequent countermeasure, which respondents have done by opening windows and doors, staying on the lawn, in the backyard, on a terrace, or under a tree, or seeking refuge in a common area like the living room. Proper ventilation and greenery embedded in building and landscape design not only make power interruptions more bearable, but they also improve the health outcomes and well-being of residents.

Ventilation is part of the basic building requirements set by the Philippines' National Building Code, which includes prescribing a minimum area for window openings relative to floor area. During the COVID-19 pandemic, health authorities have constantly reminded people to stay in well-ventilated areas. In 2020, the Department of Health issued administrative and engineering controls for the improvement of ventilation and air quality in enclosed, indoor spaces; then in 2021, the Department of Labor and Employment promulgated additional guidelines for ventilation in workplaces and public transport to prevent and control the spread of the virus.

As regards trees, the Philippine Green Building Code recommends the inclusion of green areas for indigenous or adaptable species of grass, shrubs, and trees, which must take up at least 50% of the unpaved open spaces required by the National Building Code. However, the Green Building Code applies only to new construction of buildings of at least 10,000 square meters in total gross floor area, or in the case of residential dwellings, 20,000 square meters.

A recent development in building design is "tropical architecture," which is described as an adaptation of modern trends in design and construction to the tropical climate, considering lifestyle changes that the tropical climate affords (Bay and Ong 2006). Common elements of these designs include open and semi-open spaces, verandas, balconies, and open plans. In the Philippines, architectural designs inspired by the bahay kubo (a type of stilt house) have gained interest due to their known climate-responsive characteristics (Spittka 2019).

1.4.2 Household Material Countermeasures

The availability of household material countermeasures is contingent upon one's financial capacity. While hand fans and traditional lighting supplies such as candles are generally affordable, economic differences show up in the ownership of alternative power sources like backup generator sets and solar power systems. In addition, more than half of Philippine households do not have a refrigerator

(Philippine Statistics Authority 2021), which could help prolong food storage. As earlier asserted, however, electricity consumption likely reflects household characteristics; thus, low-consuming homes would not prioritize acquiring the abovementioned equipment. Low electricity consumption often means less dependence on electricity and less disruption should power get interrupted. Even so, among household conveniences that might help during a power outage, ownership of a cellular phone is the highest at 90.5%. Ownership of radios is at a far lower level of 36.3%.

1.4.3 Individual Needs

On the individual level, needs would vary even within households. Some would find it helpful to socialize, while others would prefer to cope on their own. Nonetheless, it is generally accepted that interpersonal relationships within and among families, friends, neighborhoods, and communities strengthen household resilience to shocks and stressors like power interruptions (Heidenstrøm and Kvarnlöf 2018). The pandemic added another layer of vulnerability when it altered household and relationship dynamics, as mentioned in Section 1.3.1. Since households and individuals live in the context of a larger system, resilience interventions discussed in Section 1.4.1 would serve as the backdrop to these relationships.

Individual needs are the final and more nuanced layer of resilience suited to unique personalities and circumstances. Although no survey respondents mentioned it, household medical equipment like some electronic nebulizers and digital sphygmomanometers would not operate during a power outage. Individuals who need equipment like these can be better prepared with manual or battery-operated types.

1.5 Rethinking Electricity Policy in the Post-Pandemic World

Energy policy, under which electricity falls, has been concerned mainly with matters on the supply side. This focus is reflected in the three widely adopted goals of energy policy, i.e., environmental sustainability (emissions reductions), security of supply, and competitiveness (affordability).[2] Moreover, Vine (2008) observed that energy policies have been developed and implemented in silos (i.e., limited policy arenas) and will necessitate integration if urgent issues like climate change are to be addressed. The revealed complementary necessities discussed in this chapter show that the issue of resilience to power outages, especially in the context of a pandemic, goes beyond supply.

Recurring themes make Spangenberg's (2002) four dimensions of sustainability an appropriate framework for rethinking electricity policy in the post-pandemic world. The four dimensions are economic, social, institutional, and environmental; their interactions reflect the complexity of reality. For instance, an overarching limitation of household and individual resilience to shocks like power outages and pandemics is economic capacity. This limitation can be tempered through equitable policies that address any gaps across various demographics. Another encompassing vulnerability among individuals is health and overall well-being. Although governments and the private sector cannot interfere with interpersonal relationships and personal dispositions, they have a pivotal role in improving the backdrop upon which these can flourish. Things they can do include ensuring unimpeded access to basic goods and services, including health care; embedding public parks, green spaces, and community centers into urban planning and property development; promoting landscape and building design suited to a country's climate; and enacting policies that strengthen communities and enhance well-being. Lastly, as the effects of climate change can cut through all aspects of utility

[2] The Commission of the European Communities (2007) initially proposed these goals for the European energy policy; they have also been used by researchers and agencies like the Asian Development Bank (Fueyo, Gómez, and Dopazo 2014).

infrastructure, economy, and human survival, it is imperative for stakeholders to push harder from all fronts: they need to design and strengthen infrastructure based on climate projections, they need to come up with resilient market mechanisms, and they need to become active participants and leaders in local and global climate action.

We can then say that electricity policy goes beyond making electricity available at any point of use. Interdependencies with other systems, their dynamism, and the uncertainties that lie ahead challenge the often-limited view and approach. The enduring availability of electricity is called into question; the notion of it being the lifeblood of modern society must be reconsidered and new configurations must be explored. Without invalidating the value of supply-side measures and without relieving governments and electric utilities of their shared responsibility to improve electrical infrastructure, this chapter's grounded approach treats electricity users with "blackout competence" as credible sources of insights that may usher these new configurations into cities and communities.

1.6 Recommendations for Further Study

This chapter's use of the case of Albay, an extreme case of power interruptions and not representative of the Philippine context, is not an attempt to generalize the nationwide circumstances. We use this case to gain insight into something that *might* eventually happen on a wider scale but has been more frequently experienced in Albay. As Flyvbjerg (2006) asserts, atypical or extreme cases often reveal more information compared to average or random samples because they activate more actors and more basic mechanisms in the situation studied. While we assert that the insights generated by this study should be sufficient to spark a conversation among policy makers and other stakeholders, this study can also then serve as a strong foundation for designing the parameters of a replicable and comparable quantitative study. Such a study will allow comparison of blackout competence across different localities or respondent characteristics. For instance, the results from field and online survey respondents showed possible demographic-related differences in countermeasures (see Section 1.2.2). A deeper assessment could even reveal nuances in the coping mechanisms of vulnerable groups such as persons with illnesses or disabilities. Understanding their specific needs could help relevant stakeholders tailor their interventions.

Another aspect not considered in this chapter is Albay's disaster resilience context. A study comparing blackout competence in disaster-prone areas to those that are not may reveal how much of the preparedness for extreme climatic and geologic events becomes embedded into individuals' practices and communities, which makes them resilient to power outages as well. That is because wide-area power interruptions are often a consequence of disasters of such scale.

Although this study focused on the residential segment, other consumer segments such as industrial and commercial may also have strongly embedded countermeasures against power interruptions. Further studies looking into these are opportunities to learn about best practices that can bolster the resilience of cities and communities.

Finally, despite the practicality of implementing electricity policy top-down from the national level, this study shows the value of understanding the unique circumstances of different customer groups at different locations. Thus, policy makers should consider instituting mechanisms to avoid one-size-fits-all electricity policies and allow context-based flexibility in planning and decision making.

References

Abante, K. and H. Bendaña. 2021. *Active Transport Policies of the National Government of the Philippines: Move As One Coalition Briefer as of 16 February 2021*. https://doi.org/10.13140/RG.2.2.36373.45285

Alexander, A. et al. 2021. What Executives Are Saying about the Future of Hybrid Work. *McKinsey & Company*. https://www.mckinsey.com/business-functions/people-and-organizational-performance/our-insights/what-executives-are-saying-about-the-future-of-hybrid-work

Anderson, B. et al. 2017. Electricity Consumption and Household Characteristics: Implications for Census-Taking in a Smart Metered Future. *Computers, Environment and Urban Systems* 63: 58–67. https://doi.org/10.1016/j.compenvurbsys.2016.06.003

Asian Development Bank. 2021. *COVID-19 and Energy Sector Development in Asia and the Pacific*. Mandaluyong City, Philippines.

ASSURE Inc. 2019. *Public Parks, Open and Green Spaces: A Planning & Development Guide*. Makati City: Alliance for Safe, Sustainable and Resilient Environments (ASSURE) Inc.

Bay, J.-H. and B.-L. Ong. 2006. *Tropical Sustainable Architecture: Social and Environmental Dimensions* (1st ed.). Burlington: Elsevier Ltd.

Big County Electric Cooperative Inc. n.d. Load Shedding. https://bigcountry.coop/load-shedding (accessed 18 July 2022).

Carlson, C. et al. 2022. Climate Change Increases Cross-Species Viral Transmission Risk. *Nature*. https://doi.org/10.1038/s41586-022-04788-w

Chung, A. Y. 2015. *Learning From an Ayala Mall: Seduced by the Superficial Urban Scene*. University of California, Berkeley.

Commission of the European Communities. 2007. *Communication from the Commission to the European Council and the European Parliament: An Energy Policy for Europe* (Vol. 12). https://doi.org/10.1111/j.1467-8292.1974.tb00409.x

Energy Regulatory Commission. 2004. *Magna Carta for Residential Electricity Consumers*.

Fernandes, B. et al. 2021. Internet Use during COVID-19 Lockdown among Young People in Low- and Middle-Income Countries: Role of Psychological Wellbeing. *Addictive Behaviors Reports* 14. https://doi.org/10.1016/j.abrep.2021.100379

Flyvbjerg, B. 2006. Five Misunderstandings about Case-Study Research. *Qualitative Inquiry* 12(2): 219–245. https://doi.org/10.1177/1077800405284363

Fueyo, N., A. Gómez, and C. Dopazo. 2014. Energy Security, Sustainability, and Affordability in Asia and the Pacific. ADB Economics Working Paper Series No. 401. Metro Manila: Asian Development Bank.

Heidenstrøm, N. and L. Kvarnlöf. 2018. Coping with Blackouts: A Practice Theory Approach to Household Preparedness. *Journal of Contingencies and Crisis Management* 26(2): 272–282. https://doi.org/10.1111/1468-5973.12191

International Energy Agency. 2020. *Power Systems in Transition*. Paris: IEA.

____. 2021. *World Energy Outlook 2021*. Paris: IEA.

Japan Today. 2011. TEPCO Begins Power Blackouts. 14 March. https://japantoday.com/category/national/tokyo-power-outages-to-start-later-than-planned-trains-reduce-services

Jo, H.-H., M. Jang, and J. Kim. 2020. How Population Age Distribution Affects Future Electricity Demand in Korea: Applying Population Polynomial Function. *Energies* 13(5360): 1–17. https://doi.org/10.3390/en13205360

Kalil, A., S. Mayer, and R. Shah. 2020. *Impact of the COVID-19 Crisis on Family Dynamics in Economically Vulnerable Households*. Working Paper No. 2020–143. Chicago: Becker Friedman Institute for Economics at UChicago.

Kemp, S. 2022. *Digital 2022: The Philippines*. https://datareportal.com/reports/digital-2022-philippines

Kennedy, R. 2003. THE BLACKOUT OF 2003: TRANSPORTATION; Thousands Stranded on Foot by Crippled Trains, Crawling Buses and Traffic Gridlock. *ANew York Times*. 15 August. https://www.nytimes.com/2003/08/15/us/blackout-2003-transportation-thousands-stranded-foot-crippled-trains-crawling.html

Manila Water Company. 2021. *Gearing Up to Become a Global Filipino Water Company: 2021 Integrated Report*. Quezon City.

Maynilad Water Services. 2021. *Together, Stronger: 2020 Sustainability Report*. Quezon City.

Naz, G. A. A. et al. 2021. Disaster Risk Communication and the Zero-Casualty Goal of Albay Province, Philippines. *International Journal of Social Ecology and Sustainable Development* 12(1): 86–97. https://doi.org/10.4018/IJSESD.2021010107

de Nooij, M., C. Koopmans, and C. Bijvoet. 2007. The Value of Supply Security: The Costs of Power Interruptions: Economic Input for Damage Reduction and Investment in Networks. *Energy Economics* 29(2): 277–295. https://doi.org/10.1016/j.eneco.2006.05.022

Oluwasuji, O. I. et al. 2020. Solving the Fair Electric Load Shedding Problem in Developing Countries. *Autonomous Agents and Multi-Agent Systems* 34(12). https://doi.org/10.1007/s10458-019-09428-8

Philippine Statistics Authority. 2021. *2020 Annual Poverty Indicators Survey*. Quezon City.

Powercor and CitiPower. 2019. *Fact Sheet: Load Shedding*. Melbourne: PowerCor Australia.

de Rezende Francisco, E. et al. 2006. Electricity Consumption as a Predictor of Household Income: A Spatial Statistics Approach. *Advances in GeoInformatics* (January). https://doi.org/10.1007/978-3-540-73414-7_17

Spangenberg, J. H. 2002. Institutional Sustainability Indicators: An Analysis of the Institutions in Agenda 21 and a Draft Set of Indicators for Monitoring Their Effectivity. *Sustainable Development* 10(2): 103–115. https://doi.org/10.1002/sd.184

Spittka, R. 2019. *Passive Design Guidelines for Philippine Housing Based on the Bahay Kubo*. TU Delft.

Steetskamp, I. and A. van Wijk. 1994. *Stroomloos: Kwetsbaarheid van de samenleving: gevolgen van verstoringen van de elektriciteitsvoorziening (Powerless: The Vulnerability of Society: Consequences of Disruptions to the Electricity Supply)*. https://www.rathenau.nl/sites/default/files/STU026-Stroomloos1-1994.pdf

Sustainable Energy for All, & Advisors, C. O.-G. 2019. *Energizing Finance: Taking the Pulse 2019*. Vienna.

Thrift, N. 2004. Remembering the Technological Unconscious by Foregrounding Knowledges of Position. *Environment and Planning D: Society and Space* 22(1): 175–190. https://doi.org/10.1068/d321t

United Nations Economic and Social Council. 2022. Progress towards the Sustainable Development Goals. In *SDG Progress Report*. https://sustainabledevelopment.un.org/content/documents/29858SG_SDG_Progress_Report_2022.pdf

Uy, J. et al. 2022. The Impact of COVID-19 on Hospital Admissions for Twelve High-Burden Diseases and Five Common Procedures in the Philippines: A National Health Insurance Database Study 2019–2020. *The Lancet Regional Health, Western Pacific* 18(100310): 1–12. https://doi.org/10.1016/j.lanwpc.2021.100310

Venzon, C. 2020. "Mini Economies": Pandemic Tests the Philippines' Mighty Malls. *Nikkei Asia*. 6 November. https://asia.nikkei.com/Business/Business-Spotlight/Mini-economies-Pandemic-tests-the-Philippines-mighty-malls

Vergel, K. B. N. et al. 2022. Estimation of Transportation Energy Demand of the Philippines Using a Bottom-Up Approach. *Asian Transport Studies* 8(100058): 1–15. https://doi.org/10.1016/j.eastsj.2022.100058

Vine, E. 2008. Breaking Down the Silos: The Integration of Energy Efficiency, Renewable Energy, Demand Response and Climate Change. *Energy Efficiency* 1: 49–63. https://doi.org/10.1007/s12053-008-9004-z

Wallenborn, G. and H. Wilhite. 2014. Rethinking Embodied Knowledge and Household Consumption. *Energy Research and Social Science* 1: 56–64. https://doi.org/10.1016/j.erss.2014.03.009

Weeland, J., L. Keijsers, and S. Branje. 2021. Introduction to the Special Issue: Parenting and Family Dynamics in Times of the COVID-19 Pandemic. *Developmental Psychology* 57(10): 1559–1562. https://doi.org/10.1037/dev0001252

Wholesale Electricity Spot Market. 2014. *Management Procedure for Load Shedding*. Wholesale Electricity Spot Market.

World Bank. 2020a. *Doing Business 2020: Comparing Business Regulation in 190 Economies*. Washington, DC: World Bank. https://doi.org/10.1596/978-1-4648-1440-2

___. 2020b. *Impacts of COVID-19 on Households in the Philippines*. Washington, DC: World Bank.

CHAPTER 2

Post-Pandemic Urban Resilience Imperatives: Examining Practices of Philippine Local Governments

Karl Sam M. Maquiling, Klaribelle Anne Languayan, and Julemer Ann Aying[1]

2.1 Introduction

Resilience as a concept bridges the gap between disaster risk reduction and management (DRRM) and climate change adaptation. Resilience emerges when lessons from past disaster experiences are integrated into networks of actors and systems, alternatives with versatility to adopt strategies that enable effective and efficient responses in times of crisis, and governance approaches that usher in a conducive environment for synergy, appropriateness of interventions, and a collective vision for everyone (Arup and Rockefeller Foundation 2015; Weichselgartner and Kelman 2015).

Because resilience is multifaceted, it requires multiple measurement techniques and raises questions about the resilience of what, to what, or for whom (Meerow, Newell, and Stults 2016; Vale 2014). As a result, city managers and urban planners muddle through comprehending risk factors—minimizing exposure, mitigating impact of hazards, and managing vulnerabilities. In addition, practitioners struggle to establish resilience, and consequently urban resilience, in a complex configuration where authority is devolved but not relegated (Béné et al. 2018; Chelleri, Waters, et al. 2015; Normandin and Therrien 2016). Recently, case studies worldwide point out the importance of contextualizing resilience in a context of wider sustainability challenges including climate change, unsustainable urbanization, and social inequalities (Chelleri, Waters, et al. 2015).

Case in point, the coronavirus disease (COVID-19) pandemic revealed resilience issues such as the lack of a governance approach that looks at disaster preparedness fundamentally, insufficient capacity of urban systems during abnormal disruptions (particularly those that affect public health), and the absence of multi-sectoral coordination mechanisms with clear executive sponsorship (Sirleaf and Clark 2021).

The pandemic made more explicit the interrelatedness of economic, political, social, and cultural issues and the worsening inequalities especially in low- and medium-income countries. Further, insufficient scientific knowledge on the pandemic provokes governments and communities to institute interventions including coordination among government units, response guidelines on pandemics, policies ensuring basic services during natural disasters, and compound risk management plans (Hale et al. 2020).

The disparities between different localities' COVID-19 response and recovery measures, as well as the implications of these disparities for livelihood and public health, leave communities to grapple with

[1] The authors are grateful to Tsuyoshi Hashimoto and Shogo Kudo for their constructive comments during the enhancement of the manuscript. The authors would also like to express their gratitude to the Ateneo de Zamboanga University Automated Water-Level and Rain Monitoring Using Near Real-Time Observation (ALeRTO) team, headed by project leader Mario S. Rodriguez, for the invaluable support.

The authors disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: This article is based on the research conducted by the Ateneo de Zamboanga University ALeRTO team in aid of the development of the L!STO Disaster Preparedness Manual for Localized Weather Disturbances commissioned by the Local Government Academy of the Philippine Department of the Interior and Local Government. The authors received no additional financial support for the research or authorship of this chapter.

compounded risks from perennial extreme weather patterns and the ongoing pandemic (World Health Organization 2021). Several studies have already examined the influence of knowledge, awareness, and attitude during highly infectious disease outbreaks. Most conclude that adopting the appropriate measures hinges on correct knowledge and understanding of the particular hazards (Lin et al. 2011; Ssebuufu et al. 2020).

This chapter provides empirical evidence in the current discussion of urban resilience by tracing actors who are active in building resilience and the processes they undertake, as well as the extent to which their configuration shows up in governance structures and policy instruments (see Chelleri, Schuetze, et al. 2015; Henstra 2012; Maquiling et al. 2021). Particularly, the chapter explores the extent to which knowledge, awareness, and attitude influenced actual resilience-building measures of local government units (LGUs) frequently facing hydrometeorological hazards in the Philippines at the height of rigid COVID-19 related protocols.

2.2 Urban Resilience in the Philippines

2.2.1 Overview

The Philippine government enacted Republic Act 10121, also known as the Philippine Disaster Risk Reduction and Management Act of 2010, as an institutional response to constant exposure to flooding, volcanic eruptions, earthquakes, and civil conflict. Republic Act 10121 provides the legal framework that governs operationalizing disaster risk reduction and climate change adaptation principles in the Philippines. It shifted the DRRM paradigm from reactive measures focusing mainly on disaster response to proactive undertakings with the view of disasters as manifestations of systemic underlying factors and of people's vulnerability. Further, it established four distinct but reinforcing thematic pillars: disaster prevention and mitigation, disaster preparedness, disaster response, and disaster rehabilitation and recovery.

Republic Act 10121 defined the roles and functions between and among national and local governments based on the different thematic areas, with the National Disaster Risk Reduction and Management Council as the leader. Echoed at the local level, the Regional Disaster Risk Reduction and Management Councils are headed by the Office of Civil Defense. As the Philippines is politically subdivided into provinces, municipalities or cities, and barangays with political units that have unique administrative functions and exercise specific autonomy in local affairs, DRRM councils are also established within these subdivisions. The Provincial, Municipal/City, and Barangay Disaster Risk Reduction and Management Councils are headed by governor, mayor, and barangay captain, respectively. Other members of the local DRRM come from local government offices, allied agencies, and civil society organizations.

Local DRRM offices and councils are key to LGUs instituting critical actions before, during, and after a disaster. LGUs also create and implement the DRRM plan, contingency plan, and knowledge on emergency response systems such as the incident command system (ICS). The provincial DRRM plans result from consolidating city/municipality DRRM plans. Similarly, city/municipality DRRM plans result from consolidating barangay DRRM plans.

In 2014, the Philippine government initiated the L!STO Program, its national advocacy program for disaster preparedness and resilience. L!STO provides LGUs with prescribed sets of actions to be done before, during, and after the critical period or the onslaught of a hydrometeorological hazard. The L!STO manual also provides a checklist of early preparedness actions and minimum critical preparedness actions for mayors, governors, and *punong* barangays (barangay captains). It also includes a checklist

for local authorities such as the city and municipal local government operations officer, chief of police, and fire marshal.

2.2.2 COVID-19 Pandemic-Related Protocols

The Philippines implemented one of the world's longest lockdown and quarantine measures, which caused an economic recession (Communities 2022). The evolving international public health crisis, exacerbated by the long-standing demand to manage vulnerabilities, put the local governments in an overwhelming multi-hazard scenario.

The Philippine government made its first ever policy decision related to COVID-19 in February 2020 when it imposed selective quarantine after a case with pneumonia-like symptoms was reported to the country's Department of Health Inter-Agency Task Force (IATF) on Emerging Infectious Diseases (EID) (Vallejo and Ong 2020). This decision is connected to the People's Republic of China's announcement of a possible infectious pneumonia on 31 December 2019 and the World Health Organization's creation of the Incident Management Support Team on 1 January 2020.

All government agencies nationwide received the "Interim Guidelines on the Preparedness and Response to Novel Coronavirus (2019-nCoV) from Wuhan, [People's Republic of] China (as of 21 Jan 2020)." It laid down the background on the virus, surveillance, laboratory testing, clinical management, risk communication and community engagement, and infection prevention and control. Other details contained are prescribed community quarantine classifications with corresponding sets of measures and alert levels, daily submission of LGU case reports to Regional IATF, implementation of public health standards, hazard pay and risk allowances, penalty for noncooperation, prevention and detection, isolation and quarantine of the infected, treatment and reintegration, and lockdowns. The IATF determined alert levels covering entire cities, municipalities, and/or provinces based on their system indicators, triggers, and thresholds subject to updating. The higher the alert level, the more stringent the protocols (see Appendix 2.1).

2.2.3 Compounding Risks from Multivariate Hazards

Multi-hazard interactions are often observed in the disaster-prone Philippines. Mostly, these interactions are natural hazards that relate to geology and climate change; impacts tend to be contained in a particular geographical location (see Ybañez et al. 2020). On the other hand, COVID-19 is a declared pandemic with worldwide impacts.

Given the situation of the Philippines, local governments are encouraged by the national government to develop contingency plans for known significant hazards. These contingency plans contain logistical arrangements and core functions needed for an effective and timely response to a particular hazard. In addition, the ICS has been set up to empower local authorities to provide on-scene disaster response. The ICS is a mechanism for small to complex disasters.

Take, for example, in December 2021 when Typhoon Rai (locally called Odette) struck several areas in the southern Philippines, causing damage to houses, infrastructure, power, and telecommunications services. At that time, the Philippines was still recovering from several months of quarantine restrictions and the newly detected Omicron variant when Rai struck. Communities had to bounce back from the loss of properties and relied on dedicated facilities for dwellings. The surge in COVID-19 cases continually threatened the multiple humanitarian response operations in areas greatly affected by Typhoon Rai (United Nations Office for the Coordination of Humanitarian Affairs 2022). Several international relief grantors expressed concerns on the quarantine for international arrivals in the

Philippines, which further delayed the relief operations needed in the areas. The presence of the guidelines and the different quarantine levels muddled the local governments' mobilization and availability of resources for response. LGUs also found themselves in a predicament to implement the frequently shifting guidelines (USAID 2022).

Effects of the pandemic not only unfolded as a health emergency but extended as a global economic crisis. What aggravated this crisis even more is that actions and resolutions toward it needed substantial science-based information. This signifies that resilience in disaster risk reduction (DRR) should include health as a fundamental infrastructure. Djalante et al. (2020), writing on the pandemic and its effect on DRR measures, assert that the DRR framework, with the integration of the health sector, should use DRR assessment tools, science-backed projections, and early warning systems for pandemic-related concerns.

Lin et al. (2011), in their study on the H1N1 pandemic, looked into the knowledge, awareness, and practices of the responding public to build on data that would help the government develop preventive measures. They argue that plausible preparedness and response practices depend on accessibility of information, quality of information, correct and accurate knowledge, and up-to-date and consistent information dissemination to the public. They emphasize the early detection of diseases and understanding of the implications communicated through instituted channels to decision makers and stakeholders as a public health agenda in preparedness measures.

Countries and partners gathered by the World Health Organization recently developed the "health emergency and disaster risk management framework," recognizing the concept as one whole paradigm and thereby creating a structure of a comprehensive approach and common knowledge relevant to policy making (World Health Organization 2019). Through this framework, the Sendai framework for disaster risk reduction also adapted requirements to account for regulations on international health (Ishiwatari et al. 2020).

Ishiwatari et al. (2020) also proposed that in managing dual disasters of flooding and COVID-19, policy must prioritize the overarching concept of human life and its protection with a focus on vulnerable groups. To achieve these goals, several actors are to undertake their role in this scheme, with dynamic coordination with multiple sectors and national to local levels, and risk communication with scientific knowledge shared vigorously in communities (Ashraf 2021). Ishiwatari et al. (2020) recommend that this conceptual model should supplement contemporary sectoral practices through adaptation.

2.3 Research Design and Method

We used a cross-sectional explanatory research design to identify, describe, and explain implementation of the DRRM protocols of Philippine LGUs relative to the L!STO protocol during an ongoing pandemic. Methodologies include review of related literature as well as relevant policies and legislation, and primary data collection such as online close-ended questionnaires, semi-structured key informant interviews (KIIs), and focus group discussions (FGDs).

Specifically, the primary data collection tools focused on documenting LGUs' (i) knowledge and awareness of weather disturbance protocol, (ii) system and structure in managing risks and disasters, (iii) protocols practiced, (iv) coordination and communication processes during local weather disturbances, and (v) attitude regarding protocols and early warning systems. The study used these factors to investigate resilience building practices of Philippine LGUs because the literature points out that degree of awareness and knowledge significantly influence attitude and practice.

To extract practical learnings, the survey used a sample frame of local government units in the Philippines with high frequency and level of exposure to localized weather disturbance. The survey was done from May to August 2020 with 1,044 respondents (see Table 2.1).

Table 2.1: Summary of the Survey Respondents

Level of Government	Count
Province	22
City/Municipality	375
Barangay	647
Total	1,044

Source:

Meanwhile, key informants were randomly determined using the survey sample frame with an additional criterion of high flooding susceptibility. The interviews documented actual experiences of 23 LGUs. Maximum variation selection in finalizing key informants allowed inclusion of multilevel local government actors (province, city/municipality, barangay) from different areas. This provided a comprehensive outlook on how resilience building is practiced and perceived among key actors with different contexts. Lastly, the focus group discussions, using the KII sample frame, gathered participants according to whether they are barangay, city/municipality, or province participants.

We applied quantitative and qualitative techniques in data collection and analysis. We used frequencies and percentages to generate results and used measures of central tendency to draw out patterns of responses. Quantitative analysis provided initial assessment regarding LGU practices that were utilized in the design of KIIs. Meanwhile, we used an iterative thematic coding process to provide in-depth information of patterns and trends observed from responses. Finally, results of empirical analysis were juxtaposed with current discussion regarding urban resilience and the ongoing pandemic to extract universally accepted postulations. In particular, we conducted a comparative analysis between hydrometeorological hazards and COVID-19 on the differences in (i) protocol, (ii) early warning systems, (iii) existing knowledge, and (iv) coordination.

2.4 Results and Discussion

2.4.1 Knowledge, Attitude, and Awareness of Local Government Units regarding Weather Disturbances

Barangay level. Survey results indicate that barangay respondents have a high level of knowledge and awareness regarding protocols, systems, and structures that build resilience to local weather disturbances. The DRRM protocol and resilience-building systems are known at the barangay level, and some are reflected in their respective city/municipality's DRRM plan. Responses in the survey, reinforced by the KIIs and FGDs, point to familiarity with standardized protocols, emphasizing application of minimum critical preparedness measures by barangay representatives.

However, results across primary data collection tools regarding extent of adherence to protocols, coordination and communication, and attitude toward DRRM protocols show varied responses. Qualitative analysis highlights two significant factors in determining actual resilience-building

measures. The first factor is the extent of previous similar disaster experience, which affects budgeting and ability to initiate early preparedness including prepositioning for resource mobilization. The second one is the ability to maximize common practices for weather monitoring like physical inspection, traditional water level markers, and coordination of other local authorities in areas sharing the same major water system for flooding threat.

For example, barangay leaders base their call for preemptive evacuation on physical observation of water level in rivers and identify regular flood paths during abnormal weather disturbance regardless of whether a typhoon advisory has been issued. Barangay officials usually update their mayor, local DRRM officer, and neighboring barangays for immediate response such as heightened monitoring of threat, positioning of evacuation centers, and other logistical needs. Once an official has informed the local DRRM council, the local DRRM offices maintain bottom-up (barangay to city/municipality) and top-down (city/municipality to barangay) communication.

KIIs and FGDs reveal that budget prioritization and funding issues are most notable at the barangay level. Respondents reveal that even before the pandemic, the rollout of an early warning system in the barangay is constrained by limited funds. Regular funds are prioritized for disaster response and relief efforts such as search, rescue, and retrieval equipment, and supplies and stockpiles for relief response. This is mainly due to barangays having the most hands-on disaster experience being at the forefront during imminent threats from natural hazards.

Barangay representatives noted the predicament in the prioritization and allocation of funds for the unforeseen need to COVID-19 response, which eventually overrode the appropriation for disaster management response setup. Local DRRM funds regularly allocated to manage risks from natural hazards were redirected to COVID-19 response.

Consequently, logistics for early disaster response and relief services like evacuation management became a problem. For example, schools, usually designated as disaster-related evacuation centers, are sometimes utilized as sites for COVID-19 isolation units. On top of these issues, evacuation camps are required to observe social distancing. As such, LGUs had to utilize ill-equipped open spaces such as basketball courts as additional evacuation campsites. Unfortunately, as relayed during the KIIs and FGDs, LGUs' readiness or the lack thereof to manage evacuation camps significantly reduced participation of people in calls for evacuation.

Lastly, barangay representatives divulged that capacity building for DRRM is overdue and that the COVID-19 situation has caused neglect of disaster protocols. A barangay official mentioned that due to the pandemic, there was a need to "put to sleep" training and capacity building endeavors of some LGUs at the barangay level as the urgency to hold pandemic-related activities superseded schedules. Equipment and resources for DRR were also mobilized for these affairs.

City/Municipal level. Survey responses from those coming from the city/municipal local government units indicate strong knowledge and awareness regarding resilience-building systems and structures with measures nuanced to local context. LGUs have their own local DRRM practices depending on the applicability of prescribed protocols to the locality's geography, demographics, resource aggregated data, etc. Modified actions include the traditional way of monitoring water level through physical observation of the water level and information dissemination like the *bandillo* (house-to-house announcements).

Some practices that are not specifically included in the prescribed protocol were arbitrarily implemented. These activities include, but are not limited to, management of the dead and missing persons and

suspension of school classes. While these were also traditionally practiced and adapted from ground response and recovery experience, the practices lacked proper and on-time documentation. Relatedly, the transfer of knowledge and institutionalization of best practices are constrained by the frequent turnover of officials and council members given the highly political nature of their appointments. They have a term of three years subject to extension depending on whether allied politicians get reelected. This is the same with barangay officers; some of the first-term barangay officials divulged that they need DRRM-related capacity building activities.

Local DRRM officer respondents, during the KIIs and FGDs, pointed out the importance of timely coordination among key officials in the barangays for feedback on preparation and preventive measures, national agencies for updates on alert level, and other LGUs sharing the same major water system. This coordination extends to other LGUs and even to national government agencies.

The survey, reinforced by the KIIs and FGDs, shows that cities and municipalities are keen on having an early warning system with the condition that technology is available in the market and comes with capacity development as part of its operation and maintenance.

KII and FGD respondents shared that officials update DRRM plans by consolidating barangay plans at the city/municipality level. Unfortunately, sometimes the late submission by some barangays delays the update. Nevertheless, updated DRRM plans help LGUs identify appropriate resilience-building measures and resources for mobilization and prioritization.

A concern at this level is about technology-based early warning systems, as they could be costly, which could reduce budget allocation for disaster response. Cities/municipalities show openness to accepting assistance from provincial and national governments with regard to management and maintenance of existing early warning systems. Some city officers disclosed that out-of-pocket expenses, especially during the pandemic, have to include funds to cover volunteers' operations and other logistical requirements for quick and emergency response.

Provincial level. Survey results indicate that provincial governments are familiar with DRRM protocols—having especially high levels of knowledge and awareness of protocols—and system and structure in managing risks and disasters during local weather disturbances. Additionally, data from across data collection tools suggest that among all LGU levels, provincial LGUs are the most likely to follow measures prescribed by the L!STO protocol. Mentioned are the activation of an emergency operation center, incident management team, and the cluster response approach.

The provincial DRRM councils act as a platform to discuss, agree on, and establish DRR related protocols among DRRM frontline offices. Some of the provinces have even developed their own flood warning standards providing guidance on warning level, prioritization criteria, and interpretation of risk information for decision making on resilience-building measures.

Provincial governments coordinate with national agencies and their counterparts in barangays and cities for monitoring before and during the disaster. They handle documentary requirements from the national government for post-disaster assessment of the affected LGUs in the province. Moreover, provinces are updated about the on-the-ground situations with due acknowledgment of the city/municipal LGUs' autonomy in deciding the set of actions to be done before, during, and after occurrence of disasters.

Based on gathered data from KIIs and FGDs, there seems to be no issue at this level with funding requirements for procurement of early warning systems. However, operation, maintenance, and suitability of early warning systems to local context are primary considerations for such acquisition.

Despite overlap between protocols for typhoons and local weather disturbances and despite the national government's prompt release of guidelines for pandemic hazards, LGUs struggle to optimize local funds and human and material resources to deal with natural hazards quickly amidst the health crisis.

2.4.2 Comparison between Hydrometeorological Hazards and COVID-19

Protocols. The protocol for hydrometeorological hazards integrates learnings from several years of the country's disaster experience. The presence of a standardized protocol provided guidance for the local leaders in addressing natural hazards. While the L!STO protocol provides a standardized approach to addressing the natural hazard, results show that flexibility in implementing resilience-building measures helped LGUs to pursue appropriate actions taking into consideration indigenous or local practices. The level of community awareness and preparation is also high because local knowledge is integrated in actual resilience-building measures.

> *We painted orange, yellow, and red color code warnings placed on the coconut trees. Yellow would tell us that the water is still low. When it's already in the orange, we are already starting to prepare. When it's red, it means that the water is deep and it's time to evacuate.*
>
> *—Barangay captain respondent*

The different levels of LGUs have various ways of interpreting and applying established protocols, and they also have varying attitudes toward early warning systems. Barangays are more concerned about immediate response and relief considering their proximity to communities. Meanwhile, provinces and cities/municipalities are more likely to position resources, ensure communication channels, ready policies, etc.

The Philippine government, albeit the framework for pandemic management is still a work in progress, has established health response guidelines to also lessen community transmission. However, the protocol was crafted at the national level with local governments having limited to no flexibility in applying the protocol in the local context.

The IATF principally issues specific guidelines in terms of movement between and within zones, access to essential goods and services, and overall mobility of a local government unit. The prompt release of IATF national guidelines and the adaptability of local governments to enforce them are crucial, but public awareness and public participation are similarly important to effecting responsive resilience-building measures. Literature suggests that policies should be accepted within the local context for smooth implementation (Mintrom and O'Connor 2020). This may mean that LGUs need to do more to raise public awareness of hydrometeorological hazards and the protocols necessary to lessen the transmission of COVID-19. Moreover, an increase in personal knowledge and awareness of specific hazards not only affects the community-level outcomes, such as change in attitude and behaviors, but most importantly leads to a significant change in resource management and policy implementation (see Stepenuck and Green 2015). Thus, increased knowledge of both hazards means greater receptiveness of the people to follow the guidelines.

Early warning system and technology. Aside from early warning systems installed by the Philippine Atmospheric, Geophysical and Astronomical Services Administration nationwide, several projects

were also initiated to augment capacity for early detection of hydrometeorological hazards. In 2012, the Nationwide Operational Assessment of Hazards, or Project NOAH, was launched. Project NOAH developed high-resolution flood hazard maps of several critical river systems in the country. Due to its open-source data sharing mode, the data developed by Project NOAH became the baseline for the LGUs to update their corresponding risk profile and their corresponding DRRM strategies (Lagmay 2017).

> *If you put more investment in pre-disaster activities, you will have to invest less in response and recovery ... application of an early warning system, setting of communication protocol and procedures ahead of time are critical. We follow a lead time of 24 hours for flooding, 6–8 hours for landslides so evacuation can be possible. This is our practice, more important than operating and mastering rescue teams and relief.*
>
> *—Respondent from provincial government*

In April 2020, the Philippine government, through the DOH and the IATF, launched the COVID-19 Tracker, for updates on cases and logistics such as testing and hospital capacities and resources, and also launched a mobile application, StaySafe.ph, for contact tracing. Unfortunately, both COVID-19 trackers lack early detection information, containing only transmission figures and location.

COVID-19 limited face-to-face activities, including LGU meetings necessary for DRRM. Results of analysis point to social media channels and online teleconferencing as technological innovations that agencies can use to communicate about critical disaster preparedness and response action.

Scientific and traditional knowledge and information. The scientific knowledge on hydrometeorological hazards has grown over the years and informed policies for established protocols and local plans (DRRM plans, ICS, etc.). Also, open access data has been practiced by national agencies and government projects. Local experiences for public learnings were accounted for by the established DRRM structures, especially in the most basic government unit. This emphasizes that the combination of scientific and local knowledge is instrumental in disaster management of LGUs. It also points out the importance of integrating and reflecting indigenous knowledge in scientific evaluations of climate change (see Wolf and Moser 2011).

> *Regarding water level thresholds for early flood warning, we do not usually follow the prescribed level. We do our own setting of threshold based on institutional knowledge. We can better assess the range of water level that is critical based on realities from the ground.*
>
> *—Respondent from municipal LGU*

Scientific data on COVID-19 is scarce not just in the Philippines but worldwide. Several research projects are constantly being developed and evolving simultaneously with the need for further dissemination and popularization. The community mostly depends on government protocols to respond to COVID-19 as the pandemic unfolds. Efficient implementation of appropriate measures is a factor in the contagion of highly infectious diseases, which are often place-specific. As such, documentation and integration of localized experiences and learnings to formal policy channels is vital.

Coordination among stakeholders. Hydrometeorological hazards usually result in flooding and mudslides that affect a wide area, a compelling reason for neighboring municipalities to coordinate and communicate to determine the lead time of threats. The level of coordination among the different levels of LGUs is strong due to the presence of the protocol. This enabled the LGUs to appropriately respond to the hazard in a timely manner.

In contrast to the case of hydrometeorological hazards, the COVID-19 response involves heavily top-down multilevel government coordination. Innovation in the public sector is hampered by issues and challenges of coordination among the levels of government in human resources, information systems, feedback and participation, and leadership and trust. Despite efforts to increase coordination at the barangay level for strict implementation of guidelines, weak government systems resulted in concerns of implementation and violations (Tabuga et al. 2020).

2.4.3 Implications for Governance

Urban governance capacity plays a significant role in the management of compounding risks brought about by COVID-19 (Chu, Cheng, and Song 2021). Risks related to highly infectious diseases can be managed well if hazards are easily recognized and promptly communicated to all stakeholders for co-creation of measures and resource mobilization (see Ssebuufu et al. 2020).

Those who had experience with epidemics and outbreaks were likely to observe measures that will prevent the spread of some other highly infectious diseases (Lin et al. 2011; Ssebuufu et al. 2020). Similarly, LGUs effectively manage risk of natural hazards because of familiarity brought by recurring hydrometeorological hazards. The lack of familiarity can also partly explain why LGUs muddled through risks compounded by COVID-19.

Managing unpredictable disaster risks should allow flexibility in localizing established standardized protocols given that level of knowledge, awareness, and attitude significantly impacted the appropriateness of resilience-building measures. Such was the case of the L!STO protocol, in which certain standardized approaches to a broader spectrum of hazards were prescribed but were not necessarily useful in the process of ideating, translating, and realizing resilience-building measures from an institutional level.

While operationalizing resilience can be an arduous task, resilience building in a post-pandemic era should be understood as a dynamic approach. Before a disaster, resilience building includes planning and preparation that integrate uncertain, and often unforeseen, disaster risks into standardized protocols (e.g., ICS, contingency planning). During a disaster, resilience building requires withstanding impacts by creating a critical reflexive feedback mechanism that detects and communicates impending threats clearly and promptly to and among established institutions (e.g., early warning systems, multilevel DRRM councils, local DRRM offices). After a disaster, we can build resilience by learning from severe consequences that distinguish identities and roles for better consensus building in the future (see Sharifi, Khavarian-Garmsir, and Kummitha 2021).

2.5 Conclusion

The local governments' level of knowledge, attitude, and awareness in terms of building resilience are critical in formulating and implementing disaster preparedness strategies that are responsive and timely. Formal policy instruments enumerating a set of critical actions should allow flexibility for local governance structures to adopt protocols without necessarily creating additional structures, systems, and processes.

The COVID-19 pandemic revealed that despite implementers and decision makers acknowledging the importance of the level of knowledge, awareness, and attitude toward urban resilience, certain limitations encumber the ability to face various hazards. Specifically, this problem showed up in the absence of documentation and streamlining of preexisting localized action, underdeveloped DRRM to account for health crises, and deficient funds for contingency and disaster risk reduction.

Optimistically, sufficient literature to improve resilience building is within reach and evolving rapidly. Alongside this flow of information, streamlining knowledge should enable the development of policies, mechanisms, and systems; researchers should scientifically evaluate realities and practices; and multilevel units of society should standardize coordination. These efforts will help to manage vulnerability from risk and empower leadership and collectivization for an advanced and strengthened fundamental resilience.

Finally, learning from the localized weather disturbances experience of local government units from the Philippines, governments, development practitioners, and partners need to consider the following in building urban resilience post-pandemic.

(i) *Technology-based standardized approach to early warning systems*. Often, protocols related to hazards rely on issuance of advisories in order to enable critical actions for early preparation. Technological advancement provides for alternative sources of information needed to capacitate core functions to sustain operations in times of disruptions that restrict face-to-face interaction. Technology can facilitate more integrated planning and management involving wider stakeholders. It also can enable enhanced management of risks through early recognition, prediction, or projection of imminent threats including future uncertain hazards (see Sharifi, Khavarian-Garmsir, and Kummitha 2021; Hassankhani et al. 2021).

(ii) *Local action plan*. A local action plan is a document that outlines local risk context and streamlines current practices into a standard response of a city/municipality. It can serve as baseline information for prescribed courses of action that do not just reinforce structures and systems to absorb potential consequences of a disaster but can also ensure alternative sources of resources to ensure perpetuity of core functions and processes. Moreover, a localized action plan prescribing several courses of action, e.g., a contingency plan and activation of the ICS, can improve preparedness and avoid delay in disaster responses.

(iii) *Key focus areas*. The inclusion of a wider array of stakeholders could lead to a diverse interpretation of protocols even if it is pre-identified. To maximize varying levels of competencies while building synergy, key actors are encouraged to put emphasis on key "focus" areas for complementation. Each key actor demonstrates distinct role characteristics that are pivotal for resilience building. For example, the provincial governments as convenors could decide which intervention is best to prioritize before, during, and after a disaster, while allowing city/municipality governments to maintain autonomy. They could also reinforce efforts of the city/municipality by helping enhance the capacity of frontline responders in identifying the most appropriate course of action. Finally, barangays are fundamental in the continuous onsite monitoring and validation of threat levels and should be empowered as the smallest political unit because they are closest to the communities who could best articulate gaps on the ground.

(iv) *Convergence building*. Chu et al. (2021) argue that political context and institutional advantages can lead to a more responsive urban development model in the post-pandemic era. This chapter has provided empirical observation regarding resilience building of local government units within a multi-tiered governance structure. In responding to concurrent crises, the whole-of-government approach, which encourages multisectoral coordination, is also becoming fundamental (Potutan and Arakida 2021). Limitations in core competencies and financial capacity are best addressed when there is collective effort to accomplish desired resilience outcomes.

(v) *Monitoring and evaluation*. An appropriate monitoring and evaluation system results in streamlining effective and efficient individual initiatives to establish a collective approach to urban resilience post-pandemic.

References

Arup and Rockefeller Foundation. 2015. City Resilience Framework. London: Arup.

Ashraf, A. 2021. Lessons Learned from COVID-19 Response for Disaster Risk Management. *Natural Hazards* 107(2): 2027–2032.

Béné, C. et al. 2018. Resilience as a Policy Narrative: Potentials and Limits in the Context of Urban Planning. *Climate and Development* 10(2): 116–133.

Chelleri, L., T. Schuetze, and L. Salvati. 2015. Integrating Resilience with Urban Sustainability in Neglected Neighborhoods: Challenges and Opportunities of Transitioning to Decentralized Water Management in Mexico City. *Habitat International* 48: 122–130.

Chelleri, L., J. J. Waters, et al. 2015. Resilience Trade-Offs: Addressing Multiple Scales and Temporal Aspects of Urban Resilience. *Environment and Urbanization* 27(1): 181–198.

Chu, Z., M. Cheng, and M. Song. 2021. What Determines Urban Resilience Against COVID-19: City Size or Governance Capacity? *Sustainable Cities and Society* 75, 103304.

Communities, H. R. 2022. Symposium Report: The Impacts of the COVID-19 Pandemic on Vulnerable Communities in the Philippines.

Djalante, R., R. Shaw, and A. DeWit. 2020. Building Resilience Against Biological Hazards and Pandemics: COVID-19 and Its Implications for the Sendai Framework. *Progress in Disaster Science* 6: 100080.

Hale, T. et al. 2020. Variation in Government Responses to COVID-19. Blavatnik School of Government Working Paper.

Hassankhani, M. et al. 2021. Smart City and Crisis Management: Lessons for the COVID-19 Pandemic. International Journal on Environmental Research and Public Health.

Henstra, D. 2012. Toward the Climate-Resilient City: Extreme Weather and Urban Climate Adaptation Policies in Two Canadian Provinces. *Journal of Comparative Policy Analysis: Research and Practice* 14(2): 175–194.

Ishiwatari, M. et al. 2020. Managing Disasters Amid COVID-19 Pandemic: Approaches of Response to Flood Disasters. *Progress in Disaster Science* 6: 100096.

Lagmay, A. H. 2017. Nationwide Operational Assessment of Hazards (NOAH): A Responsive Program for Disaster Risk Reduction in the Philippines. *Humanitarian Technology Survey* 16–18. Rajaratnam School of International Studies. http://www.jstor.org/stable/resrep05932.7

Lin, Y. et al. 2011. Knowledge, Attitudes and Practices (KAP) Related to the Pandemic (H1N1) 2009 among Chinese General Population: A Telephone Survey. BioMed Central Infectious Diseases. BioMed Central Ltd.

Maquiling, K. S. M., S. De La Sala, and P. Rabé. 2021. Urban Resilience in the Aftermath of Tropical Storm Washi in the Philippines: The Role of Autonomous Household Responses. *Environment and Planning B: Urban Analytics and City Science* 48(5): 1025–1041.

Meerow, S., J. P. Newell, and M. Stults. 2016. Defining Urban Resilience: A Review. *Landscape and Urban Planning* 147: 38–49.

Mintrom, M. and R. O'Connor. 2020. The Importance of Policy Narrative: Effective Government Responses to COVID-19. Policy Design and Practice 3(3): 205–227.

Normandin, J. and M. Therrien. 2016. Resilience Factors Reconciled with Complexity: The Dynamics of Order and Disorder. *Journal of Contingencies and Crisis Management* 24(2): 107–118.

Potutan, G. and M. Arakida. 2021. Evolving Disaster Response Practices during COVID-19 Pandemic. *International Journal of Environmental Research and Public Health* 18(6): 3137.

Republic of the Philippines Interagency Task Force on Emerging Infectious Diseases. 2022. Guidelines on the Nationwide Implementation of Alert Level System for COVID-19 Response. 27 February. https://www.officialgazette.gov.ph/downloads/2022/02feb/20220227-IATF-GUIDELINES-RRD.pdf

Sharifi, A., A. R. Khavarian-Garmsir, and R. K. R. Kummitha. 2021. Contributions of Smart City Solutions and Technologies to Resilience against the COVID-19 Pandemic: A Literature Review. *Sustainability* 13(14): 8018.

Sirleaf, E. J. and H. Clark. 2021. Report of the Independent Panel for Pandemic Preparedness and Response: Making COVID-19 the Last Pandemic. *Lancet* 398(10295): 101–103. https://doi.org/10.1016/S0140-6736(21)01095-3

Ssebuufu, R. et al. 2020. Awareness, Knowledge, Attitude and Practice towards Measures for Prevention of the Spread of COVID-19 in the Ugandans: A Nationwide Online Cross-Sectional Survey. *MedRxiv*.

Stepenuck, K. F. and L. T. Green. 2015. Individual- and Community-Level Impacts of Volunteer Environmental Monitoring: A Synthesis of Peer-Reviewed Literature. *Ecology and Society* 20(3):19.

Tabuga, A. D. et al. 2020. Innovating Governance: Building Resilience against COVID-19 Pandemic and Other Risks. Philippine Institute for Development Studies Discussion Paper Series.

United Nations Office for the Coordination of Humanitarian Affairs. 2022. *Typhoon Rai Situation Report*.

United States Agency for International Development. 2022. The Philippines—Super Typhoon Rai (Fact Sheet #3). https://www.usaid.gov/sites/default/files/2022-05/2022-01-27_Philippines_Super_Typhoon_Rai_Fact_Sheet_3.pdf

Vale, L. J. 2014. The Politics of Resilient Cities: Whose Resilience and Whose City? *Building Research and Information* 42(2): 191–201.

Vallejo, B. M. and R. C. Ong. 2020. Policy Responses and Government Science Advice for the COVID 19 Pandemic in the Philippines: January to April 2020. *Progress in Disaster Science* 7.

Weichselgartner, J. and I. Kelman. 2015. Geographies of Resilience: Challenges and Opportunities of a Descriptive Concept. *Progress in Human Geography* 39(3): 249–267.

Wolf, J. and S. C. Moser. 2011. Individual Understandings, Perceptions, and Engagement with Climate Change: Insights from In-Depth Studies across the World. *Wiley Interdisciplinary Reviews: Climate Change* 2(4): 547–569.

World Health Organization. 2019. *Health Emergency and Disaster Risk Management Framework*. Geneva: World Health Organization.

____. 2021. *From Worlds Apart to a World Prepared: Global Preparedness Monitoring Board Report 2021*. Geneva: World Health Organization.

Ybañez, R. L. et al. 2020. A Multi-Hazard Interactions Framework for the Philippines. American Geophysical Union, Fall Meeting 2020.

Appendix 2.1

Table A2.1: Alert Levels under the Philippine COVID-19 Alert Level System

Alert Level	Description of Area
1	Case transmission is low and decreasing, and total bed utilization rate and intensive care unit utilization rate are low.
2	Case transmission is low and decreasing, health care utilization is low, or case counts are low but increasing, or case counts are low and decreasing but total bed utilization rate and intensive care unit utilization rate are increasing.
3	Case counts are high and/or increasing, with total bed utilization rate and intensive care unit utilization rate increasing.
4	Case counts are high and/or increasing, and total bed utilization rate and intensive care unit utilization rate are high.
5	Case counts are alarming, with total bed utilization rate and intensive care unit utilization rate at critical levels.

Source: Taken from the IATF-EID Guideline on the Nationwide Implementation of Alert Level System for COVID-19 Response (Republic of the Philippines Interagency Task Force on Emerging Infectious Diseases 2022).

PART II

Using Urban Physical and Intellectual Assets

PART II SUMMARY

Sakshi Pandey

The coronavirus disease (COVID-19) pandemic exposed shortcomings in the public health response systems as well as social differences in accessibility to safe open spaces. In several developing regions of the world, the pandemic pinpointed the disparities between the low-income and the wealthy regarding access to open spaces. The under-resourced communities are the ones most dependent on public parks for their health while often living in areas with safety issues.

Interestingly, the pandemic stimulated people to come up with various coping mechanisms using existing urban infrastructures and assets to handle challenges due to restrictions and health emergencies. One such mechanism was the rapid uptake of flexible work arrangements across nations. As a result, the outskirts of megacities began to attract migrants from urban cores due to housing affordability, greater livable space, and more attractive natural amenities. Part II, Using Urban Physical and Intellectual Assets, delves into a few infrastructural issues experienced by urban areas worldwide and explores solutions and policy recommendations.

Chapter 3 by Sharma, Samadhiya, and Asher undertakes a SWOT (strengths, weaknesses, opportunities, and strengths) analysis of the COVID-19 responses of four cities in India during the two peaks between April 2020 and July 2021. All four cities are administrative capitals of India's four provinces (states). In three cities, respective city governments, empowered by various state and central legislations, were at the forefront of this response. In contrast, the state administration led much of the response in the fourth city. It was evident from the responses that despite their limited preparedness for this pandemic, all the cities evolved a public health emergency response system that did not exist before. However, most of these responses were not institutionalized, i.e., they were not part of an existing institutional mandate and were delegated due to emergency needs. Based on the analysis, the chapter infers that to deal with such public health emergencies, it will be essential to have an institutional public health response system at the level of the cities, with greater integration of technology such that various strengths and opportunities that emerged during the last 3 years can continue to be leveraged while the weaknesses and threats can be mitigated.

Chapter 4 by Punongbayan-Dela Rosa aims to demonstrate the dynamics of urban green spaces in addressing the need for outdoor spatial requirements in the community's health and disease contagion. The proposed urban parks to be studied comprise a collection of open spaces and urban wildlife parks clustered within and around the specialized hospitals of the national government in Quezon City. These are the Ninoy Aquino Parks and Wildlife Center, the Quezon City Memorial Circle, the urban forest between the Lung Center and the National Kidney and Transplant Institute of the Philippines, and the open space of the Veterans Memorial Medical Center. The chapter focuses upon the policy recommendations.

Chapter 5 by Bessho and Yokahari discusses the issue of retrofitting the outskirts of Asian megacities to build a more livable environment suitable for post–COVID-19 work arrangements while mitigating potential environmental distress caused by development. The chapter first describes the current discussion on the recent out-migration pattern within a Japanese megacity region driven by a shift toward remote work. Then, it explores technology-supported emerging lifestyles in the Greater Tokyo Area of Japan. Secondly, by introducing two projects in Tsukuba City, the chapter explores the concept of workplace-making with nature, which may be a key to creating inclusive and resilient communities in the outskirts of cities. Lastly, the chapter discusses how the outskirts of other Asian megacities can be retrofitted for the post–COVID-19 work style by considering policies that promote (i) connecting dispersed cities with greener modes of transportation, (ii) identifying and restoring natural environments within megacity regions, and (iii) developing management schemes of workplace-making with nature.

Chapter 6 by Bharule and Miyazawa discusses big data and location intelligence with a case study of travel patterns during COVID-19 in Japan. COVID-19 has unveiled several caveats in data deficiency across the world. The pandemic period has also been accompanied by a spike in data-related and data-dependent systems powered by transformative data analysis techniques and methods. As the world emerges from the unexpected shocks of the pandemic, we see that 2021 will remain a cornerstone for data-driven decision making. The chapter draws policy implications from the case study to discover future avenues for involving location intelligence as a tool in evidence-based policy making for urban resilience.

In summary, Part II emphasizes the need for more inclusive and evidence-based informed decision making among governments and industries. As the spatial forms of our cities become increasingly complex, information and communication technologies and geospatial data become crucial to actualizing a plan for future societies. Considering this, the chapters indicate that social inclusivity and technical and interdisciplinary integration would be a way to deal with future pandemics and other emergencies.

CHAPTER 3

COVID-19 Responses in Four Indian Cities: A SWOT Analysis

Tarun Sharma, Nimisha Samadhiya, and Mukul Asher

3.1 Introduction

Through the centuries, epidemics and pandemics have had a lasting impact on the social, political, and economic growth of societies (Huremović 2019). The coronavirus disease (COVID-19), which feels like a once-in-a-century pandemic, has had such an impact. It has been challenging national and subnational capacities and is shaping our social, economic, and political needs again.

COVID-19 is caused by a new coronavirus called SARS-CoV-2 (severe acute respiratory syndrome coronavirus 2; WHO 2021). The World Health Organization (WHO) declared the outbreak of COVID-19 a public health emergency of international concern on 30 January 2020 and later recognized the spread as a pandemic on 11 March 2020, calling countries to take immediate steps to reduce further transmission (WHO 2020).

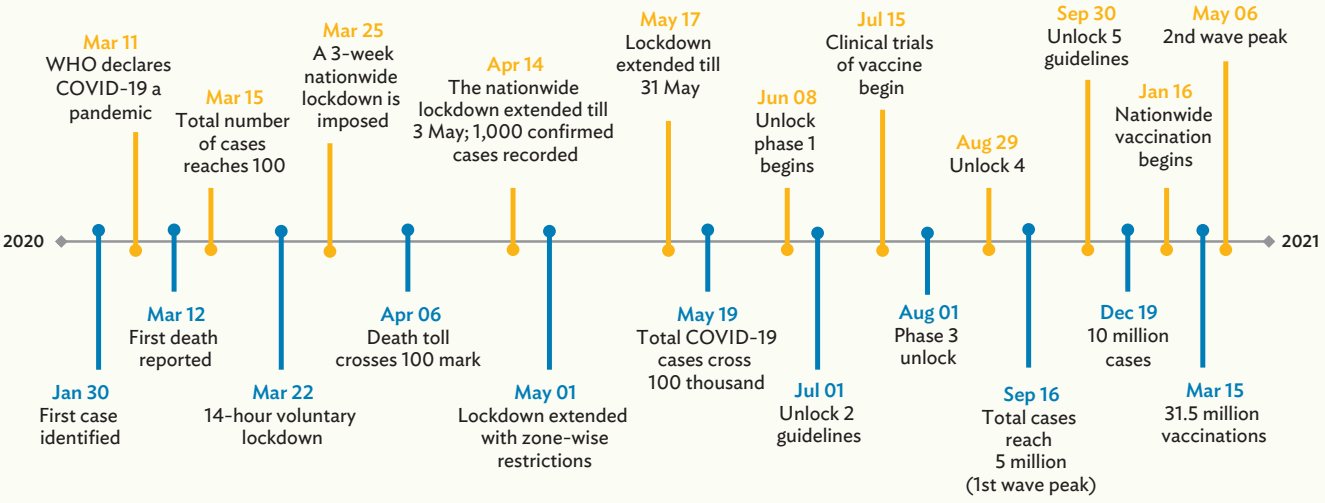
In response to the pandemic, India made wide-scale public, economic, food security, and policy reforms. Many of these responses were at the level of the cities. This chapter analyzes the COVID response strategies through an overall SWOT (strengths, weaknesses, opportunities, and threats) analysis based on responses of all the cities.

3.2 Initial Government Response to Contain COVID-19

Figure 3.1 shows the timeline of COVID-19–related events in India. To contain the spread, India's Ministry of Health and Family Welfare (MoHFW) issued travel restrictions that included a 14-day self-quarantine rule for all international travelers entering the country. MoHFW issued an advisory for social distancing on 16 March 2020 to avoid transmission and decrease the transmission rate (MoHFW 2020). At 12:00 a.m. on 25 March 2020, India imposed the first phase of a countrywide lockdown that continued for 21 days (*BusinessToday.In* 2020). People were asked to stay indoors, and everything other than essential services was shut down. As the COVID-19 cases continued to increase, the government announced the second phase of lockdown until 3 May, which was further extended until 17 May and then continued until 31 May (ET Online 2020; Jagannath 2020; PIB Delhi 2020). The first wave peaked with the seven-day average of daily cases reaching 93,617 on 16 September 2020, as Figure 3.2 shows (Mullick 2020).

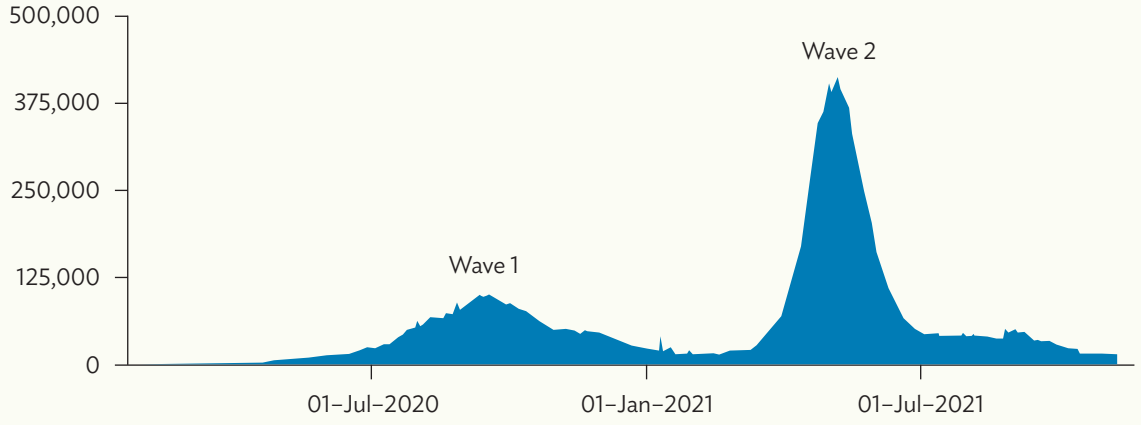
Six months later, the first week of March 2021 saw a rapid increase in the COVID cases, marking the beginning of the second wave of the pandemic in India (*Times of India* 2021b). Even though the country did not enter a nationwide lockdown at that time, almost all Indian states had some kind of statewide or localized COVID restrictions during this wave (Express 2021). India's second wave peaked in the first week of May 2021 with 414,188 total cases since the wave had begun in March (Bhatnagar 2021).

Figure 3.1: Timeline of COVID-19–Related Events in India



Source: Nagrika analysis.

Figure 3.2: COVID-19 Peaks in India



Note: Each day shows new cases reported since the previous day.

Source: Johns Hopkins University.

To make the lockdowns effective, the Indian government invoked the provisions of the Epidemic Disease Act of 1897, which empowered the state governments to take special measures necessary to contain the spread (FP Staff 2020). The 123-year-old act was also amended to ensure the safety of health care workers (FE Online 2020).

Through the policy framework enabled by the union government, states and cities undertook various measures to stem the impact of COVID-19. In Section 3.3, we look at such responses from four cities. Table 3.1 provides a snapshot of the selected cities.

Table 3.1: Snapshot of Cities Selected for the Study

	Mumbai	Chennai	Ranchi	Bhubaneswar
State	Maharashtra	Tamil Nadu	Jharkhand	Odisha
Population (2011)	12.5 million	6.7 million	0.84 million	1 million
COVID-19 cases during second wave (April–July 2021)	11,206 cases	7,564 cases	1,771 cases	1,353 cases

Note: In 2011, the Government of India approved the name change of the State of Orissa to Odisha. This publication reflects this change. However, when reference is made to policies that predate the name change, the formal name Orissa is retained.

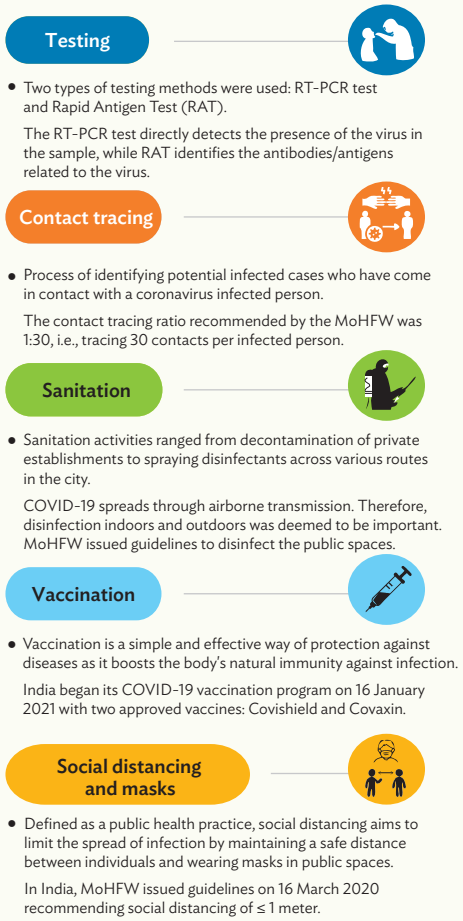
Sources: Jain and Debroy (2022), Gautham (2021), COVID19BHARAT (2021), Express News (2021c), Census 2011.

3.3 COVID-19 Response in the Four Cities

3.3.1 Description of Preventive Responses

In the wake of the high transmission of COVID-19, several preventive measures were taken to slow the spread of the virus. We grouped them into five themes: testing, contact tracing, sanitation,[1] social distancing, and vaccination. Figure 3.3 and Table 3.2 describe these responses.

Figure 3.3: Types of Preventive Responses



MoHFW = Ministry of Health and Family Welfare.

Source: Nagrika analysis.

[1] In the context of the COVID-19 responses discussed in this chapter, the term sanitation has also been used to refer to the sanitization drives led by various city governments to disinfect cities.

Table 3.2: Summary of Preventive COVID-19 Response in Four Cities

Preventive COVID-19 Response	Mumbai	Chennai	Bhubaneswar	Ranchi
Testing (number of tests per million per day during 2nd peak)	4,030	2,530	2,350	4,290
Vaccination rates (until Dec 2021)	80% in 11 months (0.67 million people/month)	45% in 10 months (0.3 million people/month)	100% in 7 months (0.12 million people/month)	NA
First guidelines issued for social distancing	21 March 2020	1 May 2020	1 May 2020	22 March 2020
First guidelines issued for mask mandate	8 April 2020	1 May 2020	9 April 2020	23 July 2020
Contact tracing (number of contacts to trace per positive patient)	Initial count of 5–20 fell to 3–15 in 2nd wave	25 to 30	NA	NA
Number of teams involved in sanitation to prevent the spread	32 teams	NA	A team of 4 in each of the three administrative zones	A team of 4 deputed to every 2 wards

Sources: Debroy (2021), TNN (2021), ANI (2020a, 2021), Condé Nast Traveller (2020), ET Bureau (2020), Staff Reporter (2020), Vidya (2020), Singha (2020), Express Web (2020), Mishra (2021), Koushik (2021), Murray (2020), Ganapatye (2020), Himanshu (2021), Giri (2021).

Testing. In the larger cities of Chennai and Mumbai, the city governments set up kiosks (Chennai) and booths (Mumbai) to provide easier access to testing (TNM Staff 2020; India TV News 2020). In Chennai, testing drives, which included door-to-door surveillance, were conducted during the first wave; in Bhubaneswar, testing drives were conducted during the second wave (Poovanna 2020; Express News 2021e). In the case of Ranchi, the testing capacity of the state-run hospital, Rajendra Institute of Medical Sciences, was augmented to cope with the surge of cases during the second wave (Saran 2020; Pandey 2020).

Contact tracing. All four cities deployed teams to conduct contact tracing during the first wave. This included using strategies such as memory recall (Chennai) and door-to-door surprise testing (Bhubaneswar, Ranchi) to find cases before they spread to a larger group of people (Suffian 2020).

Sanitation. A perceived difference in sanitation approaches seems to be that in the first wave, most of these activities were undertaken by the city governments, and by the second wave, other partners were helping. The partnerships varied in the different cities, including partnerships with fire departments, engineering colleges, private companies, and waste collection departments (Special Correspondent 2020; Mohapatra 2020). In the case of Mumbai, a private conglomerate provided support to help disinfect public areas in the city. In Bhubaneswar and in Chennai, the civic body also used drones to spray disinfectants on major roads across the city (ANI 2020c; Travel News 2020).

Vaccination. The mechanisms to ensure speedy and effective vaccinations across the cities mostly included vaccination drives. In addition to these drives, Chennai and Ranchi also conducted mobile camps that involved a van that conducted door-to-door vaccination. In Ranchi, people could call a dedicated phone number to avail the services of a mobile van (TT Correspondent 2021c).

Bhubaneswar became the first city to achieve 100% vaccination in just 7 months since the vaccination process started in the country in January 2021 (ANI 2021). In Mumbai, the civic body launched

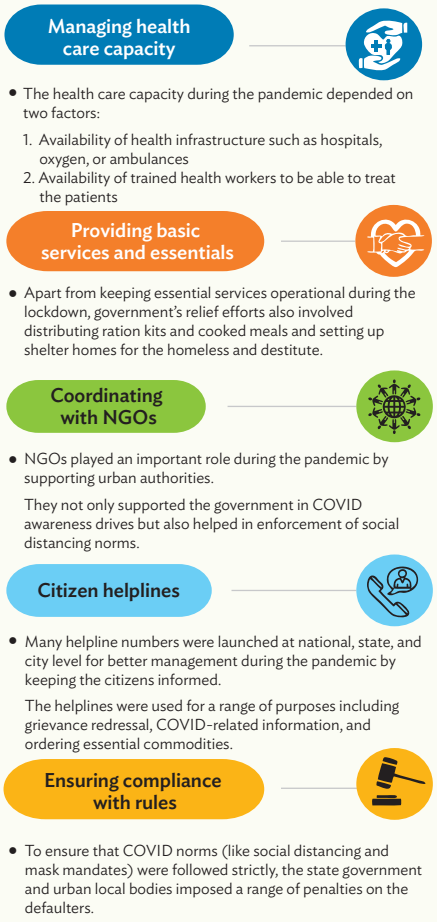
a large-scale vaccination drive for fisherfolk and vulnerable communities in collaboration with a nongovernment organization (NGO; HT Correspondent 2021). Mumbai achieved the highest full vaccination coverage within the state by vaccinating more than 80% of the population by December 2021 (Debroy 2021).

Social distancing and mask mandate. On 21 March 2020, the municipal corporation in Mumbai issued a specific set of social distancing orders imposing 50% customer capacity and maintaining 3 feet between customers in all eateries (Condé Nast Traveller 2020). In addition to strict adherence to social distancing rules, wearing masks in public spaces became compulsory in all four cities, and defaulters received heavy penalties (Vidya 2020; Express Web 2020; Staff Reporter 2020; ET Bureau 2020; Singha 2020).

3.3.2 Description of Management Responses

Management responses fall into five broad categories: managing health care capacity, providing basic services, coordinating with NGOs, launching citizen helplines, and ensuring compliance with rules. A summary is provided in Figure 3.4 and Table 3.3.

Figure 3.4: Types of Management Responses



NGO = nongovernment organization.

Source: Nagrika analysis.

Table 3.3: Summary of Management Responses to COVID-19 in Four Cities

Management Response	Mumbai	Chennai	Bhubaneswar	Ranchi
Launching citizen helplines	Each of the 24 ward offices has a disaster control room, which has been turned into a COVID-19 response "war room"	Greater Chennai Corporation's tele-counseling center acts as a common platform to assist citizens	24-7 toll-free helpline offers citizens guidance; 8 help desks at all the dedicated COVID-19 hospitals provide patients information	Helpline registers complaints against black-marketing/ overcharging, and bed availability
Managing health care capacity (total beds for COVID-19 during second peak)	12,000 beds	17,813 beds	1,124 beds	NA
Coordinating with NGOs	Yes	Yes	Yes	Yes
Providing basic services (quantity of rations provided)	Around 0.75 million meals per day during the lockdown months (from April 2020) plus 0.4 million dry ration kits	Free food from 400 Amma canteens plus ₹500 groceries kits	5 kg rice/person/ month and 1 kg arhar dal/ family /month for April–June 2020 (3 months)	Double ration (10 kg instead of 5 kg rice) from April to June 2020 and additional 5 kg free of cost
Ensuring compliance with rules (total fines collected)	Over ₹600 million	Over ₹0.5 million	Over ₹0.6 million	₹0.8 million

kg = kilogram, NGO = nongovernment organization.

Source: Mahale (2021), Pinto (2022), Marpakwar (2021a), Ahuja (2021), Ministry of Housing and Urban Affairs, India, and Smart City (2020), MD (2021), PTI (2020b), Madhav (2021a), Express News (2021d), Maharana (2021b), ANI (2020b), OB Bureau (2021b), Prabhat Kabar (2021), Kumar (2020), Telegraph Online (2021), Newswrap (2021).

Managing health care capacity. As the positive cases increased and availability of beds decreased, urban local bodies augmented the health infrastructure by constructing makeshift hospitals or converting vacant buildings into temporary health care facilities. Many innovative solutions emerged from these efforts. For example, in Mumbai, buildings that were yet to be given an occupation certificate were converted into a 1,000-bed quarantine facility by the city government (PTI 2020d). Greater Chennai Corporation converted 250 taxis into special mini ambulances for COVID-19 with a partition system to reduce pressure on 108 ambulances (Madhav 2021b). Ranchi Municipal Corporation roped in a social outfit to repair and operate the defunct electric crematorium to manage the last rites in the first wave (TT Correspondent 2020).

In terms of the health care workers, India faced a severe shortage of medical staff during the pandemic. To fight COVID-19, many state governments launched recruitment drives and increased the retirement age of medical professionals to manage the shortage of workers.

In the four cities, initiatives fell into two main types. One was to ensure that existing staff do not leave during the crisis. The other was to bring in new trainees quickly into the workforce. For example, both Bhubaneswar and Mumbai increased the retirement age of health professionals. In Bhubaneswar, the retirement age was increased thrice: from 58 to 60, 60 to 62, and finally to 65 (*Orissa Post* 2020). Similarly, the retirement age in all civic-run hospitals in Mumbai was raised by 1 year (from 58 to 59)

in the first wave (PTI 2020c). In Chennai, senior trainee medical students were hired to take on tasks at the hospital and support the work of the doctors. In Ranchi, the Rajendra Institute of Medical Sciences trained 100 constables of the India Reserve Battalion to cater to the patients in immediate need of oxygen support in its temporary COVID-19 facility (Ray 2021).

Providing basic services and essentials. Many states launched online home delivery apps to avoid crowding at marketplaces. The city governments took on multiple tasks including provision of meals, direct monetary assistance to families, and provision of groceries.

In Mumbai, the city authorities distributed 750,000 meals per day during the first major lockdown (April–June 2020; Marpakwar 2021a). In addition, cities like Chennai, Mumbai, and Bhubaneswar built temporary shelter homes for people stranded due to the first lockdown. In Ranchi, most of the initiatives were taken up by the district administration. The city government in Chennai collaborated with NGOs to supply essential commodities to low-income neighborhoods and slums (Special Correspondent 2020).

Coordinating with nongovernment organizations and other civil society actors/individuals. Many NGOs across various cities came together to help COVID-19 patients during both waves of the pandemic. In the first wave, much of the help involved mitigating the migration crisis because of the lockdown. In the second wave, the activities related more to health and provision of medical attention. NGOs helped in various ways, including distributing oxygen cylinders and medicines; providing food rations; connecting with hospitals; conducting vaccination drives; and raising awareness about COVID-19. The fact that the NGOs were already well established in many of the communities helped in delivery of these services.

In Chennai, NGOs supported the city government in launching extension centers by gathering and sponsoring the team of doctors and nurses for COVID-19 treatment (Special Correspondent 2021). Members and volunteers of resident welfare associations were deployed at neighborhood markets to ensure social distancing (Kanthimathi 2020).

Launching citizen helplines. The cities used the tactic of setting up war rooms to manage and monitor the COVID-19 situation in each ward (Mahale 2021). Cities also used technology; in Chennai, for instance, the city government launched a 24-7 consultation app called VIDMED for patients to consult a doctor via video conferencing (Ministry of Housing and Urban Affairs and WRI India 2020). At the very least, all cities had a helpline that citizens could reach. The staffing for this helpline varied based on what was available in each city. In Mumbai, teachers supported the helpline; in Chennai, social workers; in Bhubaneswar, various city government departments. In Ranchi, the state government ran the helpline.

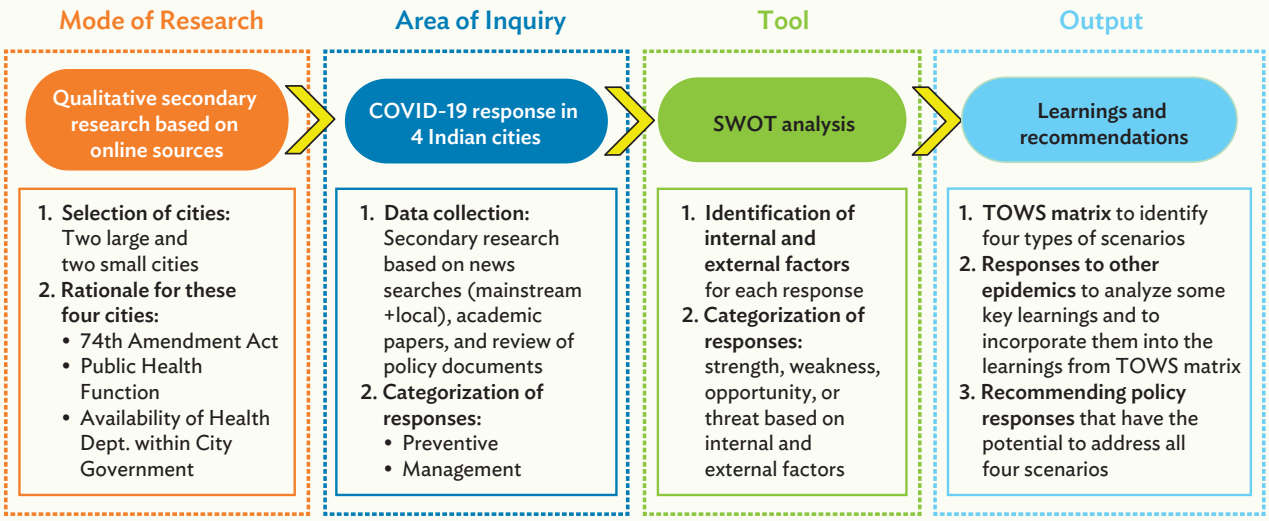
Ensuring compliance with COVID-19 norms. The most basic penalties were for individuals not wearing masks in public spaces. While Mumbai collected almost ₹600 million in fines only for people not wearing masks in public spaces, Bhubaneswar collected only ₹17,600 in fines during the first lockdown.

Some of the more serious penalties were those Mumbai put forth, such as suspension orders or dismissal of health workers who failed to report to work after repeated warnings (Singh 2020). Ranchi also imposed a penalty of ₹100,000 and a jail term of 2 years for violators of COVID-19 norms (Express Web 2020). However, it was not clear if any people received this penalty.

3.4 Methodology

The methodology for this research consisted of secondary research based on news reports, policy and academic papers, and a review of policy documents from government websites. Figure 3.5 is a flowchart summarizing the methodology.

Figure 3.5: Methodology Flowchart



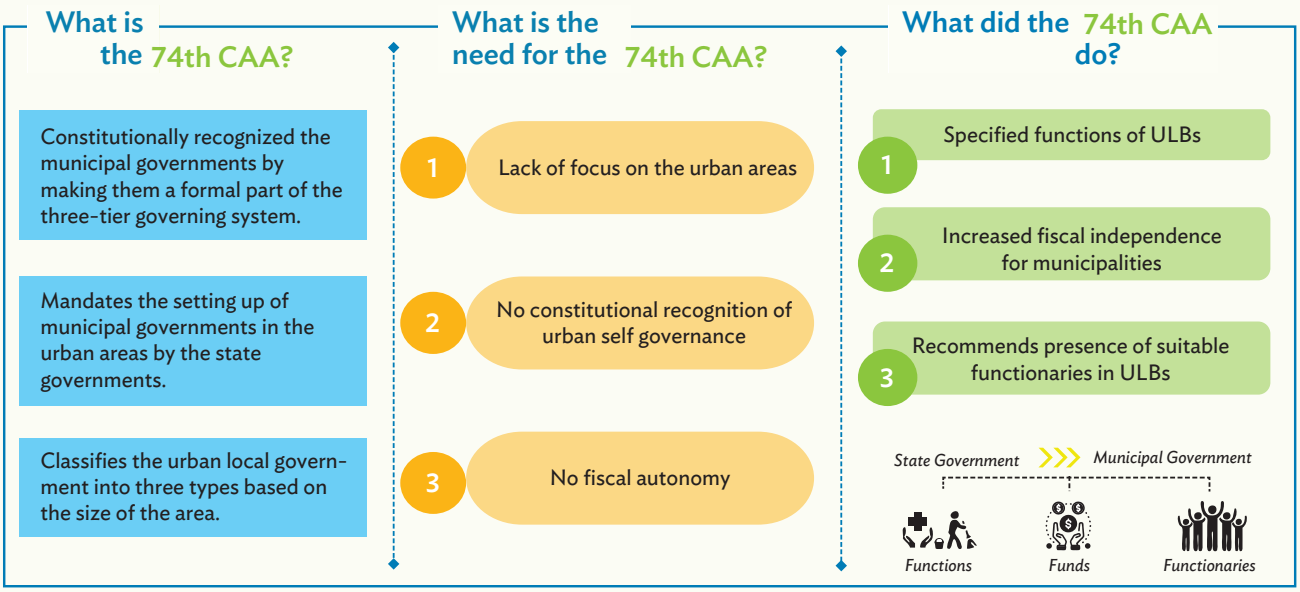
SWOT = strengths, weaknesses, opportunities, and threats, TOWS = threats, opportunities, weaknesses, and strengths.

3.4.1 Selection of Cities

Decentralization of functions. As per the 74th amendment of the Indian constitution, the public health function was to be decentralized at the level of the city governments (Figure 3.6, Tables 3.4 and 3.5). While most municipal acts in India were amended to reflect this decentralization, only a few states made changes to the functioning of city governments (Nagrika Research 2018). Only the states of Maharashtra, Tamil Nadu, Jharkhand, and Odisha[2] have devolved this function to the city governments (although to different degrees), so we chose the four cities from these states.

[2] In 2011, the Government of India approved the name change of the State of Orissa to Odisha. This chapter reflects this change. However, when reference is made to policies that predate the name change, the formal name Orissa is retained.

Figure 3.6: The 74th Constitutional Amendment Act



CAA = Constitutional Amendment Act, ULB = urban local body.

Source: Nagrika analysis.

Table 3.4: 18 Functions Mentioned in the 74th Constitutional Amendment Act

1		Urban planning including town planning	10		Slum improvement and upgradation
2		Planning of land use and construction of buildings	11		Urban poverty alleviation
3		Planning for economic and social development	12		Provision of urban amenities and facilities such as parks, gardens, and playgrounds
4		Roads and bridges	13		Promotion of cultural, educational, and aesthetic aspects
5		Water supply for domestic, industrial, and commercial purposes	14		Burials and burial grounds; cremations, cremation grounds, and electric crematoriums
6		Public health, sanitation conservancy, and solid waste management	15		Cattle pounds; prevention of cruelty to animals
7		Fire services	16		Vital statistics including registration of births and deaths
8		Urban forestry, protection of the environment, and promotion of ecological aspects	17		Public amenities including street lighting, parking lots, bus stops, and public conveniences
9		Safeguarding the interests of vulnerable sections of society, including the physically and intellectually disabled	18		Regulation of slaughterhouses and tanneries

Source: 12th schedule under the 74th Constitutional Amendment.

Table 3.5: Institutional Responsibility before COVID-19

Function	Mumbai	Chennai	Ranchi	Bhubaneswar
Managing hospitals				
Managing health staff				
Health emergency system as per the Municipal Act				

Legend	
Administration	Color Code
City government	
State government/district administration	
State health department	
Both city and state government	

Source: Nagrika analysis.

Administrative capitals. We selected four cities: Mumbai, Chennai, Bhubaneswar, and Ranchi. The four cities are the administrative capitals of Indian provincial governments (states). We chose these cities because the three levels of government (national, state, and city) are in closest proximity and the level of coordination between them is higher than in the capitals of other states.

Diversity of population and size. The cities vary in size. Mumbai and Chennai are relatively large compared to the smaller cities of Bhubaneswar and Ranchi (refer to Table 3.1 for population).

3.4.2 Collection of Data on COVID-19 Response

We conducted an extensive search for news articles in the mainstream news as well as local newspapers for the response of the city governments. We examined approximately 250 articles covering the variety of COVID-19 responses undertaken at city level, with a focus on the responses led by the city governments. We focused on the time during the two peaks from April 2020 to July 2021.

3.4.3 Categorization of Responses

We then categorized responses under two categories: prevention and management. Under prevention, we identified all the responses aimed at preventing new infections. These included testing drives, vaccine drives, and sanitation of the city. Under management, we included responses that helped in managing the existing caseload and infections. Such responses included managing hospitals and health infrastructure, providing essential services, and providing helplines.

3.4.4 Strengths, Weaknesses, Opportunities, and Threats (SWOT) Analysis

The cities we analyzed responded according to their varied capabilities and jurisdictions. Hence, there was a wide diversity in the information about the way they responded to COVID-19. Additionally, the COVID-19 response of the cities depended on many factors. Some factors were intrinsic, such as internal capacity, while others were external, such as external infrastructure.

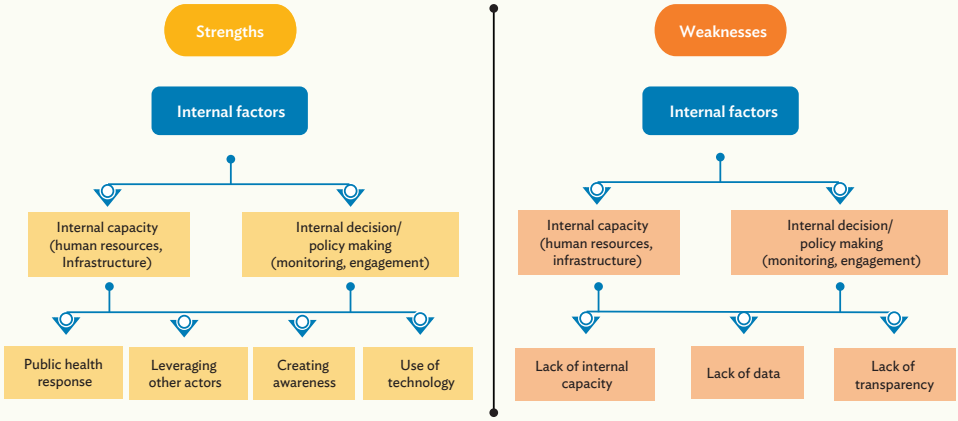
Since the objective of the research was to come up with strategic policy-level lessons, we chose SWOT analysis as a tool. Defined as a strategic planning and management technique, SWOT (acronym for strengths, weaknesses, opportunities, and threats) analysis is an evaluation framework used to assess the internal and external factors that affect the current and future potential of a project or

an intervention (Kenton 2021). Though originally from the realm of strategic business management (Jasiulewicz-Kaczmarek 2016), SWOT has been a tool employed for analysis of the internal and external environment in which public sector organizations operate (Vining 2016). Such SWOT analysis can be useful in making informed decisions through strategic planning that builds on strengths, minimizes weaknesses, seizes opportunities, and counteracts threats (*Business Queensland* 2021).

Additionally, SWOT has been known as a strategic analysis tool to aid decision making for strategic issues by reducing the "quantity of information" (Helms and Nixon 2010) as was the case with the large amount of information on the varied responses across the four cities. Simple strategy heuristics such as SWOT are also considered as strategic analysis tools for public agencies especially when the analysis is to be done in "unpredictable and changing environments" (Vining 2016), which was the case with the COVID-19 responses, which were undertaken in extremely dynamic circumstances between the two waves.

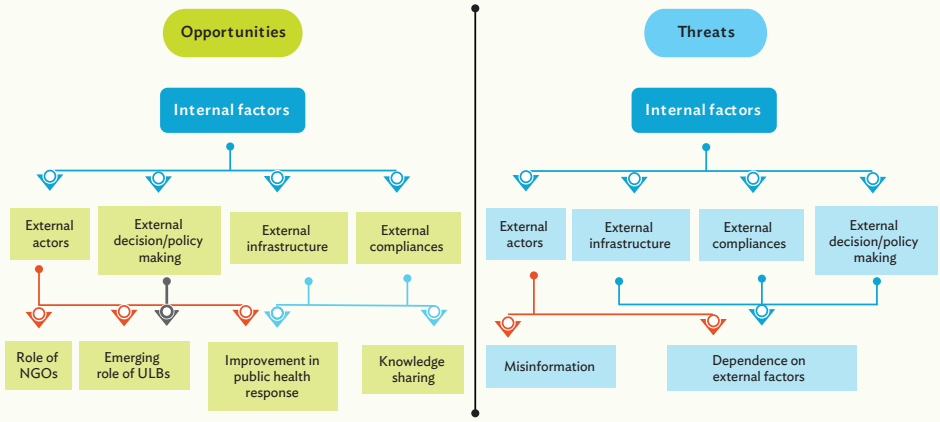
We thus identified the various internal and external factors that underlined the responses of the four cities in the form of the SWOT (see Figures 3.7 and 3.8).

Figure 3.7: Internal Factors for Strengths and Weaknesses



Source: Nagrika analysis.

Figure 3.8: External Factors for Opportunities and Threats



NGO = nongovernment organization, ULB = urban local body.

Source: Nagrika analysis.

3.4.5 Threats, Opportunities, Weaknesses, and Strengths Matrix

Based on the identified SWOT, we developed a TOWS matrix (Jasiulewicz-Kaczmarek 2016; Wang and Wang 2020). This is a tool for generating future strategies by taking into consideration the future opportunities and threats while leveraging the strengths to address the weaknesses (Jasiulewicz-Kaczmarek 2016). Through the matrix, we arrived at lessons that can be useful in providing a strong public health emergency response system at the city level. The lessons are discussed in Section 3.6.

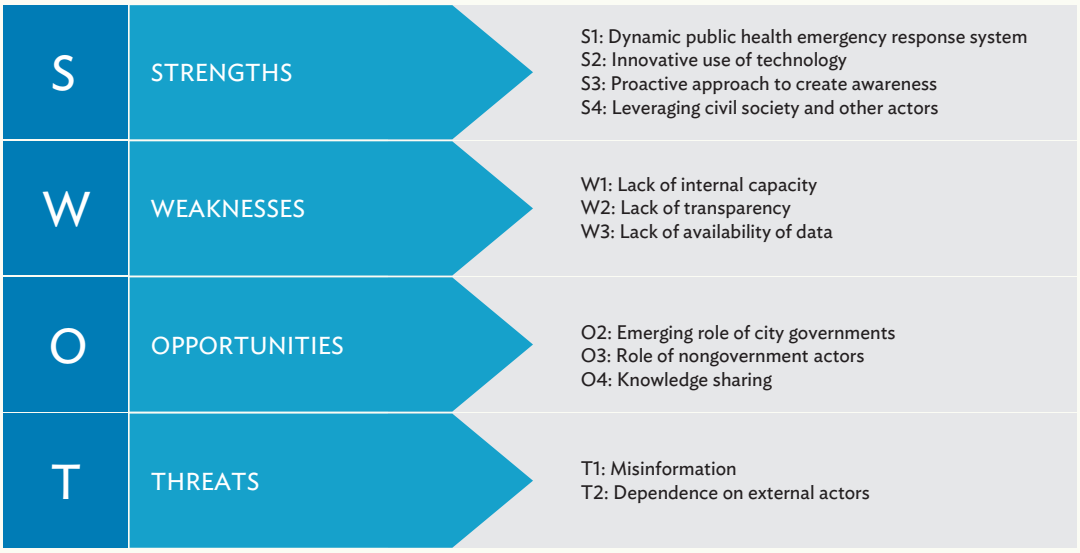
3.4.6 Responses to Other Epidemics in Other Countries

We also examined the global epidemics in the last few decades including SARS and MERS. We analyzed some of the key lessons from them and incorporated them into the lessons from the TOWS matrix.

3.5 SWOT Analysis

Figure 3.9 summarizes the strengths, weaknesses, opportunities, and threats that we identified.

Figure 3.9: Summary of the SWOT



SWOT = strengths, weaknesses, opportunities, and threats.

Source: Nagrika analysis.

3.5.1 Analysis of Strengths

In the context of our research, strengths refer to the strengths within the internal environment of the agencies, which helped them in their responses to COVID-19.

Dynamic public health emergency response. To better deal with public health emergencies, local city-level agencies must be well equipped to take timely actions (CDC 2018). When COVID-19 surged into the first wave during the second quarter of 2020, none of the cities we reviewed had any specialized public health emergency response systems, standard operating procedures, legal and regulatory

frameworks, or other established protocols. Despite the unprecedented nature of the COVID-19 pandemic, most of the cities we analyzed responded dynamically to the challenges that arose as the crisis unfolded. These cities evolved health response systems to respond to the emergency imposed by COVID-19. These systems were tested again during the second wave and then again recalled during the feared third wave, which fortunately did not turn out to be very severe.

The various components of this health response were rooted in preventive and management approaches toward COVID-19. They included COVID-19 war rooms, COVID-19 care centers, graded lockdowns and unlocks, task forces, rapid response teams, and command and control centers (PTI 2020a; IANS 2020b; Express News 2021b, 2021f; Srikanth 2020). As most of the cities were facing shortages of health infrastructure in the form of hospitals and beds, these cities quickly constructed additional health facilities to cater to this need. Mumbai, for example, constructed a "jumbo" COVID-19 facility in just 35 days (Bharadwaj and Nandy 2021). Similarly, Bhubaneswar and Chennai promptly augmented the response teams that were responsible for contact tracing of the infected patients (WCE 2021; Srikanth 2020). The emergence of this ad hoc yet strong response system provided the cities with a strong framework to respond to the crises.

Innovative use of technology. Use of technologies such as big data, mobile health applications, and telehealth services can be extremely effective in preventing and controlling pandemics (Ye 2020). This was evident in the COVID-19 response of many of the selected cities.

One of the biggest strengths of the COVID-19 response in most of the selected cities was innovative use of technology. While some cities used it to provide help desks and helplines to those who were impacted by the pandemic, others used it to deliver essential services through consumer-centric apps. Drones were used by most of these cities for various purposes. While Chennai used them to deliver essentials to COVID-19 patients and their families, Bhubaneswar used them to disinfect roads. During the first wave, Mumbai used drones to monitor COVID-19 hot spots and high-density areas and effectively enforce the lockdown (Bhalerao 2020). For quick transfer of patients to health care facilities, ambulances in Bhubaneswar were fitted with onboard GPS units for real-time tracking (PTI 2021). To strictly enforce the mandatory 14-day home quarantine, international travelers arriving in the city were tracked and monitored through the GPS location of their phones (Barnagarwala 2020). Mumbai also benefited from in-house advancement in medical technology when it undertook successful experimentation of a cocktail of two antibody drugs to treat COVID-19 and then implemented this cocktail medicine system on a pilot basis.

Proactive approach to create awareness. Communication to inform and educate the public about a pandemic is deemed amongst the most effective non-pharmaceutical interventions in the fight against COVID-19 (Tam et al. 2021). This was evident from the selected cities' use of public awareness and communication as a COVID-19 response strategy. Mumbai used various innovative communication techniques to increase vaccination rates as well as to fight misinformation (India TV 2021; IANS 2020a; HT Correspondent 2021). Similarly, Ranchi witnessed an awareness campaign led by medical professionals to sensitize citizens toward getting vaccinated. The campaign was supported by an initiative called Doctor on Road, started by a doctor in the neighboring state of Uttar Pradesh (Pandey 2021). Similarly, Bhubaneswar also undertook mass awareness campaigns, conducted interactive sessions, and collaborated with civil society to raise awareness of COVID-19–appropriate behavior (Prameyanews 2021).

Leveraging civil society and other actors. Given the severity of the COVID-19 pandemic, governments across the globe realized that a larger number of actors were needed to respond to the pandemic, and the task was beyond the capacity of government agencies alone. The Indian cities under review also swiftly engaged the services of civil society organizations in various such roles. This action was due to

the ability of the cities to procure and manage the services of these agencies. While some cities engaged with NGOs that were providing relief materials and essentials such as food grains, others also engaged with NGOs for raising awareness and providing medical assistance such as supply of oxygen (Special Correspondent 2020, 2021; Prameyanews 2021; Mumbai Live 2021).

3.5.2 Analysis of Weaknesses

While the selected city governments utilized their internal strengths to put up a strong COVID-19 response, their inherent weaknesses impeded their response strategies.

Lack of internal capacity. COVID-19 put the capacity of health care service providers and various civic agencies to an unprecedented test, especially in low- and middle-income countries (Mahendradhata et al. 2021; GRID COVID-19 Study Group 2020). This lack of capacity meant that the cities had difficulties in "flattening the curve" (India Budget 2021). Most of the cities we analyzed suffered from a lack of capacity and hence could not flatten the curve in their respective locations. While in some cities, this situation was due to the lack of health staff (doctors, nurses, other medical staff), others faced shortages in beds, oxygen supply, and other health infrastructure. Larger cities such as Mumbai responded by getting support from private hospitals and institutes for health care workers at makeshift hospitals (Tare 2020). This lack of capacity in flattening the curve led to poor monitoring and supervision of COVID-19–related issues in the cities and eventually resulted in various unintended outcomes such as unfair practices (overcharging) at hospitals and crematoriums (Mumbai Online 2020; OB Bureau 2021a; Shahi 2021), inefficient quarantine and sealing norms (Trivedi and Pandharipande 2020), and black marketing of drugs and devices (Prabhat Khabar 2021). The Chennai civic body suffered from a lack of human resources to enforce the COVID-19 norms and standard operating procedures (Express News 2021a). The city recruited bachelor of medicine and bachelor of surgery (MBBS) students as trainee medical officers for COVID-19 duties (Kirubakaran 2021).

The lack of capacity was also reflected in the health infrastructure. In Bhubaneswar, a severe shortage of beds in intensive care units, high-dependency units, and neonatal intensive care units caused some critical patients to suffer (Maharana 2021a). Ranchi faced similar internal capacity issues in providing funeral services at its crematoriums, where not enough staff was available to handle the volume of COVID-19 deaths. People had to wait for hours before police officials stepped in to streamline the process (TT Correspondent 2021b).

Lack of transparency. The significance of securing trust of the community through transparent functioning and information disclosure has been a key lesson in pandemic management since the outbreak of SARS, one of the early pandemics of this century in 2003 (Sadanandan 2020). While the cities did well in sharing information about COVID-19 guidelines and vaccination, they were not transparent enough in disclosing information about their own efforts in managing the pandemic. In multiple instances, key information about COVID-19–related actions was not disclosed. Such information related to procurement, award of contracts, expenditure, and actual number of cases and deaths (ANI 2020e; Marpakwar, Baliga, and Naik 2020).

Lack of availability of data and information. To better understand the nature of disease outbreaks, we need different types of data from different sources (Badker et al. 2021). The lack of such data with the authorities in these cities created an inherent weakness in the COVID-19 response strategies. In the case of Mumbai, the correct death rate of the city was not known as the city had been adding "older deaths" in the death tally (Marpakwar, Baliga, and Naik 2020). Similarly, for Bhubaneswar, the data on COVID-19 deaths was being reconciled while information on lower numbers of COVID-19 deaths was being projected as official figures (Mohanty 2021). These inconsistencies made it difficult to gauge

the real severity of the pandemic and to know whether the cases were increasing or decreasing, thus confounding the COVID-19 measures. As discussed in the previous point, most cities lacked the internal capacity to come up with their own projections and calculations and hence had to rely on externally provided data to make their decisions.

3.5.3 Analysis of Opportunities

Improvement in public health emergency response. The public health response of the cities holds significant potential for developing a holistic and consistent health emergency system for the cities. While the various guidelines, organizational structures, and decisions were developed as the need arose, they can be incorporated into the administrative and legal frameworks after due codification. Such a health emergency response system can align the resources to be better prepared for emergencies. These resources can include embedded technological systems, training programs and courses in health emergency responses, and specialized health emergency professionals.

Emerging role of city governments. The response of the cities to prevent and manage COVID-19 involved a variety of actors operating at the city scale. In most cities, the city governments acted as the anchor organization coordinating the efforts of other actors as well. During the two waves, the city governments demonstrated their capabilities of taking up increased responsibilities as the government closest to citizens (Nagrika Research 2020). COVID-19 presented an unprecedented opportunity where the city government performed functions that they had not performed before but that they had the ability to perform. The city governments became the focus point of collecting aid, coordinating with civil society actors, attending to grievances, formulating and issuing COVID-19 guidelines, creating databases, and taking various similar initiatives.

Role of nongovernment actors. While the administrative and public health capacity was being put to the test due to COVID-19, the role of nongovernment actors emerged as one of the biggest opportunities from the pandemic. Such actors play a significant role in various ways such as in providing health care, social protection, and welfare-related services, often focused on those with little access or those who with the most need. They "responded to the crisis faster, more nimbly, and more effectively than governments" (GovAsia 2020: 2). We found evidence of the same in the cities we analyzed. Actors from civil society lent support in providing rations, organizing oxygen, raising awareness about vaccines, providing vaccines, and enforcing social distancing, among others. They were "responsive, flexible and grounded" and, through their wider networks, were able to bridge the "welfare service delivery" gap of the governments (Tandon and Aravind 2021: 152). They had a ground-level connection with the communities, so they were able to effectively undertake the COVID-19 relief measures. The role of these actors was significant. They can continue to play similar roles in the future as well, as some such partnerships are already doing. For example, Project Mumbai had set up a mental health helpline for those impacted by COVID-19. They have continued their partnership with Municipal Corporation of Greater Mumbai (MCGM) and are undertaking initiatives for creating city-specific solutions along with MCGM and academic institutions (Raj 2022).

Knowledge sharing. As the cities came across problems they had not seen before, they also came across knowledge-based solutions and knowledge networks they had not utilized before. Many such solutions were developed while dealing with the pandemic. For example, all the cities we reviewed deployed various technological solutions for the first time. They either built them in-house or with support of private agencies, start-ups, or individuals. The lessons from such experiences provide a significant opportunity for other cities. For example, Chennai developed an in-house app for monitoring COVID-19 symptoms as well as geo-locating infected areas and crowded spots (Aadeetya 2020). Bhubaneswar also developed an app to streamline the delivery of essential products to households through home delivery

(Ministry of Housing and Urban Affairs and WRI India 2020). Many of these solutions can be used by other city governments for similar purposes or for other issues faced by those cities. An example would be creating crowdsourced geotagged maps (of potholes, littered spots, and dysfunctional streetlights, among others). Such applications, otherwise prohibitively expensive, can be within the reach of city governments and other city-based actors because of the opportunity the pandemic has presented.

3.5.4 Analysis of Threats

Misinformation. One of the significant credible threats the cities faced was misinformation. While the public and the authorities were already in a state of heightened tension, fake news pertaining to various aspects of the disease made it even more difficult for the agencies to handle the ground-level responses. Many of the cities had to undertake significant efforts to quell fake news about imposition of lockdowns or opening of the city after the lockdown (Arvind 2021; Yadav 2020; ANI 2020d; Das 2021). Other rumors propagated misinformation about the spread of the disease. Messages circulated on social media saying that more children were being affected by COVID-19 and their infection was not being detected (Mirror Online 2021).

Dependence on external agents. Most of the cities benefited greatly from the help of external agents. However, long-term dependence without an institutional mechanism for securing this help can be a threat in the longer run. There could be issues of poor planning, accountability, and quality control when city agencies depend on external agents without adequate institutional safeguards. There were concerns about the efficacy of such safeguards as some of the private hospitals indulged in profiteering during the pandemic (Marathe and Shukla 2021). Similarly, most of the cities issued guidelines to private labs for COVID-19 testing. However, in many instances, labs overcharged the patients, delayed reporting results, reported false results, or otherwise acted outside the cities' guidelines (Jain 2020; Pathak 2021; Mukesh 2021; Pradhan 2020; Tripathi 2020; TT Correspondent 2021a; TNN 2020). Such need-based dependence can also lead to poor planning. For example, Mumbai leveraged the funding available with a few private companies under their corporate social responsibility heads to create a large temporary COVID-19 facility during the first wave. Not even one patient was admitted there, and it was eventually dismantled within a few months. During the second wave, MCGM floated a tender to create another facility in the same place at a cost of ₹450 million. This action attracted a lot of criticism as it was seen as a waste of money (Marpakwar 2021b).

3.6 Discussion

In this section, we discuss the lessons from the SWOT analysis. The first part of the discussion is based on the TOWS analysis, where we elaborate on a few strategies that can inform policy decisions. The second part discusses some key policy-level recommendations based on the strategies. The third part briefly discusses the lessons from the similarities and differences between the responses of the four cities.

3.6.1 Lessons from SWOT-TOWS Analysis

Based on the identified strengths, weaknesses, opportunities, and threats, we developed a TOWS (threats, opportunities, weaknesses, and strengths) matrix (Wang and Wang 2020). TOWS presents four scenarios, and based on the SWOT of the cities, we came up with the following scenarios.

(i) **SO (strengths and opportunities)—Use strengths to optimize opportunities.**
- Use an institutional system and technology (strengths) to provide roles to multiple actors and enable knowledge sharing (opportunities).

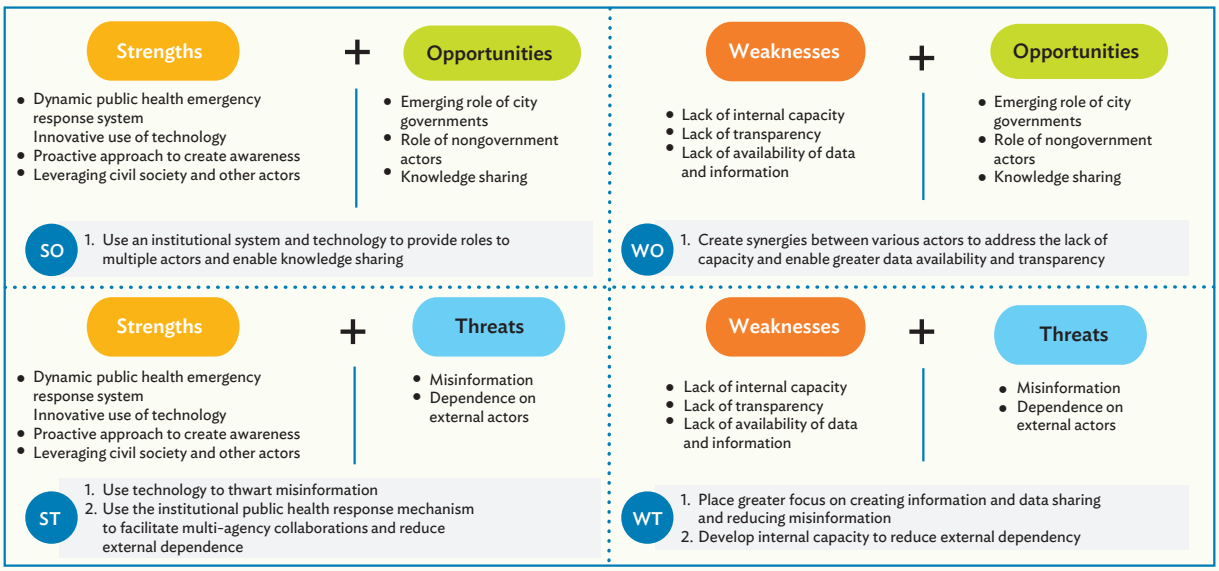
(ii) **WO (weaknesses and opportunities)—Use opportunities to minimize weaknesses.**
- Create synergies between various actors (opportunities) to address the lack of capacity and enable greater data availability and transparency (weaknesses).

(iii) **ST (strengths and threats)—Use strengths to minimize threats.**
- Use technology (strength) to thwart misinformation (threat).
- Use the institutional public health response mechanism (strength) to facilitate multi-agency collaborations and reduce external dependence (threat).

(iv) **WT (weaknesses and threats)—Minimize weaknesses to minimize threats.**
- Place greater focus on creating information and data sharing (weakness) and reduce misinformation (threat).
- Develop internal capacity (weakness) to reduce external dependency (threat).

Figure 3.10 summarizes the TOWS analysis.

Figure 3.10: TOWS Analysis



TOWS = threats, opportunities, weaknesses, and strengths.

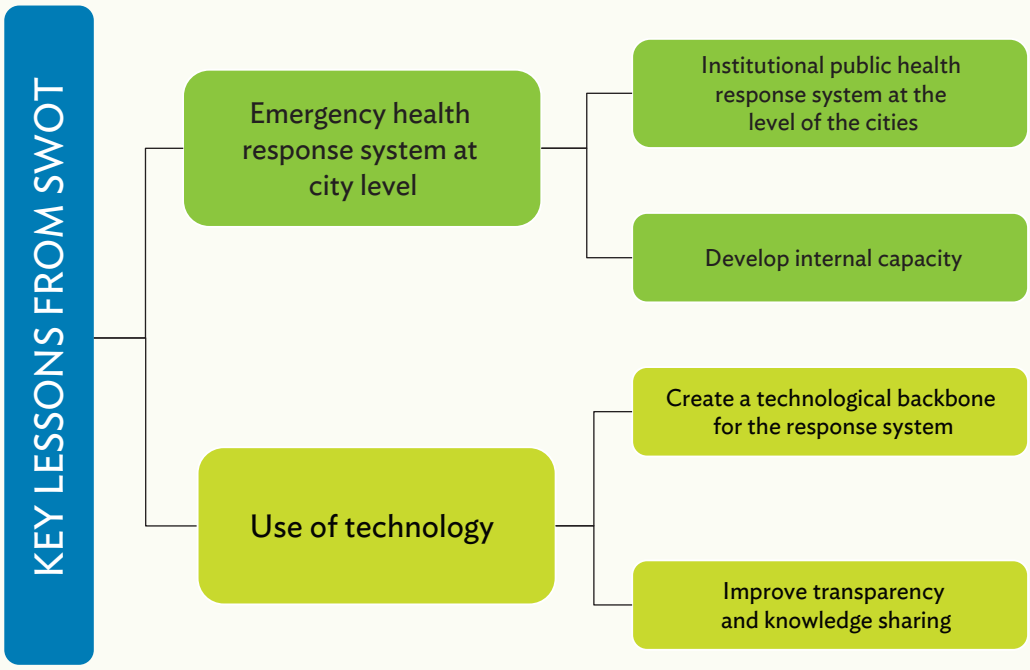
Source: Nagrika analysis.

Drawing from the four scenarios, we discuss suggestions that can inform the future policy responses of the cities while dealing with such public health emergencies and consolidate these scenarios into two larger policy responses:

(i) emergency health response system at the city level and
(ii) use of technology.

These two responses address all the four scenarios and thereby ensure the cities will be able to capitalize on the strengths and opportunities while mitigating the weaknesses and threats (see Figure 3.11).

Figure 3.11: Key Lessons from SWOT Analysis



SWOT = strengths, weaknesses, opportunities, and threats.

Source: Nagrika analysis.

Emergency health response system. To implement the first policy response, the emergency health response system at the city level, one recommended action is to develop the needed institutional framework. Table 3.6 shows each city's levels of institutional responsibility for the various COVID-19 responses.

As we discussed in the previous sections, the public health response system evolved as the needs arose and was not an institutionalized system. It will be important to develop an institutional public health response system at the city level, one that is ready to respond to such crises in the future. Such a system will provide clear inter-organizational relationships for city governments, delineate roles and responsibilities during such crises, and not depend on emergency powers. As Table 3.6 shows, for Ranchi, the city government did not have the institutional mandate for most of the preventive and management responses. The states had to seek approval from the union government to undertake some of the measures such as using drones to deliver vaccines. This was granted only for a period of 1 year (Pandey 2021). Similarly, for the cities where they undertook the responses themselves, the mandate largely came from national/state-level legislations such as designating containment zones. Many of the other functions were also passed on to local authorities through the Epidemic Diseases Act and Disaster Management Act (*Times of India* 2021a; Javed 2022).

While such an institutional system will ensure multi-agency collaboration, it will also address any overlaps or confusion that may otherwise arise in the absence of a clear institutional mandate. It will enable these actors to act decisively and with trust. The importance of an institutional mandate in an effective response against COVID-19 was evident from the COVID-19 response of one of the states in India where "robust, long-term support for local governments" made them into institutions of

Table 3.6: Institutional Responsibility during COVID-19

Prevention				
COVID-19 Response	Mumbai	Chennai	Bhubaneswar	Ranchi
Testing				
Vaccination				
Lockdown				
Containment				
Social distancing/masks				
Contact tracing				
Sanitation				
Management				
Helpline/help desk				
Managing hospitals				
Managing health infrastructure				
Managing health staff				
Providing basic services and essentials				
Providing basic services and essentials (through shops/vendors)				
Coordinating with NGOs and other civil society actors/individuals				
Penalties/ensuring compliance				

Legend	
Administration	Color Code
City government	
State government/district administration	
State health department	
Both city and state government	

NGO = nongovernment organization.

Source: Nagrika analysis based on various newspaper articles cited in the text.

"a formidable force for confronting the present pandemic, exemplified by a strong degree of trust and collaboration between state actors and citizens" (Dutta and Fischer 2021).

In addition to developing an institutional public health response system, the other recommended action for creating a city-level emergency health response system is to develop internal capacity. While the public health response system should leverage the strengths of various actors available at the city level, the system must focus on developing internal capacity at the city level to leverage such strengths. As highlighted above, many of these cities had to depend on external agencies but found themselves unable to monitor them. Local governments depended on private labs and hospitals for support in testing and treatments. They depended on civil society actors for distribution of relief materials. Developing such internal capacity can convert dependencies into synergies. While the city governments in Mumbai, Chennai, and Bhubaneswar led much of the COVID-19 response, most of the

measures in Ranchi were taken up by state- or district-level agencies. Ranchi's city government did not have much control or capacity other than sanitation, cremation, and enforcement of regulations. States will benefit by reallocating their resources in a manner that builds the internal capacity of the cities in the form of human, financial, and technological resources.

Use of technology. Our second policy response involves the use of technology. The first recommended action in implementing this policy response is to create a technological backbone for the health emergency response system. Global evidence from developed countries suggests that technological advances hold great potential in controlling epidemics while improving service delivery and ensuring patient satisfaction (Hewagama 2021). Health informatics, which is the application of information technology to the field of health care, is one such aspect of the health emergency response system. Systems in the past also utilized health informatics to "improve real-time surveillance systems, communication, and sharing of information among various agencies" (Williams, Oke, and Zachary 2019: 236). Some of the past pandemics such as Zika and Ebola were swiftly brought under control because of these technologies (Nagrika Research 2020). The COVID-19 pandemic saw similar digital technology interventions by the governments across the globe to contain and mitigate its spread. In countries like the Republic of Korea and Singapore, governments integrated technology into efforts for testing, contact tracing, surveillance, and ensuring adherence to quarantine rules to contain the infection. Using tools like facial recognition, security camera footage, GPS tracking, and Bluetooth helped the two countries to maintain the lowest per capita mortality rates (Whitelaw et al. 2020).

Lack of technology or technological platforms has been identified as a key challenge in enabling multi-agency collaboration especially during disaster management. In the absence of suitable technologies, it can be difficult to share data and information. This could eventually lead to poor communication between the actors, making collaboration difficult (Abdeen et al. 2021; Janssen et al. 2010). A technology-driven system will also allow for better coordination and interoperability of various actors. Just as the response to COVID-19 was a result of multi-agency coordination, any such future response will require efficient and effective collaboration between these multiple actors—and that collaboration can be strengthened by technological interventions.

Our second recommended action in the use of technology is to improve transparency and knowledge sharing. Greater transparency can increase the credibility of local government decision making (French 2011). Various technologies were used for decision making to counter COVID-19. These technologies included "surveillance, case identification, contact tracing, evaluation of (COVID response) interventions based on mobility data, and communication with the public" (Budd et al. 2020: 1183). These technologies provided a significant opportunity to create and disseminate data and information. While these technologies were used to inform the decision making of the agencies, an opportunity remains for creating greater transparency around the way these responses were formulated.

Sharing information about internal goals, functioning, and outcomes can enhance transparency and hence trust with the community. Similarly, sharing knowledge about the initiatives can help other agencies in their efforts through peer learning. Some of the technological tools were already used to this effect to manage COVID-19, though a huge scope remains to further these efforts. Such responses were also seen after some of the pandemics in the past. Agencies in the Republic of Korea used information and communication technology–enabled surveillance and contact tracing to identify and inform people about possible infections and their future directions. They also used rigorous epidemiologic field investigations, which they complemented with additional data to improve reliability; data used included patient interviews and medical records, credit card transactions, and GPS data from cell phones and cars (You 2020).

Another role for technology within this public health response system is to fight misinformation. India is already taking steps at the national level with the creation of a fact-checking unit within the Press Information Bureau, which is the national government's nodal agency to communicate with media (*Business Standard* 2021). Enabling such units driven by technological solutions at the local government level can help in countering "infodemics," i.e., an excessive amount of information leading to indecision, especially during the times of a public health emergency and hence impacting the public health response (WHO 2020).

3.6.2 Policy Lessons from City-Level Responses

Policies to institutionalize the health response plan. Institutionalizing public health emergency response at the city level will not be possible without mainstreaming it through policy. Such institutionalization happened in many countries during the past pandemics as well. Post-SARS, the People's Republic of China invested CNY6.8 billion in creating a three-tiered network of disease control and prevention (Bouey 2020). The majority of the prefectures (municipalities) and counties set up independent health supervision agencies (Wang et al. 2019). After the outbreak of MERS, the Republic of Korea institutionalized its infectious disease management plans at a national level while requiring local governments to create their local-level execution plans. The national and local plans were revised every 5 years and are built on principles of intergovernmental cooperation. The health response system in the Republic of Korea also upgrades the standard operating procedures for emerging infectious diseases and clearly delineates the institutional responsibilities of all actors (You 2020).

It will be important that governments formalize such institutionalization through the policy route by amending relevant statutes such as state municipal acts, planning guidelines, and redefining institutional practices in ongoing programs and schemes. Some steps are already being taken. For example, in light of COVID-19, the Master Plan of Delhi talks about provisioning multi-facility plots in dense areas, which can be temporarily used for different purposes such as COVID-19 care centers (Chitlangia 2021). Similarly, Mumbai's civic body turned its existing disaster control rooms into COVID-19 response war rooms at the administrative ward level to decentralize the allocation of beds (Phadke 2020; Mahale 2021). The authorities then decided to institutionalize this ward war room approach for addressing future health and disaster-related issues (Minhas 2021). A four-tiered legal framework that may support such institutional arrangements is also being put in place through a public health bill that is in the draft stage (Javed 2022).

Mainstreaming technology through policy. COVID-19 led to a surge in technology-based health innovations as was seen in many of the cities analyzed for SWOT. However, not all technologies meet the goals of an equitable, efficient, and quality health system (Mukherjee 2021). This was evident in the analyzed cities, where only certain cities or user groups were able to benefit from a given technology. For example, the various online platforms or apps launched by the municipal corporations and other agencies benefited the internet users more as compared to those who did not have the access to internet. As another example, this unequal access to the internet resulted in unequal access to vaccines as well (Jain 2021). Similarly, not all technologies are effective in dealing with the issues they are intended for (Mukherjee 2021). For example, some testing technologies turned out to be inadequate because they gave false negatives.

Hence, there is a need for a framework that allows for technological innovations to be integrated in policy based on criteria such as clinical effectiveness, cost efficiency, and social equity (Prinja et al. 2017). Frameworks such as health technology assessments (HTAs) can be valuable for countries like India in achieving this goal (Prinja et al. 2017; Mukherjee 2021).

India is currently developing a framework for HTAs along with a network of technical organizations that can help in the assessments (HTAIn 2022). It will be useful to include a larger number of health institutions (such as hospitals at the city level, especially in smaller cities) and city governments as part of the network that informs as well as benefits from such HTAs. Greater decentralization of health infrastructure and human resources, coupled with HTAs at the decentralized city level, will generate more context-specific evidence on the most effective health interventions and technologies. Lessons from different cities may be made available to other cities. This may help them in their own assessments of the efficacy of any health-based technology innovation.

Community engagement in epidemiological projections. Projections are amongst the most important preparatory measures against a pandemic as they can allow for advanced planning (Sarkar et al. 2020). Unlike Mumbai and Chennai, the other two cities we analyzed lacked access to or capability of predicting future infections. Most of the projections used even in the larger cities were based on national-level calculations that failed to factor in local conditions. India has a national disease surveillance program, but it is not mapped to local governments and doesn't have an active field surveillance component at the local level. There were examples where field-based wastewater surveillance led to detection of COVID-19 in the community (HT Correspondent 2022). Hence, it is important that policy action in epidemiological projections integrate disease surveillance and field-based community inputs to give more realistic and context-specific projections.

Policy-based preventive action. Preventive strategies are critical to averting a pandemic. Our analysis of the COVID-19 responses suggested that all the cities had the capacity to focus on preventive measures. While they all took preventive actions, these actions were not rooted in a policy framework. Lockdowns, containments, and quarantines were some of the major preventive measures adopted by most cities, even though these are considered the last resort, given their negative impacts on the economy and people's mental health, among others (Rossello et al. 2021). Additionally, while lockdowns were in place, the cities were not able to adequately test or trace, and hence were not able to flatten the curve. Cities need an objective policy framework that can guide them to take an appropriate combination of preventive strategies that suit them. For example, there are preventive strategies based on the trade-off between quarantine and testing, considering infection probability as well as costs of testing or quarantine (Rossello et al. 2021).

Policies to develop management capacity. While all four cities were able to undertake preventive measures to a certain degree on their own, they all faced issues in management responses due to chronic lack of adequate health infrastructure and human resources (ECERIH 2019). An expert group appointed by the government attributes the lack of human resources to various factors including regional imbalance in providing medical education in both the public and private sectors, the quality of health care education, and lack of finances. It recommends favorable state and labor policies to correct this imbalance (ECERIH 2019) for both medical doctors and nursing staff. For health infrastructure, the committee recommends mobilizing massive financial outlays for creating such infrastructure and deploying it in various states according to the deficit.

In the context of epidemics, such recommendations point to the need for a national-level policy for management of epidemics that is well informed by the structural imbalances of the various regions in India. Such a policy with a focus on epidemics must be created or its place must be carved within the existing policy frameworks such as the National Health Policy, National Health Mission, and Indian Public Health Standards. For example, after the outbreak of Ebola, Liberia updated its preexisting national health investment plan funds to prioritize improvement of its preexisting structural vulnerabilities such as the health workforce, medical supplies and diagnostics, infrastructure and technology, and epidemic preparedness (Ministry of Health, Liberia 2015).

3.6.3 Lessons from Similarities and Differences between the Cities' Responses

Since all cities had differences in the way they responded to COVID-19, we did an aggregate SWOT analysis based on this diversity of responses so that we could cover a wider number of strategies that were not necessarily based on all four cities. However, the differences (and similarities) were also instructive and may be used to inform the previously mentioned policies based on city size and governance structures. Table 3.7 lists the notable similarities and differences among the four cities.

Table 3.7: Similarities and Differences in the Response of Four Cities

Similarities in Response	Differences in Response
• Focus on testing, contact tracing, vaccination, and sanitation drives • Lack of adequate health infrastructure and human resources • Involvement of nongovernment actors • Citizen helplines and grievance redressal • Basic services support • Awareness creation • Penalties	• Use of technology • Capacity to fine, penalize, and enforce • Direct response by city governments vs dependence on district administration/state government

Source: Nagrika analysis.

Impact of city size and governance structures. The lessons from the existing interrelationships due to the varying city sizes and governance structures can also help design institutional policies. Bigger cities have more agencies, a situation that can lead to overlap in institutional responsibilities. For example, in Mumbai, the Mumbai Metropolitan Regional Development Authority (MMRDA) was entrusted with the responsibility of constructing a COVID-19 hospital facility and then handing it over to the city government (MCGM). However, MMRDA later asked the MCGM to pay the cost for construction. The city government then alleged that MMRDA was not competent to make hospitals and that its doctors should have been consulted (Marpakwar 2020). In small cities, the number of agencies with a designated role are limited and if planned well, small cities may coordinate better with less ambiguity in roles. For example, in Bhubaneswar, the city government and Bhubaneswar Development Authority formed a joint team to enforce COVID-19 norms (Express News Service 2020). For any city, a useful action would be to list the roles played by various city-based agencies during the COVID-19 response and carefully map that list against the agencies' prescribed institutional roles. These roles can be modified based on the suitability and efficacy as seen during the COVID-19 responses.

Variance in preventive and management measures. The inherent strengths and weaknesses of cities may be kept in mind to strengthen their preventive and management capacity through context-specific policies. All four cities had the capacity to focus on preventive measures such as testing, contact tracing, vaccination, and sanitation drives. However, we found variation in the manner in which these activities were conducted. This variation depended on the autonomy of the city governments. For example, Mumbai's civic body joined hands with a private organization to disinfect public spaces while in Ranchi, the municipal corporation coordinated with the state fire department to do the same.

All four cities faced problems in their preventive measures due to lack of adequate health infrastructure and human resources. The cities managed this shortage based on their capacity and the availability of alternative options.

Impact of the difference between state jurisdictions and local autonomy. The jurisdiction and autonomy of the city should be considered while reexamining the institutional policy framework that may reassign roles and responsibilities. For example, though the cities had similarities in their COVID-19 responses, some variance was observed in terms of the ability to directly respond or take decisions. The majority of COVID-19 responses, both preventive and management, in three of the cities—Mumbai, Chennai, and Bhubaneswar—were led by the city governments. However, in the case of Ranchi, these decisions were taken by the district administration or state government. For example, Ranchi's district administration was responsible for conducting testing and vaccination drives and for deploying teams for contact tracing, whereas in the other three cities, the municipal corporations were responsible for these efforts. Similar was the case in managing the health infrastructure during the pandemic.

Variance in the ability to leverage civil society. The role of nongovernment actors came into the spotlight during the pandemic, but larger cities were able to leverage these actors more effectively compared to the smaller ones. In Chennai, NGOs supported the civic body in managing the shortage of health staff for COVID-19 treatment. NGOs in Mumbai supported the fight against the virus by fighting vaccine hesitancy and promoting COVID-19–appropriate behavior among citizens. Hence, institutional authority and capacity of the local governments to meaningfully engage with civil society may be provided in the case of smaller cities.

Variance in the ability to leverage technology. As mentioned earlier, innovative use of technology by the authorities in all four cities turned out to be one of the biggest strengths of the COVID-19 response. But the cities differed in their ability to leverage technology. Most of the cities used technology to set up citizen helplines to provide assistance, home delivery apps for essential items, and even online medical portals to provide free e-consultation to patients. Further, in cities like Chennai and Bhubaneswar, civic bodies were able to use drones to deliver essentials and disinfect roads while in Mumbai, they used drones to monitor COVID-19 hot spots. Mumbai's civic body was also able to successfully implement a cocktail medicine system on a pilot basis with the help of in-house advancement in medical technology. In Ranchi, the district administration collaborated with an online medical portal to provide free e-consultation to patients in home isolation. It will be important to develop smaller cities' capability to understand and utilize health-related technologies.

3.7 Conclusion

It is not the mountain we conquer but ourselves.

—Edmund Hillary

This is the summary of the world that we are currently living in and may continue to live in, in the shadow of COVID-19. It exposed all of us including cities in the most vulnerable places. As described in this chapter, the cities capitalized on all that they had and all they could gather to put up a brave fight with the virus. In the process, cities' efforts brought forth capabilities and opportunities that they had never encountered before, including weaknesses in institutional structures, relationships, and policies. Going forward, all cities, especially small to mid-sized cities, will benefit if their ability to respond to such crises is strengthened through an institutional policy-based route. We hope that the findings from this chapter may serve to inform such policies.

References

Aadeetya, S. 2020. Chennai Govt Creates New App to Track Coronavirus Affected People. *The Quint*. 3 April. https://www.thequint.com/tech-and-auto/tech-news/chennai-coronavirus-tracker-mobile-app-feature-click-selfie-more#read-more (accessed 5 April 2022).

Abdeen, F. N. et al. 2021. Challenges in Multi-Agency Collaboration in Disaster Management: A Sri Lankan Perspective. *International Journal of Disaster Risk Reduction*. 62 (August). https://www.sciencedirect.com/science/article/pii/S2212420921003605?via%3Dihub

Ahuja, P. 2021. Mumbai Mask Fine: BMC Collects over Rs 60 Crore in Fines from People Not Wearing Face Masks in Public. *Times of India*. 16 July. https://timesofindia.indiatimes.com/city/mumbai/mumbai-bmc-collects-over-rs-60-crore-in-fines-from-people-not-wearing-face-masks-in-public/articleshow/84468214.cms (accessed 5 April 2022).

ANI. 2020a. Jharkhand Goes under Lockdown till March 31 to Curb COVID-19 Spread. *The New Indian Express*. 22 March. https://www.newindianexpress.com/nation/2020/mar/22/jharkhand-goes-under-lockdown-till-march-31-to-curb-covid-19-spread-2120229.html

____. 2020b. Odisha Govt to Provide 3 Months' Free Ration to 94 Lakh Families. *ANI News*. 12 April. https://www.aninews.in/news/national/general-news/odisha-govt-to-provide-3-months-free-ration-to-94-lakh-families20200412202442/ (accessed 5 April 2022).

____. 2020c. Odisha: Drones to Spray Disinfectants on Bhubaneswar Roads amid COVID-19 Outbreaks. *Business Standard*. 14 April. https://www.business-standard.com/article/news-ani/odisha-drones-to-spray-disinfectants-on-bhubaneswar-roads-amid-covid-19-outbreak-120041400508_1.html (accessed 5 April 2022).

____. 2020d. Jharkhand Police Issue Advisory to Curb Hate Content, Fake News on Social Media. *Times of India*. 15 April. https://timesofindia.indiatimes.com/india/jharkhand-police-issue-advisory-to-curb-hate-content-fake-news-on-social-media/articleshow/75165407.cms (accessed 5 April 2022).

____. 2020e. MMRDA Spends Rs 53 Cr on Makeshift Covid-19 Hospital at Mumbai's BKCs. *Business Standard*. July 11. https://www.business-standard.com/article/current-affairs/mmrda-spends-rs-53-cr-on-makeshift-covid-19-hospital-at-mumbai-s-bkc-120071100442_1.html (accessed 5 April 2022).

____. 2021. Bhubaneswar Becomes First City to Achieve 100 Per Cent COVID-19 Vaccination: BMC. *ANI News*. 31 July. https://www.aninews.in/news/national/general-news/bhubaneswar-becomes-first-city-to-achieve-100-per-cent-covid-19-vaccination-bmc20210731200213/ (accessed 5 April 2022).

Arvind, Y. 2021. No Lockdown in Chennai: GCC Dispels Rumours. *The News Minute*. 16 April. https://www.thenewsminute.com/article/no-lockdown-chennai-gcc-dispels-rumours-147232 (accessed 5 April 2022).

Badker, R., et al. 2021. Challenges in Reported COVID-19 Data: Best Practices and Recommendations for Future Epidemics. *BMJ Glob Health* 6. https://gh.bmj.com/content/bmjgh/6/5/e005542.full.pdf

Barnagarwala, T. 2020. Coronavirus: Mumbai Civic Body Turns to Phone GPS to Enforce Home Quarantine Rules. *The Indian Express*. 19 March. https://indianexpress.com/article/india/coronavirus-mumbai-civic-body-turns-to-phone-gps-to-enforce-home-quarantine-rules-6321098/ (accessed 5 April 2022).

Bhalerao, S. 2020. Mumbai: Civic Body using Drones to Monitor Lockdown in Hotspots, Densely Populated Areas. *The Indian Express*. 9 April. https://indianexpress.com/article/cities/mumbai/civic-body-using-drones-to-monitor-lockdown-in-hotspots-densely-populated-areas-6353878/ (accessed 5 April 2022).

Bharadwaj, P. and S. Nandy. 2021. Mumbai's New 2,170-Bed Jumbo Covid Facility Built in Just 35 Days. *NDTV.com*. 28 June. https://www.ndtv.com/india-news/mumbais-new-2-170-bed-jumbo-covid-facility-was-built-in-just-35-days-2474578 (accessed 5 April 2022).

Bhatnagar, A. 2021. In 5 Charts: How India's Second Wave Is Declining as Quickly as It Peaked. *Times of India*. 12 June. https://timesofindia.indiatimes.com/india/in-5-charts-how-indias-second-wave-is-declining-as-quickly-as-it-peaked/articleshow/83462403.cms (accessed 5 April 2022).

Bouey, J. 2020. Strengthening China's Public Health Response System: From SARS to COVID-19. *AJPH COVID-19* 110(7): 939–940. https://ajph.aphapublications.org/doi/pdf/10.2105/AJPH.2020.305654

Budd, J. et al. 2020. Digital Technologies in the Public-Health Response to COVID-19. *Nature Medicine* 26(August): 1183–1192. https://www.nature.com/articles/s41591-020-1011-4#citeas

Business Queensland. 2021. Uses of SWOT Analysis. *Business Queensland*. https://www.business.qld.gov.au/starting-business/planning/market-customer-research/swot-analysis/uses (accessed 5 April 2022).

Business Standard. 2021. Govt Has Taken Several Steps to Deal with Fake News: Rajeev Chandrasekhar. *Business Standard*. 1 December. https://www.business-standard.com/article/current-affairs/govt-has-taken-several-steps-to-deal-with-fake-news-rajeev-chandrasekhar-121120101400_1.html (accessed 8 April 2022).

BusinessToday.In. 2020. Coronavirus in India: 21-Day Lockdown Begins; Key Highlights of PM Modi's Speech. *Business Today*. 25 March. https://www.businesstoday.in/latest/economy-politics/story/coronavirus-in-india-21-day-lockdown-begins-key-highlights-of-pm-modi-speech-253038-2020-03-25 (accessed 5 April 2022).

CDC. 2018. Public Health Emergency Preparedness and Response Capabilities: National Standards for State, Local, Tribal, and Territorial Pub. CDC. https://www.cdc.gov/cpr/readiness/00_docs/CDC_PreparednesResponseCapabilities_October2018_Final_508.pdf

Chitlangia, R. 2021. Draft Master Plan 2041: Focus on Density, Public Spaces in Wake of Covid-19. *Hindustan Times*. 10 June. https://www.hindustantimes.com/cities/others/draft-master-plan-2041-focus-on-density-public-spaces-in-wake-of-covid19-101623263769224.html (accessed 6 July 2022).

Condé Nast Traveller. 2020. Mumbai's Social Distancing Rules: What Remains Open, What Does Not. Condé Nast Traveler India. 21 March. https://www.cntraveller.in/story/mumbai-social-distancing-rules-bmc-cafe-restaurant-remains-open-doesnt-list/ (accessed 5 April 2022).

COVID19BHARAT. 2021. Jharkhand. COVID19BHARAT. https://covid19bharat.org/state/JH (accessed 28 March 2022).

Das, D. 2021. Jharkhand Police File FIR against Unknown Persons over Fake COVID Lockdown Post. *Republic World*. 6 December. https://www.republicworld.com/india-news/law-and-order/jharkhand-police-file-fir-against-unknown-persons-over-fake-covid-lockdown-post.html (accessed 5 April 2022).

Debroy, S. 2021. More than 80% of Mumbai Residents Fully Vaxxed. *Times of India*. 15 December. https://timesofindia.indiatimes.com/city/mumbai/more-than-80-of-mumbai-residents-doubly-vaxxed/articleshow/88285853.cms (accessed 5 April 2022).

Dutta, A. and H. W. Fischer. 2021. The Local Governance of COVID-19: Disease Prevention and Social Security in Rural India. *World Development* 138(105234, February). https://www.sciencedirect.com/science/article/pii/S0305750X20303612

ECERIH. 2019. Human Recourses and Infrastructure for Health Sector in India. https://nhsrcindia.org/sites/default/files/2021-06/20.Report%20of%20Sub%20Group%20IV%20of%20Expert%20Committee%20on%20enhancing%20resource%20investment%20in%20health.pdf (accessed 1 July 2022).

ET Bureau. 2020. Individuals Flouting Rules to Pay Rs 100 Fine per Day and Quarantined for 14 Days: Greater Chennai Corporation. *The Economic Times*. 1 May. https://economictimes.indiatimes.com/news/politics-and-nation/individuals-flouting-rules-to-pay-rs-100-fine-per-day-and-quarantined-for-14-days-greater-chennai-corporation/articleshow/75495106.cms?from=mdr (accessed 5 April 2022).

ET Online. 2020. PM Modi Extends National Lockdown till May 3, Next One Week Crucial in Covid Fight. *The Economic Times*. 14 April. https://economictimes.indiatimes.com/news/politics-and-nation/pm-modi-extends-national-lockdown-till-may-3/articleshow/75133926.cms (accessed 5 April 2022).

Express. 2021. Covid-19 Second Wave: Here's a List of States That Have Imposed Full Lockdown. *The Indian Express*. 9 May. https://indianexpress.com/article/india/covid-19-second-wave-heres-a-list-of-states-that-have-imposed-lockdowns-7306634/ (accessed 5 April 2022).

Express News. 2021a. Manpower Shortage at Chennai Corporation Cause of Worry. *New Indian Express*. 22 March. https://www.newindianexpress.com/cities/chennai/2021/mar/22/manpower-shortage-at-chennai-corporation-cause-of-worry-2279701.html (accessed 5 April 2022).

____. 2021b. Unified Command Centre Launched. *New Indian Express*. 1 May. https://www.newindianexpress.com/states/tamil-nadu/2021/may/01/unified-command-centre-launched-2297090.html (accessed 5 April 2022).

____. 2021c. Bhubaneswar Registers Highest Single-Day Spike in Covid Cases. *New Indian Express*. 17 May. https://www.newindianexpress.com/cities/bhubaneswar/2021/may/17/bhubaneswar-registers-highest-single-day-spike-in-covid-cases-2303538.html (accesses 5 April 2022)

____. 2021d. BMC Opens 8 Help Desks in Covid-19 Hospitals. *New Indian Express*. 25 May. https://www.newindianexpress.com/cities/bhubaneswar/2021/may/25/bmc-opens-8-help-desks-in-covid-19-hospitals-2307246.html (accessed 5 April 2022).

____. 2021e. COVID-19: Bhubaneswar Civic Body Resumes Mass Testing for Street Vendors. *New Indian Express*. 5 June. https://www.newindianexpress.com/cities/bhubaneswar/2021/jun/05/covid-19-bhubaneswar-civic-body-resumes-mass-testing-for-street-vendors-2312049.html (accessed 5 April 2022).

____. 2021f. Odisha Extends Partial Lockdown till July 16 with Graded Unlocking. *New Indian Express*. 30 June. https://www.newindianexpress.com/states/odisha/2021/jun/30/odisha-extends-partial-lockdown-till-july-16-with-graded-unlocking-2323599.html (accessed 5 April 2022).

Express News Service. 2020. Bhubaneswar Man Fined Rs 7,000 for Inviting Guests for "Griha Pravesh" amid COVID-19 Threat. *The New Indian Express*. 2 July. https://www.newindianexpress.com/cities/bhubaneswar/2020/jul/02/bhubaneswar-man-fined-rs-7000-for-inviting-guests-for-griha-pravesh-amid-covid-19-threat-2164254.html (accessed 14 April 2023)

Express Web. 2020. Jharkhand's "No Mask" Penalty – Up to Rs 1 Lakh; Here's How Other States Are Dealing with Covid Rule Violators. *Indian Express*. 23 July. https://indianexpress.com/article/india/jharkhands-no-mask-penalty-up-to-rs-1-lakh-heres-how-other-states-are-dealing-with-covid-rule-violators-6520089/ (accessed 5 April 2022).

FE Online. 2020. Coronavirus Pandemic: Up to 7 Years in Jail for Attack on Doctors, Health Workers; Centre Brings Ordinance. *The Financial Express*. 22 April. https://www.financialexpress.com/india-news/coronavirus-pandemic-up-to-7-years-in-jail-for-attack-on-doctors-health-workers-centre-to-bring-ordinance/1936454/ (accessed 5 April 2022).

FP Staff. 2020. To Combat Coronavirus, India Invokes Provisions of Colonial-Era Epidemic Diseases Act: A Look at What This Means-Health News. *Firstpost*. 12 March. https://www.firstpost.com/health/to-combat-coronavirus-india-invokes-provisions-of-colonial-era-epidemic-act-all-you-need-to-know-8142601.html (accessed 5 April 2022).

French, P. E. 2011. Enhancing the Legitimacy of Local Government Pandemic Influenza Planning through Transparency and Public Engagement. *Public Administration Review* 71(2): 253–264. https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1540-6210.2011.02336.x

Ganapatye, S. 2020. Fire Brigade Sprays 3 Lakh Litre Disinfectant Covering 13,728 Km Area of the City. *Mumbai Mirror*. 1 May. https://mumbaimirror.indiatimes.com/coronavirus/news/fire-brigade-sprays-3-lakh-litre-disinfectant-covering-13728-km-area-of-the-city/articleshow/75490383.cms (accessed 5 April 2022).

Gautham, K. 2021. Chennai: How Covid-19 Second Wave Rose Like Tsunami and Is Crashing Fast. *Times of India*. 8 June. https://timesofindia.indiatimes.com/city/chennai/chennai-how-covid-19-second-wave-rose-like-tsunami-and-is-crashing-fast/articleshow/83328936.cms (accessed 5 April 2022).

Giri, V. 2021. नगर नगिम ने चलाया वशिष सफाई अभयिान, शहर के कई इलाकों में सालों से जमा कचरा हटाया [The Municipal Corporation launched a special cleaning campaign, removed the garbage accumulated in many areas of the city for years]. *Jagran*. 23 May. https://www.jagran.com/jharkhand/ranchi-ranchi-nagar-nigam-run-special-cleaning-drive-in-ranchi-today-21669275.html (accessed 5 April 2022).

GovAsia. 2020. Civil Society in Southeast Asia during COVID-19: Responding and Evolving under Pressure. The Asia Foundation. https://think-asia.org/bitstream/handle/11540/12608/GovAsia-1.1-Civil-society-in-Southeast-Asia-during-the-COVID-19-pandemic.pdf?sequence=1 (accessed 5 April 2022).

GRID COVID-19 Study Group. 2020. Combating the COVID-19 Pandemic in a Resource-Constrained Setting: Insights from Initial Response in India. *BMJ Glob Health* 5. https://gh.bmj.com/content/bmjgh/5/11/e003416.full.pdf (accessed 5 April 2022).

Helms, M. M. and J. Nixon. 2010. Exploring SWOT Analysis – Where Are We Now? A Review of Academic Research from the Last Decade. *Journal of Strategy and Management* 3(3): 215–251. https://www.emerald.com/insight/content/doi/10.1108/17554251011064837/full/html

Hewagama, S. P. 2021. The Impact of Health Informatics on Public Health Emergency Response during the COVID-19 Pandemic in Developing Countries – Systematic Review. *Sri Lankan Journal of Medical Administration* 22(1): 56–62. https://sljma.sljol.info/articles/abstract/10.4038/sljma.v22i1.5363/

Himanshu. 2021. BMC Carries Out Massive Sanitization Drive across Bhubaneswar. KalingaTV.com. 15 May. https://kalingatv.com/state/bmc-carries-out-massive-sanitization-drive-across-bhubaneswar/ (accessed 5 April 2022).

HT Correspondent. 2021. Mumbai University Students Mount Campaign to Fight Covid Vaccine Hesitancy. *Hindustan Times*. 29 June. https://www.hindustantimes.com/cities/mumbai-news/mumbai-university-students-mount-campaign-to-fight-covid-vaccine-hesitancy-101624860911632.html (accessed 5 April 2022).

HT Correspondent. 2022. NIBMG Scientists to Look for Early Signs of Covid-19 Outbreak in City's Sewage Water. *Hindustan Times*. 3 July. https://www.hindustantimes.com/india-news/nibmg-scientists-to-look-for-early-signs-of-covid-19-outbreak-in-city-s-sewage-water-101656789702446.html (accessed 1 July 2022).

HTAIn. 2022. Health Technology Assessment in India Department of Health Research. https://htain.icmr.org.in/# (accessed 6 July 2022).

Huremović, D. 2019. Brief History of Pandemics (Pandemics Throughout History). *Psychiatry of Pandemics: A Mental Health Response to Infection Outbreak* 7–35. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7123574/.

IANS. 2020a. Mumbai Police Give "Stree" Touch to COVID-19 Awareness Poster. *Times of India*. 15 April. https://timesofindia.indiatimes.com/entertainment/hindi/bollywood/news/mumbai-police-give-stree-touch-to-covid-19-awareness-poster/articleshow/75155711.cms (accessed 5 April 2022).

____. 2020b. BMC Augments Covid-19 Beds in Mumbai. *Sify.com*. 15 May. https://www.sify.com/news/bmc-augments-covid-19-beds-in-mumbai-news-education-ufqhwwgdijegi.html (accessed 5 April 2022).

India Budget. 2021. Saving Lives and Livelihoods Amidst a Once-in-a-Century Crisis. https://www.indiabudget.gov.in/budget2021-22/economicsurvey/doc/vol1chapter/echap01_vol1.pdf (accessed 6 July 2022). (accessed 5 April 2022).

India TV. 2021. Mumbai Police Includes Dev Anand, Kareena, Madhuri Dixit and Others in Memes for COVID Awareness. *IndiaTV News*. 23 May. https://www.indiatvnews.com/trending/news-mumbai-police-includes-dev-anand-kareena-madhuri-dixit-others-in-memes-for-covid-awareness-706447 (accessed 5 April 2020).

India TV News. 2020. Mumbai: BMC Installs "SAFEST" Machine for Rapid Swab Testing of Coronavirus. *India TV*. 7 April. https://www.indiatvnews.com/news/india/mumbai-bmc-installs-swab-tech-machine-coronavirus-rapid-testing-605340 (accessed 5 April 2022).

____. 2021. Mumbai Police Includes Dev Anand, Kareena, Madhuri Dixit and Others in Memes for COVID Awareness. *IndiaTV News*. 23 May. https://www.indiatvnews.com/trending/news-mumbai-police-includes-dev-anand-kareena-madhuri-dixit-others-in-memes-for-covid-awareness-706447 (accessed 5 April 2022).

Jagannath, J. 2020. Lockdown Extended till 17 May: What Will Open, Remain Closed. *Mint*. 1 May. https://www.livemint.com/news/india/lockdown-extended-till-17-may-what-will-open-remain-closed-11588340829516.html (accessed 5 April 2022).

Jain, B. and S. Debroy. 2022. Mumbai Covid Cases: Mumbai Likely to Cross Second Wave's Peak of 11,206 Daily Cases Today. *Times of India*. 5 January. https://timesofindia.indiatimes.com/city/mumbai/city-likely-to-cross-2nd-waves-peak-of-11206-daily-cases-today/articleshow/88699159.cms (accessed 5 April 2022).

Jain, M. 2021. Why India's Digital Divide Is Hampering Vaccine Access. *Devex*. 20 May. https://www.devex.com/news/why-india-s-digital-divide-is-hampering-vaccine-access-99943 (accessed 6 July 2022).

Jain, S. 2020. Mumbai's Largest Lab Metropolis Barred for A Month from Coronavirus Tests by BMC. *NDTV.com*. 12 June. https://www.ndtv.com/mumbai-news/mumbais-largest-lab-barred-for-a-month-from-coronavirus-tests-2244803 (accessed 5 April 2022).

Janssen, M. et al. 2010. Advances in Multi-Agency Disaster Management: Key Elements in Disaster Research. *Information Systems Frontiers* 12 (March): 1–7. https://link.springer.com/article/10.1007/s10796-009-9176-x#citeas

Jasiulewicz-Kaczmarek, M. 2016. SWOT Analysis for Planned Maintenance Strategy—A Case Study. *IFAC-PapersOnLine* 49(12): 674–679. https://www.sciencedirect.com/science/article/pii/S2405896316310709#section-cited-by

Javed, S. 2022. New Draft Health Law to Replace the Epidemic Diseases Act: An Overview. *The Leaflet*. 29 March. https://theleaflet.in/new-draft-health-law-to-replace-the-epidemic-diseases-act-an-overview/

Kanthimathi, L. 2020. RWAs in Chennai Take Measures to Prevent Crowding in Public Places. *The Hindu*. 9 May. https://www.thehindu.com/news/cities/chennai/rwas-take-measures-to-prevent-crowding-in-public-places/article31546576.ece (accessed 5 April 2022).

Kenton, W. 2021. How SWOT (Strength, Weakness, Opportunity, and Threat) Analysis Works. Investopedia. https://www.investopedia.com/terms/s/swot.asp (accessed 5 April 2022).

Kirubakaran, P. 2021. TN Govt Recruits 135 MBBS Students as Trainee Officers to Aid in COVID-19 Fight in Chennai. *Republic World*. 15 May. https://www.republicworld.com/india-news/general-news/tn-govt-recruits-135-mbbs-students-as-trainee-officers-to-aid-in-covid-19-fight-in-chennai.html (accessed 5 April 2022).

Koushik, J. 2021. Tamil Nadu Aims for 90,000 RT-PCR Tests a Day, Frontline Workers to Get Covid Shot in 2 Weeks. *Indian Express*. 12 April. https://indianexpress.com/article/cities/chennai/tamil-nadu-aims-for-90000-rt-pcr-tests-a-day-7270732/ (accessed 5 April 2022).

Kumar, V. 2020. In Jharkhand, a Mockery of "Right to Food" as Lockdown Relief Measures Fail to Deliver. *The Wire*. 13 May. https://thewire.in/food/lockdown-jharkhand-hunger-deaths-corruption-food (accessed 5 April 2022).

Madhav, P. 2021a. Over Rs 5 Lakh Collected as Fine for Violating Covid Rules in Chennai since April 8. *India Today*. 12 April. https://www.indiatoday.in/cities/chennai/story/over-5-lakh-rupees-collected-fine-violating-covid-rules-chennai-1790073-2021-04-12 (accessed 5 April 2022).

____. 2021b. Chennai News. *India Today*. 13 May. https://www.indiatoday.in/cities/chennai/story/chennai-taxis-converted-covid-mini-ambulances-spike-in-demand-1802172-2021-05-13 (accessed 5 April 2022).

Mahale, A. 2021. BMC's 24X7 Decentralised "War Rooms" Helping Stem COVID-19 Cases in Mumbai. *Down To Earth*. 5 May. https://www.downtoearth.org.in/news/health/bmc-s-24x7-decentralised-war-rooms-helping-stem-covid-19-cases-in-mumbai-76801 (accessed 5 April 2022).

Maharana, S. 2021a. Private Hospitals in Bhubaneswar Stop Admitting Patients. *New Indian Express*. 27 April. https://www.newindianexpress.com/cities/bhubaneswar/2021/apr/27/private-hospitals-in-bhubaneswar-stop-admitting-patients-2295383.html (accessed 5 April 2022).

____. 2021b. Bhubaneswar COVID Hospitals Run Out of ICU Beds. *New Indian Express*. 16 May. https://www.newindianexpress.com/cities/bhubaneswar/2021/may/16/bhubaneswar-covid-hospitals-run-out-of-icu-beds-2303192.html (accessed 5 April 2022).

Mahendradhata, Y. et al. 2021. The Capacity of the Indonesian Healthcare System to Respond to COVID-19. *Front. Public Health* (July). https://www.frontiersin.org/articles/10.3389/fpubh.2021.649819/full#B1.

Marathe, S. and A. Shukla. 2021. Lessons from Private Sector Engagement with COVID-19 for Universal Health Care. *The Leaflet*. 18 December. https://theleaflet.in/lessons-from-private-sector-engagement-with-covid-19-for-universal-health-care/ (accessed 14 April 2023).

Marpakwar, C. 2020. MMRDA to Bill BMC Rs 54 Crore for Two Jumbo Covid-19 Centers. *Mumbai Mirror*. 27 July. https://mumbaimirror.indiatimes.com/coronavirus/news/mmrda-to-bill-bmc-rs-54-cr-for-two-jumbo-covid-centres/articleshow/77188451.cms (accessed 6 July 2022).

____. 2021a. Mumbai: BMC's Food Distribution Effort during Lockdown Wins Award | Mumbai News. *Times of India*. 30 January. https://timesofindia.indiatimes.com/city/mumbai/mumbai-bmcs-food-distribution-effort-during-lock-down-wins-award/articleshow/80603698.cms (accessed 5 April 2022).

____. 2021b. Mumbai: Four Months after Dismantling Covid Center, BMC to Rebuild at Rs 45 Crore. *Times of India*. 1 May. https://timesofindia.indiatimes.com/city/mumbai/mumbai-4-mths-after-dismantling-covid-centre-bmc-to-rebuild-at-rs-45cr/articleshow/82335902.cms (accessed 5 April 2022).

Marpakwar, C, L. Baliga, and Y. Naik. 2020. BMC Adding Old COVID-19 Deaths to Daily Numbers, but Unclear When These "Old Deaths" Took Place. *Mumbai Mirror*. 1 July. https://mumbaimirror.indiatimes.com/coronavirus/news/numbers-dont-lie-but-bmc-numbers-also-dont-tell-the-entire-truth/articleshow/76720484.cms (accessed 5 April 2022).

MD, O. 2021. Second Wave: About 35% of Beds Vacant in Chennai Government Tertiary Hospitals. *New Indian Express*. 20 April. https://www.newindianexpress.com/cities/chennai/2021/apr/20/second-wave-about-35-of-beds-vacant-in-chennai-government-tertiary-hospitals-2292326.html (accessed 5 April 2022).

Minhas, G. 2021. BMC to Continue Mumbai Model in Future. *Governance Now*. 17 June. https://www.governancenow.com/news/regular-story/bmc-to-continue-mumbai-model-in-future (accessed 5 April 2022).

Ministry of Health, Liberia. 2015. Investment Plan for Building a Resilient Health System in Liberia. African Union. https://au.int/web/sites/default/files/newsevents/workingdocuments/27027-wd-liberia-_investment_plan_for_building_a_resilient_health_system.pdf (accessed 5 April 2022).

Ministry of Housing and Urban Affairs and WRI India. 2020. The Smart Responses to COVID-19: A Documentation of Innovative Actions by India's Smart Cities during the Pandemic. SMARTNET NIUA. https://smartnet.niua.org/content/54959890-1972-44ea-acad-93506ffb93b8 (accessed 5 April 2022).

Mirror Online. 2021. Beware! BMC Warns Citizens about Fake News of Kids Testing Covid-19 Positive. *Mumbai Mirror*. 31 March. https://mumbaimirror.indiatimes.com/coronavirus/news/beware-bmc-warns-citizens-of-fake-news-of-kids-testing-covid-19-positive/articleshow/81775951.cms (accessed 5 April 2022).

Mishra, S. 2021. Mumbai: Contact Tracing in City 1/10th of Centre Protocol. *Free Press Journal*. 14 August. https://www.freepressjournal.in/mumbai/mumbai-contact-tracing-in-city-110th-of-centre-protocol (accessed 5 April 2022).

Mohanty, D. 2021. Odisha: Covid-19 Deaths Not Reconciled, Data Doesn't Reflect True Picture. *Hindustan Times*. 6 May. https://www.hindustantimes.com/india-news/odisha-covid-19-deaths-not-reconciled-data-doesn-t-reflect-true-picture-101620282469949.html (accessed 5 April 2022).

Mohapatra, D. 2020. Disinfection Drive Launched in Bhubaneswar to Combat Covid-19. *Times of India*. 1 April. https://timesofindia.indiatimes.com/city/bhubaneswar/disinfection-drive-launched-in-bhubaneswar-to-combat-covid-19/articleshow/74928700.cms (accessed 5 April 2022).

MoHFW. 2020. Advisory on Social Distancing Measure in View of Spread of COVID-19 Disease Social Distancing Is a Non-Pharmaceutical Infection. Ministry of Health and Family Welfare.

https://www.mohfw.gov.in/pdf/SocialDistancingAdvisorybyMOHFW.pdf (accessed 5 April 2022).

Mukesh, A. 2021. Health System Falls Apart in Ranchi, Covid Spike Sparks "Medical Loot." *Times of India*. 14 April. https://timesofindia.indiatimes.com/city/ranchi/health-system-falls-apart-in-ranchi-covid-spike-sparks-medical-loot/articleshow/82054825.cms (accessed 5 April 2022).

Mukherjee, K. 2021. Integrating Technology, Innovation and Policy: COVID-19 and HTA. *Health Policy and Technology* 10(1): 16–20. https://www.sciencedirect.com/science/article/pii/S2211883721000034#bib0022

Mullick, J. 2020. India's First Covid-19 Wave Finally Recedes. *Hindustan Times*. 8 October. https://www.hindustantimes.com/india-news/india-s-first-covid-19-wave-finally-recedes/story-clQaMmmD2TiYD3i1CSmw3J.html (accessed 5 April 2022).

Mumbai Live. 2021. These 5 NGOs Provide Free Oxygen Cylinder for COVID-19 Patients in Mumbai. *Mumbai Live*. 27 April. https://www.mumbailive.com/en/health/this-5-foundations-provide-free-oxygen-cylinder-for-covid-patients-in-mumbai-64205 (accessed 5 April 2022).

Mumbai Online. 2020. BMC Files FIR against Nanavati Hospital for Overcharging COVID-19 Patient. *Mumbai Mirror*. 2 July. https://mumbaimirror.indiatimes.com/coronavirus/news/bmc-files-fir-against-nanavati-hospital-for-overcharging-covid-19-patient/articleshow/76753756.cms (accessed 5 April 2022).

Murray, S. J. 2020. Coronavirus: Contact Tracing in Chennai Proves Tough. *The Hindu*. 30 April. https://www.thehindu.com/news/cities/chennai/contact-tracing-in-chennai-proves-tough/article31476879.ece (accessed 5 April 2022).

Nagrika Research. 2018. Urban Sanitation: In the Driver's seat. Nagrika. https://www.nagrika.org/nagrikaspeak/urban-sanitation-in-the-drivers-seat (accessed 5 April 2022).

____. 2020. City Governments and COVID19. Nagrika. https://www.nagrika.org/nagrikaspeak/city-governments-and-covid-19 (accessed 5 April 2022).

Newswrap. 2021. Information on Beds Will Be Available on Ranchi District Helpline Number. *Hindustan*. 20 April. https://www.livehindustan.com/jharkhand/ranchi/story-information-on-beds-will-be-available-on-ranchi-district-helpline-number-call-0651-2411144-3986887.html (accessed 13 April 2023).

OB Bureau. 2021a. BMC Show Cause to Private Hospital tor Overcharging COVID Patients. *Odisha Bytes*. 14 May. https://odishabytes.com/bmc-show-cause-to-private-hospital-for-overcharging-covid-patients/ (accessed 5 April 2022).

____. 2021b. Civic Body Collects Fine of over Rs 6 Lakh in Three Months for Violation of COVID-19 Guidelines in Bhubaneswar. *Odisha Bytes*. 30 July. https://odishabytes.com/civic-body-collects-fine-of-over-rs-6-lakh-in-three-months-for-violation-of-covid-19-guidelines-in-bhubaneswar/ (accessed 5 April 2022).

Orissa Post. 2020. Doctor Shortage Plagues Health Sector in Odisha. Dailyhunt. https://m.dailyhunt.in/news/nepal/english/orissa+post-epaper-orisapos/doctor+shortage+plagues+health+sector+in+odisha-newsid-n201749034 (accessed 5 April 2022).

Pandey, G. 2020. 5 Dist Hosps Start Using Truenat Machines for Covid-19 Test. *Times of India*. 22 May. https://timesofindia.indiatimes.com/city/ranchi/5-dist-hosps-start-using-truenat-machines-for-covid-19-test/articleshow/75876069.cms (accessed 5 April 2022).

____. 2021. Uttar Pradesh Medico, Team in Ranchi to Create Covid Awareness. *Times of India*. 16 July. https://timesofindia.indiatimes.com/city/ranchi/up-medico-team-in-city-to-create-covid-awareness/articleshow/84452147.cms (accessed 5 April 2022).

Pathak, M. 2021. Mumbai: Lab Operator Arrested over False Covid-19 Report. *Hindustan Times*. 8 March. https://www.hindustantimes.com/cities/mumbai-news/mumbai-lab-operator-arrested-over-false-covid-19-report-101615144033996.html (accessed 5 April 2022).

Phadke, M. 2020. Mumbai Civic Body Introduces "War Rooms" in Every Administrative Ward to Manage Covid Beds. *ThePrint*. 7 June. https://theprint.in/india/mumbai-civic-body-introduces-war-rooms-in-every-administrative-ward-to-manage-covid-beds/437523/ (accessed 5 April 2022).

PIB Delhi. 2020. Extension of Lockdown up to May 31. *Press Information Bureau Government of India*. 17 May. https://pib.gov.in/PressReleasePage.aspx?PRID=1624763 (accessed 5 April 2022).

Pinto, R. 2022. Mumbai: Private Hospitals Told to Take Bed Count to 2nd Wave Peak Levels. *Times of India*. 6 January. https://timesofindia.indiatimes.com/city/mumbai/pvt-hospitals-told-to-take-bed-count-to-2nd-wave-peak-levels/articleshow/88721618.cms (accessed 5 April 2022).

Poovanna, S. 2020. Covid-19: Chennai Civic Body Conducts Door-to-Door Surveillance. *Mint*. 7 April. https://www.livemint.com/news/india/covid-19-chennai-civic-body-to-conduct-door-to-door-surveillance-11586251475267.html (accessed 5 April 2022).

Prabhat Khabar. 2021. नहीं रूक रही झारखंड में दवाओं की काला बाजारी, तीन गुना महंगी बेच रहे दवा, कफन का भी हो रहा सौदा [Coronavirus Update in Jharkhand: Black Market of Drugs is Not Stopping in Jharkhand; Medicines Are Being Sold Three Times More Expensive; Shroud is Also Being Sold]. *Prabhat Khabar*. 26 April. https://www.prabhatkhabar.com/state/jharkhand/ranchi/coronavirus-update-in-jharkhand-black-market-of-drugs-is-not-stopping-in-jharkhand-medicines-are-being-sold-three-times-more-expensive-shroud-is-also-being-sold-srn (accessed 5 April 2022).

Pradhan, A. 2020. Odisha's Private Hospitals Ignore Govt Order on Covid Test Prices. *Times of India*. 22 December. https://timesofindia.indiatimes.com/city/bhubaneswar/odishas-private-hospitals-ignore-govt-order-on-covid-test-prices/articleshow/79852451.cms (accessed 5 April 2022).

Prameyanews. 2021. BMC Gets Allies for Awareness Drive against Covid-19. *Prameyanews.com*. 24 March. https://www.prameyanews.com/bmc-gets-allies-for-awareness-drive-against-covid-19/ (accessed 5 April 2022).

Prinja, S. et al. 2017. Health Technology Assessment for Policy Making in India: Current Scenario and Way Forward. *PharmacoEconomics – Open* 21–3 (2018). https://doi.org/10.1007/s41669-017-0037-0

PTI. 2020a. Mumbai: BMC Makes Public GIS Map of COVID-19 Affected Areas. *Business Standard*. 2 April. https://www.business-standard.com/article/pti-stories/mumbai-bmc-makes-public-gis-map-of-covid-19-affected-areas-120040200792_1.html (accessed 5 April 2022).

____. 2020b. Now, Even Non-Ration Card Holders in TN Can Get Grocery Kits in PDS Shops. *News Minute*. 24 April. https://www.thenewsminute.com/article/now-even-non-ration-card-holders-tn-can-get-grocery-kits-pds-shops-123218 (accessed 5 April 2022).

____. 2020c. COVID-19: BMC Raises Retirement Age for Civic Health Officers by a Year. *The Financial Express*. 1 May. https://www.financialexpress.com/india-news/covid-19-bmc-raises-retirement-age-for-civic-health-officers-by-a-year/1945636/ (accessed 5 April 2022).

____. 2020d. COVID-19 Contact Tracing Ramped Up in Mumbai: BMC Tells HC. *Business Insider India*. 17 June. https://www.businessinsider.in/india/news/covid-19-contact-tracing-ramped-up-in-mumbai-bmc-tells-hc/articleshow/76421510.cms (accessed 5 April 2022).

____. 2021. GPS Tracking of Ambulances for Quick Transfer of Covid Patients to Hospitals. *Business Standard*. 15 May. https://www.business-standard.com/article/current-affairs/gps-tracking-of-ambulances-for-quick-transfer-of-covid-patients-to-hospital-121051500173_1.html (accessed 5 April 2022).

Raj, S. 2022. Project Mumbai: How Founder and CEO Shishir Joshi Found the NGO with Vision of Making Maximum City a Better Place to Live, Work, Play. *Free Press Journal*. 26 March. https://www.freepressjournal.in/mumbai/project-mumbai-how-founder-and-ceo-shishir-joshi-found-the-ngo-with-vision-of-making-maximum-city-a-better-place-to-live-work-play (accessed 5 April 2022).

Ray, D. 2021. Jharkhand: Section of Nurses on Strike Returns to Work at City Hospital. *Times of India*. 26 April. https://timesofindia.indiatimes.com/city/ranchi/section-of-nurses-on-strike-returns-to-work-at-city-hosp/articleshow/82246921.cms (accessed 5 April 2022).

Rossello, N. et al. 2021. On the Effect of the Number of Tests and Their Time of Application in Tracing Policies against COVID-19. *IFAC-PapersOnLine* 54(15): 157–162. https://www.sciencedirect.com/science/article/pii/S2405896321016517?ref=pdf_download&fr=RR-2&rr=725e6ee6f99533ea

Sadanandan, R. 2020. Kerala's Response to COVID19. *Indian Journal of Public Health* 64(6): 99–101. https://www.ijph.in/text.asp?2020/64/6/99/285594

Saran, B. 2020. Four New Covid-19 Testing Machines in Ranchi, Dhanbad to Start Functioning Next Week. *Hindustan Times*. 5 April. https://www.hindustantimes.com/ranchi/four-new-covid-19-testing-machines-in-ranchi-dhanbad-to-start-functioning-next-week/story-YPY0M1S3QDlFAbovZ9qGqM.html (accessed 5 April 2022).

Sarkar, A. et al. 2020. Public Health Preparedness and Responses to the Coronavirus Disease 2019 (COVID-19) Pandemic in South Asia: A Situation and Policy Analysis. *Global Health Journal* 4(4): 121–132. https://www.sciencedirect.com/science/article/pii/S2414644720300567?ref=pdf_download&fr=RR-2&rr=725e71325eb63386

Shahi, A. 2021. Jharkhand: रांची में ड्यूटी से गायब 5 डॉक्टरों पर FIR... अंतमि संस्कार में पैसे वसूलने वाला गरिफ्तार [FIR lodged against 5 doctors missing from duty in Ranchi, One rrested for collecting money for funeral]. *Dainik Jagran*. 28 April. https://www.jagran.com/jharkhand/ranchi-ranchi-dc-ordered-to-fir-in-epidemic-disease-act-against-5-doctors-who-absent-from-duty-in-sadar-hospital-ranchi-jharkhand-21597521.html (accessed 5 April 2022).

Singh, D. 2020. Mumbai: BMC Ultimatum to Staff Not Reporting for COVID-19 Duties. *Free Press Journal*. 5 June. https://www.freepressjournal.in/mumbai/mumbai-bmc-ultimatum-to-staff-not-reporting-for-covid-19-duties (accessed 5 April 2022).

Singha, M. 2020. Odisha to Fine People without Masks. *Times of India*. 10 April. https://timesofindia.indiatimes.com/india/odisha-to-fine-people-without-masks/articleshow/75074779.cms (accessed 5 April 2022).

Special Correspondent. 2020. COVID-19: Chennai Corporation to Embark on a Mass Disinfection Drive from Tomorrow. *The Hindu*. 23 March. https://www.thehindu.com/news/cities/chennai/covid-19-chennai-corporation-to-embark-on-a-mass-disinfection-drive-from-tomorrow/article31143140.ece (accessed 5 April 2022).

____. 2021. Major Schools, Colleges in Chennai to Turn "Extension Centres" of Govt Hospitals to Treat COVID-19 Patients. *The Hindu*. 16 May. https://www.thehindu.com/news/national/tamil-nadu/major-schools-colleges-in-chennai-to-turn-extension-centres-of-govt-hospitals-to-treat-covid-19-patients/article34570967.ece (accessed 5 April 2022).

Srikanth, R. 2020. Coronavirus | Chennai Corporation Forms 200 Response Teams for Better Management of Patient Care. *The Hindu*. 18 June. https://www.thehindu.com/news/cities/chennai/coronavirus-chennai-corporation-forms-200-response-teams-for-better-management-of-patient-care/article31864189.ece (accessed 5 April 2022).

Staff Reporter. 2020. Coronavirus | Not Keeping Physical Distancing Will Attract Fine in Bhubaneswar. *The Hindu*. 1 May. https://www.thehindu.com/news/national/other-states/coronavirus-not-keeping-physical-distancing-will-attract-fine-in-bhubaneswar/article31477264.ece (accessed 5 April 2022).

Suffian, M. 2020. BMC Begins Door to Door Health Screening in Odisha's Bhubaneswar after Spike in Covid-19 Cases. *India Today*. 13 September. https://www.indiatoday.in/coronavirus-outbreak/story/bmc-begins-door-to-door-health-screening-in-odisha-s-bhubaneswar-after-spike-in-covid-19-cases-1721377-2020-09-13 (accessed 5 April 2022).

Tam, L. T. et al. 2021. Receptivity of Governmental Communication and Its Effectiveness During COVID-19 Pandemic Emergency in Vietnam: A Qualitative Study. *Global Journal of Flexible Systems Management*. 22: 45–64. https://link.springer.com/article/10.1007/s40171-021-00269-7 (accessed 13 April 2023)

Tandon, R. and R. Aravind. 2021. Source of Life or Kiss of Death: Revisiting State-Civil Society Dynamics in India during COVID-19 Pandemic. *Nonprofit Policy Forum* 12(1): 147–163. https://www.degruyter.com/document/doi/10.1515/npf-2020-0045/html?lang=en

Tare, K. 2020. BMC Outsources Treatment of Coronavirus Patients at Mumbai's Makeshift Hospitals. *India Today*. 8 July. https://www.indiatoday.in/india/story/bmc-outsources-treatment-of-coronavirus-patients-at-mumbai-s-makeshift-hospitals-1698456-2020-07-08 (accessed 5 April 2022).

Telegraph Online. 2021. Mask Violations Net Rs 8 Lakh in Fines in Ranchi in Five Days. *Telegraph Online*. 23 March. https://www.telegraphindia.com/jharkhand/mask-violations-net-rs-8-lakh-in-fines-in-ranchi-in-five-days/cid/1810404 (accessed 5 April 2022).

Times of India. 2021a. Maharashtra: Guidelines for Small Containment Zones Issued | Mumbai News. Times of India. 20 April. https://timesofindia.indiatimes.com/city/mumbai/maharashtra-guidelines-for-small-containment-zones-issued/articleshow/82152543.cms (accessed 5 April 2022).

Times of India. 2021b. First vs Second Wave of Covid-19 in India: Things You Need to Know. *Times of India*. 19 April. https://timesofindia.indiatimes.com/india/first-vs-second-wave-of-covid-19-in-india-things-you-need-to-know/articleshow/82143427.cms (accessed 5 April 2022).

Travel News. 2020. COVID-19: Tamil Nadu to Start Using Drones to Sanitize the State. *Timestravel*. 31 March. https://timesofindia.indiatimes.com/travel/destinations/covid-19-tamil-nadu-to-start-using-drones-to-sanitize-the-state/articleshow/74909520.cms (accessed 5 April 2022)

TNM Staff. 2020. Trade Center in Chennai Converted into a 550-Bed COVID-19 Quarantine Ward. *The News Minute*. 15 April. https://www.thenewsminute.com/article/trade-centre-chennai-converted-550-bed-covid-19-quarantine-ward-122629 (accessed 5 April 2022).

TNN. 2020. Chennai Lab Sealed for False Positive Results. *Times of India*. 13 October. https://timesofindia.indiatimes.com/city/chennai/chennai-lab-sealed-for-false-positive-results/articleshow/78630654.cms (accessed 5 April 2022).

____. 2021. Nearly 40 Per Cent in Tamil Nadu Fully Vaccinated. 23 November. https://timesofindia.indiatimes.com/city/chennai/nearly-40-per-cent-in-tamil-nadu-fully-vaccinated/articleshow/87860141.cms (accessed 5 April 2022).

Tripathi, S. 2020. Despite Fixed Fee for Virus Testing, Pvt Labs Charge Double. *DTNext*. 18 August. https://www.dtnext.in/News/TopNews/2020/08/18035711/1246282/Despite-fixed-fee-for-virus-testing-pvt-labs-charge-.vpf (accessed 5 April 2022).

Trivedi, N. and N. Pandharipande. 2020. Mumbai High-Rises Report Spike in COVID-19 Cases, but Implementation of Sealing Norms Patchy; BMC Puts Onus on Housing Societies-Health News. *Firstpost*. 22 June. https://www.firstpost.com/health/mumbai-high-rises-report-spike-in-covid-19-cases-but-implementation-of-sealing-norms-patchy-bmc-puts-onus-on-housing-societies-8509391.html (accessed 5 April 2022).

TT Correspondent. 2020. Revival for Ranchi Crematorium in Light of Coronavirus Outbreak. *Telegraph India*. 22 April. https://www.telegraphindia.com/jharkhand/revival-for-ranchi-crematorium-in-light-of-coronavirus-outbreak/cid/1767235 (accessed 5 April 2022).

____. 2021a. Covid Reports Delayed as Ranchi Labs Flooded with Swab Samples. *Telegraph India*. 11 April. https://www.telegraphindia.com/jharkhand/covid-reports-delayed-as-ranchi-labs-flooded-with-swab-samples/cid/1812241 (accessed 5 April 2022).

____. 2021b. Crematorium Staff Missing, Ambulances with Bodies Wait for Hours in Ranchi. *Telegraph India*. 19 April. https://www.telegraphindia.com/jharkhand/crematorium-staff-missing-ambulances-with-bodies-wait-for-hours-in-ranchi/cid/1813042 (accessed 5 April 2022).

____. 2021c. Vaccines—Ranchi Launches Door-to-Door Vaccine Drive. *Telegraph India*. 28 May. https://www.telegraphindia.com/jharkhand/ranchi-launches-door-to-door-vaccine-drive/cid/1817034 (accessed 5 April 2022).

Vidya. 2020. Coronavirus: Now, You Will Be Punished If You Don't Wear Mask in Mumbai. *India Today*. 8 April. https://www.indiatoday.in/india/story/coronavirus-now-you-will-be-punished-if-you-don-t-wear-mask-in-mumbai-1664746-2020-04-08 (accessed 5 April 2022).

Vining, A. 2016. What Is Public Agency Strategic Analysis (PASA) and How Does It Differ from Public Policy Analysis and Firm Strategy Analysis? *Administrative Sciences* 6(4): 1–31. https://www.econstor.eu/handle/10419/239777

Wang, J. and Z. Wang. 2020. Strengths, Weaknesses, Opportunities and Threats (SWOT) Analysis of China's Prevention and Control Strategy for the COVID-19 Epidemic. *Int J Environ Res Public Health* 17(7). https://pubmed.ncbi.nlm.nih.gov/32225019/

Wang, L. et al. 2019. The Development and Reform of Public Health in China from 1949 to 2019. *Global Health* 15(45). https://doi.org/10.1186/s12992-019-0486-6

WCE. 2021. BMC Gets 13 Rapid Response Teams to Speed Up Contact Tracing. *Kalinga TV*. 22 April. https://kalingatv.com/state/covid-19-bhubaneswar-municipal-corporation-increases-rapid-response-team-to-speed-up-contact-tracing/ (accessed 5 April 2022).

Whitelaw, S. et al. 2020. Applications of Digital Technology in COVID-19 Pandemic Planning and Response. *Lancet Digit Health* 2(8): 435–440. https://www.thelancet.com/journals/landig/article/PIIS2589-7500(20)30142-4/fulltext#articleInformation

WHO. 2020. Managing the COVID-19 Infodemic: Promoting Healthy Behaviours and Mitigating the Harm from Misinformation and Disinformation. Geneva: World Health Organization. https://www.who.int/news/item/23-09-2020-managing-the-covid-19-infodemic-promoting-healthy-behaviours-and-mitigating-the-harm-from-misinformation-and-disinformation (assessed 8 April 2022).

____. 2021. Coronavirus Disease (COVID-19). Geneva: World Health Organization. https://www.who.int/emergencies/diseases/novel-coronavirus-2019/question-and-answers-hub/q-a-detail/coronavirus-disease-covid-19 (accessed 5 April 2022).

Williams, F., A. Oke, and I. Zachary. 2019. Public Health Delivery in the Information Age: The Role of Informatics and Technology. *Perspectives in Public Health* 139(5): 236–254. https://journals.sagepub.com/doi/abs/10.1177/1757913918802308

Yadav, V. 2020. Mumbai Police Remove over 600 Misleading Social Media Posts on Covid-19, Share Tips to Spot Fake News. *Hindustan Times*. 30 April. https://www.hindustantimes.com/mumbai-news/mumbai-police-remove-over-600-misleading-social-media-posts-on-covid-19-share-tips-to-spot-fake-news/story-kxU4yCbSzntwj8C1uFV7GK.html (accessed 5 April 2022).

Ye, J. 2020. The Role of Health Technology and Informatics in a Global Public Health Emergency: Practices and Implications from the COVID-19 Pandemic. *JMIR Med Inform* 8(7). https://medinform.jmir.org/2020/7/e19866/

You, J. 2020. Lessons From South Korea's Covid-19 Policy Response. *The American Review of Public Administration* 50(6–7): 801–808. https://doi.org/10.1177/0275074020943708

CHAPTER 4

Urban Parks: Spatial Defense against Disease Contagion and Pandemics[1]

Leah M. Punongbayan-Dela Rosa

4.1 Introduction

Humanity has been shocked at the sudden change we are experiencing in these modern times. Undoubtedly, the world was caught off guard when this recent pandemic hit us and forever changed the way we view community health and well-being.

The outbreak of the coronavirus disease (COVID-19) pandemic caused several challenges in cities worldwide. Developing countries like the Philippines are most vulnerable because of limited resources and technical capacities. Metro Manila is the region in the country that experienced the longest time under quarantine from March 2020 to February 2022 due to the threat of the virus. The restrictions were only lifted by officials on 1 March 2022, along with 38 other cities and provinces, when COVID-19 cases were dropping (NBC News 2022).

In understanding this event, the urban history of diseases also revolves around how aspects of modern urban planning, the rise of urban parks, and certain elements of modern architecture have emerged partly in response to disease outbreaks and measures to contain them.

Urbanization has caused a tremendous rise in dense communities around the world that practically made it impossible to practice the required parameters of social distancing. High urbanization growth, population, close contact with people, and mobility and shared transport are factors in a good formula for spreading diseases and outbreaks. Access to outdoor green space is a demonstrated public health asset. Spending time in outdoor spaces is important for avoiding social isolation and engaging in physical activities, outdoor play, or simply enjoying a change of scenery and fresh air. Due to restrictions on gatherings, movement, and related closures of workplaces and indoor recreational spaces, the pandemic has further amplified the overall contribution of outdoor public spaces to physical and mental health (Freeman and Eykelbosh 2020).

This study demonstrates the dynamics of urban green spaces in addressing the need for outdoor spatial requirements in this time of health and disease contagion in the community.

This research aims to:

- Determine how the use of urban parks and spaces can act as a defense against transmission of contagious diseases.
- Understand urban parks and how to improve access to such spaces in order to reduce the costs of health care.
- Identify, within the urban parks, the possible areas for building temporary hospital facilities during pandemics. Such facilities include contact tracing kiosks, PCR testing booths, temporary emergency treatment facilities, and patient wards.

[1] This chapter is an extended abstract. The full paper will be published as a forthcoming ADBI working paper.

- Provide a guide for policy makers in reshaping and prioritizing green spaces in the future planning of cities and making programs for the health of their constituents in response to contagious diseases.

COVID-19 has revealed the mental health benefits of being outdoors and the devastating effects of being cooped up indoors for a long time. In the quarantine months of March to May 2020, the National Center for Mental Health of the Philippines received double the calls for mental health consults per month compared to the months before the lockdowns (Ranada 2020).

The area of study is urban parks in Quezon City, Philippines—the country's capital city from 1949 to 1976. These urban parks comprise a collection of open spaces and urban wildlife parks clustered within and around the specialized hospitals of the national government. These are the Ninoy Aquino Parks and Wildlife Center, the Quezon City Memorial Circle, the urban forest between the Lung Center and the National Kidney and Transplant Institute of the Philippines, and the open space of the Veterans Memorial Medical Center. Quezon City is the largest city in Metro Manila with the largest estimated land area for green spaces. In history, Quezon City's master plan is anchored in the garden city concept of Harry Frost, which also allocated open spaces for future unpredictable and unforeseen uses.

This chapter also looks at notable parks such as Central Park in New York, United States; Hyde Park in London, United Kingdom; and Rizal Park in Manila, Philippines as case studies on how these open spaces served the people, especially during health crises—Hyde Park during the Great Plague in 1665; Central Park and Rizal Park during the COVID-19 pandemic.

This study is based on two frameworks: (i) the biophilic cities framework and (ii) the socio-ecological model of the use of urban green space.

Biophilic design holds that good design at the building, site, city, and regional scale must include nature and natural elements. This design practice is based especially on the concept of biophilia, promoted by Harvard myrmecologist and sociobiologist E .O. Wilson. He considers that humans have co-evolved with nature and that we carry with us our ancient brains and our need to connect with and affiliate with nature to be happy and healthy.

According to Beatley and Newman (2013), open and green spaces such as parks and forests significantly contribute to biophilic urbanism, a planning and urban design approach that aims to connect the urban fabric with nature. These open spaces offer opportunities for physical activities, socializing, and establishing new friendships, enabling people to overcome social isolation and increasing individual and family resilience to life challenges.

A city can establish a better urban transport system by transitioning from a car-centric model to a system that promotes an active lifestyle. Social distancing programs are likely to remain in place for the foreseeable future, so we need to prepare our cities for this, for example by rapidly putting in place an adequate and safe infrastructure for walking and cycling to work, providing opportunities for daily physical activity without causing high air pollution levels, and creating sufficient safe public spaces (parks, beaches, and other outdoor spaces) where people can meet and exercise without running a high risk of contagion (Nieuwenhuijsen 2020).

The past decades of planning, design, and public health have focused on three areas—chronic disease, hazards and disasters, and the vulnerable—and less on infectious diseases. For chronic diseases, the environment has been planned for physical activities and mental restoration. For hazards, the environment has been designed and planned to address flooding, droughts, and climate-led migration. For the vulnerable, the environment has been designed specifically for the old, young, those with

pre-existing conditions, or those who have low incomes. The current pandemic calls us to next prioritize research and practice designing with infectious diseases in mind (Forsyth 2020).

This study looks into the policy and spatial planning guidelines and recommendations of institutions such as the Centers for Disease Control and Prevention, United Nations Habitat, and the National Association of City Transportation Officials. Among these guidelines and recommendations are social distancing and lockdown policies, closing of schools, work from home or staggered working hour strategies among businesses, slow street programs, sanitation and hygiene stations, and the creation and maintenance of park networks.

Equitable access to local green space is critical for physical, emotional, and mental health. The COVID-19 pandemic has brought so much change in the community environment, including curtailing the ability to go out and get some fresh air. With the lockdown, urban green spaces were deserted depending on the extent of rules in the locale.

We have to accept that human society and cities can suffer at any time from various crises, such as floods, earthquakes, tsunamis, volcanic eruptions, fires, and environmental pollution and other disasters. However, because of mobility and the development of transportation and human migration, pandemics have become another form of global crisis.

In the past half-century, humans have suffered from the H5N1 virus, cholera, Ebola virus disease, SARS, and other large-scale epidemics. Each pandemic has had a tremendous negative impact on human society. With COVID-19 declared as an international public health emergency in 2020, many countries have implemented quarantine protocols and policies in domestic cities to prevent the spread of virus infection. However, the prevalence of urban quarantine strategies drastically altered residents' normal lives and caused a variety of adverse effects (Yang 2020).

Reducing personal contact or physical distancing is a central measure against the spread of COVID-19 or any infectious disease. This measure calls for better urban planning in increasing the areas of parks and improving their conditions to help people to cope physically, mentally, and emotionally with any disease. Planners must remember that humans naturally need to connect and affiliate with nature to be happy and healthy.

Open spaces should be considered for future public health emergencies as well—for temporary hospitals, vaccination sites, or simply a space for people to cope mentally through interaction and physically through exercise.

The biophilic cities framework is a good guide for future studies and crafting guidelines further exploring the role of open spaces from buildings, into the streets, to communities, and up to the regional level.

4.2 Methodology

The study will utilize the urban green space (UGS) analysis method (M'Ikiugu, Kinoshita, and Tashiro 2012). The method is as follows:

(i) Use orthographic photographs, geographic information system (GIS) vector maps, and a UGS suitability checklist as the basic data collection and generation elements.
(ii) Conduct initial environmental scanning using these orthographic photographs as well as video clips and drone-generated satellite images of the study area.

(iii) Formulate baseline data through remote systems.
(iv) Conduct key informant structured interviews and online surveys of experts in the fields of public health, urban planning, and landscape architecture, including those in the civil service, academic institutions, and private practice.
(v) Conduct visual identification of UGS patches and observe how they vary across the study area in number, size, shape, and class.

References

Beatley, T. and P. Newman. 2013. Biophilic Cities Are Sustainable, Resilient Cities. *Sustainability* 5(8): 3328–3345.

Forsyth, A. 2020. What Role Do Planning and Design Play in a Pandemic? Ann Forsyth Reflects on COVID-19's Impact on the Future of Urban Life. Cambridge, MA: Harvard University Graduate School of Design. https://www.gsd.harvard.edu/2020/03/what-role-do-planning-and-design-play-in-a-pandemic-ann-forsyth-reflects-on-covid-19s-impact-on-the-future-of-urban-life/

Freeman, S. and A. Eykelbosh. 2020. COVID-19 and Outdoor Safety: Considerations for Use of Outdoor Recreational Spaces. Vancouver, BC: National Collaborating Centre for Environmental Health. https://ncceh.ca/documents/guide/covid-19-and-outdoor-safety-considerations-use-outdoor-recreational-spaces

M'Ikiugu, M, I. Kinoshita, and Y. Tashiro. 2012. Urban Green Space Analysis and Identification of its Potential Expansion Areas. *Procedia - Social and Behavioral Sciences* 35: 449–458. https://doi.org/10.1016/j.sbspro.2012.02.110

Nieuwenhuijsen, M. J. 2020. COVID-19 and the City: How is the Pandemic Affecting Urban Health? ISGlobal Barcelona Institute for Global Health Blog. https://www.isglobal.org/en/healthisglobal/-/custom-blog-portlet/covid-19-en-las-ciudades-como-esta-afectando-la-pandemia-a-la-salud-urbana-/4735173/0

NBC News. 2022. Traffic Jams Back in Philippine Capital as Officials Ease Pandemic Restrictions. NBC News. 1 March. https://www.nbcnews.com/news/world/philippines-lifts-pandemic-restrictions-rcna18073

Ranada, P. 2020. Parks Will Save Us: Pandemic Highlights Lack of Metro Manila Green, Open Spaces. Rappler. 7 October. https://www.rappler.com/newsbreak/in-depth/covid-19-pandemic-highlights-lack-metro-manila-green-open-spaces

Yang, S. et al. 2020. The Mental Health Burden of the COVID-19 Pandemic on Physical Therapists. *International Journal of Environmental Research and Public Health* 17(10): 3723.

CHAPTER 5

Retrofitting the Outskirts of Asian Megacities: Workplace-Making with Nature

Akane Bessho and Makoto Yokohari

5.1 Introduction

Before the global outbreak of the coronavirus disease (COVID-19), remote working was not prevalent in most countries. Conventionally, office workers commuted to urban cores for work and spent limited time in their local communities. However, the COVID-19 pandemic has raised a critical question about the ways we work and live in cities (Mouratidis 2021). With successive stay-at-home measures and sudden closure of offices and workplaces, many office workers switched to working from home across countries.

As the pandemic continues, this change in the working mode seems to permanently affect people's perception of how they normally work in the post–COVID-19 era (Mori 2021). In most Western countries, the working-from-home arrangement has received positive feedback from workers. According to Eurofound's survey on European Union countries (Ahrendt et al. 2022), the share of people usually working from home increased from 5% in 2019 to 12% in 2020. In the United Kingdom, approximately 59% of workers are working from home full time or most of the time, according to the Pew Research Center survey in 2022 (Parker, Horowitz, and Minkin 2022). The survey showed that 61% of respondents choose not to work from the workplace, rather than out of necessity. In the United Kingdom, the survey showed that more than four in five workers wanted to continue the "hybrid work" work style, wherein workers split their time between home and the office (Office for National Statistics 2022). While many people still return to the office, companies across nations recognize the demand for a permanent shift from full-time office work and start promoting diverse work styles that are most suitable for workers' productive activities.

The pandemic boosted a discussion among urban planners about reinventing cities to address the emerging demand for diverse remote work arrangements, and Asian cities are no exception. According to a McKinsey Global Survey in 2020, while the expected time required for organizations in Asia and the Pacific to respond to or implement remote working before COVID-19 was 454 days, it actually took them only 10.5 days (LaBerge et al. 2020). At the same time, reports indicate that during the early waves of the pandemic, workers in Asia, particularly India, Indonesia, and the Philippines, struggled to implement working from home. Challenges include having small apartments, difficulty maintaining work-life balance, and poor technological infrastructure at home (Fachriansyah 2020). Addressing the existing challenges, Asian cities have since been promoting the advancement of digital transformation and implementation of smart cities.

The uptake of remote work will significantly impact people's cultural norms toward work and transform transportation and settlement patterns in the long run. What has been observed among megacities across nations is that more urbanites are interested in moving away from large cities to small towns and secondary cities for affordability, a less densely populated environment, and better natural amenities (Henderson 2022; Vivan 2020). Kang, Won, and Kim (2021) explored people's concerns about urban living and residence relocation in the Republic of Korea. They found that people aged 40 or older, living in a townhouse or a single-detached house, and spending a longer time at home than they previously did were more likely to consider moving to a less dense area. Having faced the overheated housing market coupled with the long-term pandemic-induced business disruption, many people found living

in large cities no longer financially sustainable and started considering relocation to the outskirts. As the number of people leaving the centralized, densely populated urban environments is expected to rise, the outskirts of megacities are more likely to be redeveloped for working-class newcomers in the post–COVID-19 era.

How can the outskirts of Asian megacities be retrofitted to build a more livable environment suitable for post–COVID-19 work arrangements and mitigate potential environmental distress caused by the development? What are essential policy making tools available for the change? In this chapter, we first give an overview of the current discussion on emerging lifestyles driven by remote working in Japan and explore the impact of the uptake of remote working in Japan's Greater Tokyo Area. Secondly, by introducing two projects in Tsukuba City, the chapter explores the concept of "workplace-making with nature," which may be a key to creating inclusive and resilient communities in the outskirts. Finally, the chapter discusses how the outskirts of other Asian megacities can be retrofitted for the post–COVID-19 work style by considering policies that promote (i) connecting dispersed cities with greener modes of transportation, (ii) identifying and restoring natural environments within megacity regions, and (iii) developing management schemes for workplace-making with nature.

5.2 Emerging Workstyles Driven by Remote Working in the Greater Tokyo Area

Before the COVID-19 pandemic, the Japanese government had promoted teleworking, particularly after the Great East Japan Earthquake of 11 March 2011. Prior to the disasters, most Japanese companies that conventionally evaluated employees' job performance in the office environment were reluctant to implement teleworking. However, the 2011 earthquake and the Fukushima nuclear plant accident led the government to introduce an electricity conservation policy that imposes power-saving measures on companies (Sato 2013). Companies started to develop business continuity plans for disasters and other potential crises and mitigating congestion (Matsushita 2021). Despite these efforts, the nationwide share of companies implementing teleworking was only 17.6% in March 2020. A drastic change occurred immediately after the COVID-19 pandemic began. The percentage increased to 56.4% during the first state of emergency in May 2020 and settled at 38.4% in March 2021 (Ministry of Internal Affairs and Communications 2021).

The National Capital Region ("*Shutoken*"), or Greater Tokyo Area, is made up of Tokyo and the seven surrounding prefectures. It is one of the most populous urban areas in the world, with a population of over 44 million and 2.9 million work or school commuters flowing into the city center in 2015 (Statistics Bureau, Ministry of Internal Affairs and Communications 2015). After the declaration of a state of emergency in April 2020 in Tokyo, most companies and schools transitioned to using technology to allow people to work/study from home to contain the spread of COVID-19. According to the survey conducted by the Tokyo Chamber of Commerce and Industry, 67.3% of 1,111 surveyed companies implemented working from home during May to June 2020, indicating a rapid change in work styles compared to the previous study in March 2020—which recorded just 26.0% of 1,283 companies implementing work from home (Tokyo Chamber of Commerce and Industry 2020). The survey conducted in June 2022 found that 54.6% of companies in Tokyo continued remote work arrangements, and 47.7% of companies implemented remote working more than 3 days a week (Tokyo Metropolitan Government 2022).

As workers continued remote work, companies and individuals started promoting numerous forms of work styles outside of conventional office spaces. For example, coworking spaces gained popularity

among remote workers. These workplaces enable people to benefit from exchanging knowledge and business ideas through horizontal interaction with others (Spinuzzi 2012). Also, as Figure 5.1 shows, several coworking spaces incorporate surrounding natural environments, including forests, rivers, and beaches. In addition, some workers began engaging in "workations," a compound word for work and vacation. A workation aims to enable workers to "refresh and recuperate (Retreat), enjoy hobbies (Activity) such as surfing, and spend time with their family" (Matsushita 2021: 215). Moreover, a workation contributes to revitalizing rural regions by encouraging urban workers to spend time away from the city center and build social and economic relationships with rural areas (Matsushita 2022). As Matsushita (2022) points out, the COVID-19 pandemic has influenced a drastic work style reconfiguration such that, following the pandemic, workers are selecting their work styles based not on *where* they work (place-based workplaces) but rather on *how* they work (style-based workplaces).

Figure 5.1: CAWAZ Base, a Riverside Coworking Space in Hidaka City

Photo credit: Aya Matsumoto.

According to the Annual Report on Internal Migration in Japan 2021 by the Statistics Bureau of Japan, in Tokyo's 23 wards, the number of people moving out exceeded the number of people moving in, hitting the city's most significant net loss in 14 years (Statistics Bureau of Japan 2022). Notably, the report suggests that comparing before and after the COVID-19 pandemic, destinations of out-migrants of Tokyo's 23 wards shifted to cities farther from the metropolitan center (Tables 5.1, 5.2, and Figure 5.2). The tables show that the average population density of the 10 destination cities decreased from 8,152.4 people per square kilometer in 2019 to 5,954.2 people per square kilometer in 2021; and the average residential land value fell from 214,059 yen per square meter in 2019 to 162,400 yen per square meter in 2021. These changes indicate that the out-migration destinations changed to less dense and more affordable areas. In addition, it is worth mentioning that while the average total travel distance from the city center—Akihabara Station—to the nearest stations increased from 31.3 kilometers in 2019 to 39.8 kilometers in 2021, the average travel time by train remained almost unchanged, with the negligible increase from 50.1 minutes in 2019 to 51.3 minutes in 2021. These changes suggest that more people in Tokyo's 23 wards prefer relocating to cities that are farther from Tokyo's central point and have access to high-speed trains.

Table 5.1 Top 10 Major Out-Migration Destinations of Tokyo's 23 Wards in 2019

Rank	City	Prefecture	Population Density Mean: 8,152.4/km²	Travel Distance Mean: 31.3 km	Travel Time Mean: 50.1 minutes	Residential Land Price Mean: 214,059 yen
1	Fujimi	Saitama	5,646/km²	32.3 km	58 minutes	168,777 yen
2	Kashiwa	Chiba	3,707/km²	29.1 km	32 minutes	109,984 yen
3	Nishi Tokyo	Tokyo	12,796/km²	28.0 km	55 minutes	284,161 yen
4	Mitaka	Tokyo	11,401/km²	22.4 km	34 minutes	405,000 yen
5	Hachioji	Tokyo	3,017/km²	45.7 km	54 minutes	116,246 yen
6	Yamato	Kanagawa	8,705/km²	46.0 km	75 minutes	185,630 yen
7	Soka	Saitama	9,049/km²	16.3 km	30 minutes	135,565 yen
8	Kunitachi	Tokyo	9,330/km²	32.8 km	54 minutes	335,636 yen
9	Higashikurume	Tokyo	9,076/km²	24.9 km	51 minutes	213,682 yen
10	Higashimurayama	Tokyo	8,797/km²	35.3 km	58 minutes	185,909 yen

km = kilometer.

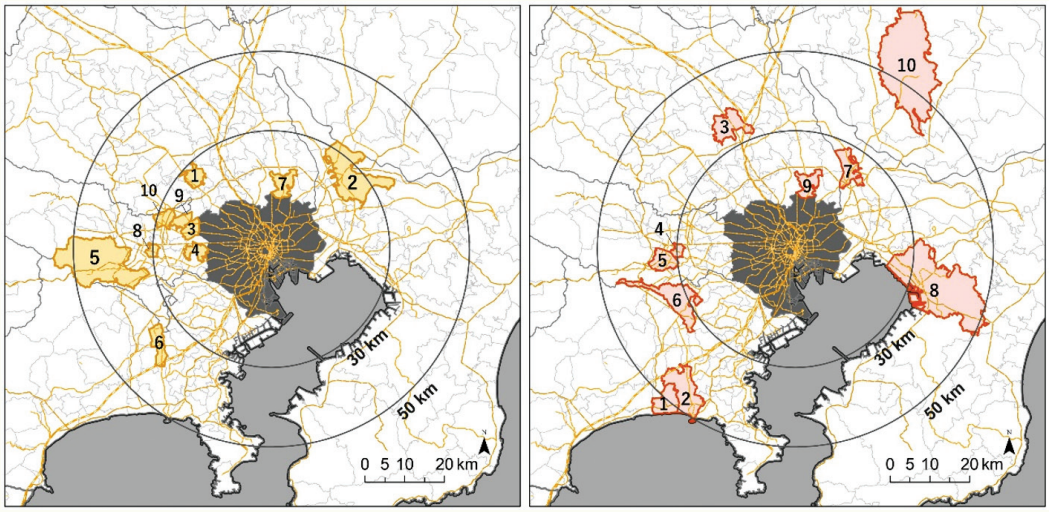
Data sources: Ranking: Statistics Bureau of Japan (2021); Population density: municipality's population in early 2019 divided by the municipality area; Travel time: average train ride duration from Akihabara Station to the nearest station by rapid trains; Residential land value: appraised land price by the Ministry of Land, Infrastructure, Transport and Tourism.

Table 5.2: Top 10 Major Out-Migration Destinations of Tokyo's 23 Wards in 2021

Rank	City	Prefecture	Population Density Mean: 5,954.2/km²	Travel Distance Mean: 39.8 km	Travel Time Mean: 51.3 minutes	Residential Land Price Mean: 162,400 yen
1	Chagatai	Kanagawa	6,790/km²	60.6 km	68 minutes	192,758 yen
2	Fujisawa	Kanagawa	6,297/km²	53.1 km	60 minutes	187,903 yen
3	Ageo	Saitama	5,043/km²	36.5 km	48 minutes	113,367 yen
4	Kunitachi	Tokyo	9,371/km²	32.8 km	54 minutes	339,455 yen
5	Hino	Tokyo	6,789/km²	39.1 km	64 minutes	188,514 yen
6	Machida	Tokyo	5,998/km²	39.4 km	62 minutes	155,945 yen
7	Nagareyama	Chiba	5,701/km²	24.3 km	30 minutes	130,416 yen
8	Chiba	Chiba	3,590/km²	37.8 km	44 minutes	120,216 yen
9	Soka	Saitama	9,112/km²	16.3 km	30 minutes	136,958 yen
10	Tsukuba	Ibaraki	851/km²	58.3 km	53 minutes	58,471 yen

km = kilometer.

Figure 5.2: Top 10 Major Internal Out-Migration Destinations of Tokyo's 23 Wards (2019 and 2021)



km = kilometer.

Source: Maps created by Akane Bessho. The GIS data were obtained from the National Land Information Division, MILT (https://nlftp.mlit.go.jp/).

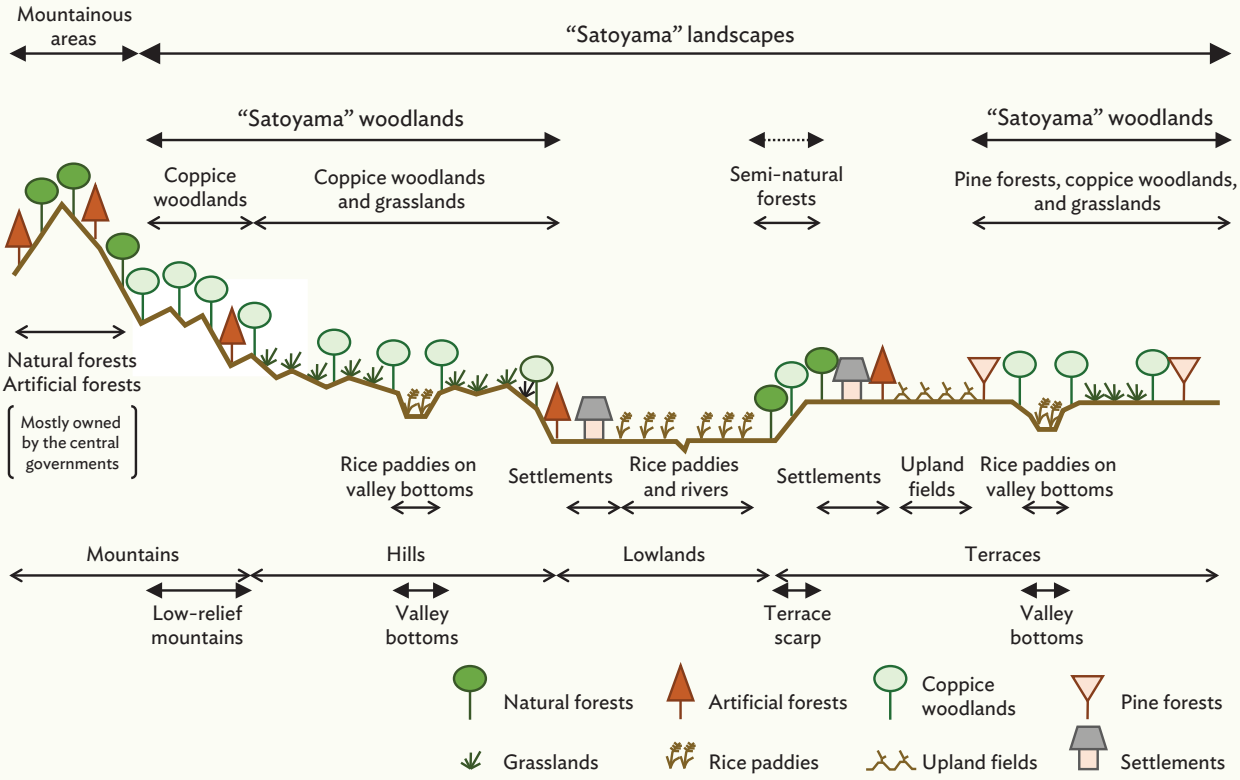
5.3 Workplace-Making with Nature

5.3.1 Satoyama Landscapes in the Outskirts of Tokyo

In many of the outskirt regions of the Greater Tokyo Area there is what scholars refer to as the "*satoyama* landscape," which is now gaining attention as an environment with attractive and collaborative natural amenities for residents. As Takeuchi et al. (2008) illustrated (Figure 5.3), "satoyama woodlands" are typically described as coppice woodlands and grasslands that were traditionally crucial for providing fuelwood and organic fertilizer materials for farmers. On the other hand, the "satoyama landscape," as a more comprehensive term, indicates a set of "interlinked units including settlements, rice paddies, agricultural fields, bamboo forests, woodlands, and grasslands" (Yokohari and Bolthouse 2011). Until Japan's Energy Revolution, satoyama landscapes were traditionally an important source of firewood and organic and inorganic materials for farming (Morimoto 2011). As satoyama landscapes account for approximately 40% of Japan's total land area, the term conjures the idyllic image of Japanese rural livelihoods where "Sato (village/people) and Yama (mountain/nature) coexist side by side in harmony" (Imamori 1995: 153, English translation by Yokohari and Bolthouse 2011).

A large body of research has been addressing the biodiversity and ecosystem services of satoyama landscapes (Takeuchi et al. 2008; Duraiappah et al. 2012). During the rapid economic growth of the late 1960s, the fringes of the Greater Tokyo Area underwent significant urban development, leading to the loss of the satoyama landscapes. Consequently, many citizens began natural conservation in their neighborhoods in the early 1990s across Japan (Terada 2012). Regarding satoyama landscapes, existing studies on citizen-led conservation activities of satoyama forests explored practical management methods for secondary forests (Hiratsuka et al. 2020), motivations and benefits of participants (Shimpo 2021), and organizational characteristics (Ishihara et al. 2005). Shimpo (2021) pointed out that these

Figure 5.3: Schematic Presentation of Landscape Elements in the "Satoyama" and "Satochi"



Note: "Satochi-satoyama" is used interchangeably with satoyama landscapes.

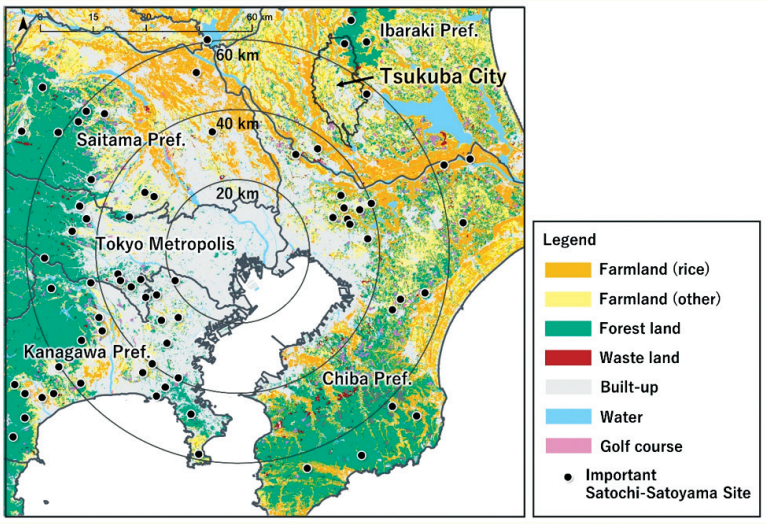
Source: Proposed by Takeuchi et al. (2008) and adjusted by the authors.

activities offer participants short-term benefits, like social interaction and health promotion, and offer the local community long-term benefits, such as cultural transmission and scenic conservation.

Following the National Biodiversity Strategy of Japan 2010, the Ministry of the Environment compiled the National Action Plan for the Conservation and Sustainable Use of Socio-ecological Production Landscapes (Satochi-satoyama) in 2010. The plan states the following fundamental values of satoyama landscapes: (i) biodiversity conservation, (ii) provision of biomass energy, (iii) preservation of historical landscapes and livelihood culture, (iv) environmental educational value, and (v) prevention against global warming (Ministry of the Environment 2010: 3–4). The plan also aims to promote the active involvement of stakeholders, including the central government, local authorities, corporations, agriculture and forestry industries, local communities, nonprofit organizations, and citizens with satoyama conservation activities. As shown in Figure 5.4, the plan selected 500 important satochi-satoyama sites situated on the periphery of the Greater Tokyo Area.

As Japanese society entered the phase of rapid aging and population decline, especially in the countryside, the idea of "*den'en kaiki*" ("return to the country") was actively promoted by the Ministry of Internal Affairs and Communications as well as the Ministry of Agriculture, Forestry and Fisheries to increase migration from urban areas to rural areas during the 2010s (Sakuno 2016). Prior to COVID-19,

Figure 5.4: Important Satochi-Satoyama Sites in the Outskirts of the Greater Tokyo Area Selected by the Ministry of the Environment

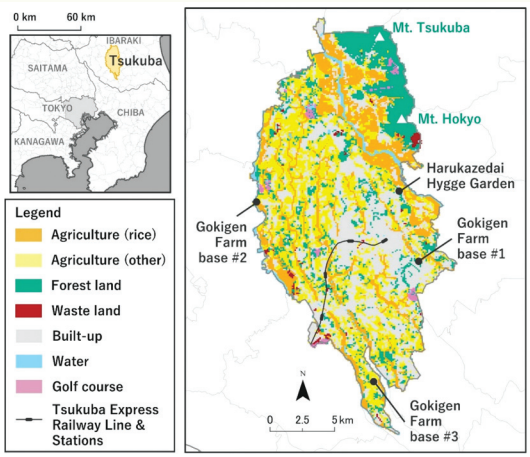


Source: Created by the authors.

such an option, however, was largely limited to digital nomads or those who had decided to leave a white-collar job in cities. The destinations mainly were in the countryside far from the metropolitan region. However, with the rapid uptake of remote working arrangements, more city office workers are expected to consider out-migration to areas that have both urban facilities and traditional rural landscapes while keeping their previous occupations. As the satoyama landscapes offer critical environmental and cultural services to the local community, there is a need for practical approaches to incorporate newcomers' participation and engage in what we call "workplace-making with nature," a concept of arranging and managing spaces that enhance the living/working experience of residents using the surrounding environmental resources, including secondary forests and farmlands.

In this section, we take Tsukuba City, located 50 kilometers from Tokyo's urban core, as an example of an outskirt city that underwent postwar urban development yet maintains the satoyama landscapes at its urban fringes (Figure 5.5). Tsukuba Station, located in the city's central district, is the terminal station of the Tsukuba Express Line, a high-speed rail line that runs from the Tokyo area. This line travels the entire 58.3-kilometer distance in just 45 minutes at its top speed (Metropolitan Intercity Railway Company 2022). While the central district of Tsukuba City has been developed with shopping centers and research facilities, green spaces—including farmlands, forest land, and parks—account for over 60% of the city area (City of Tsukuba 2016). Driven by the pandemic, in 2021, the city received a total of 4,643 in-migrants, the highest number within the prefecture (Statistics Bureau of Japan 2022).

Figure 5.5: Location and Geographic Characteristics of Tsukuba City, Ibaraki Prefecture

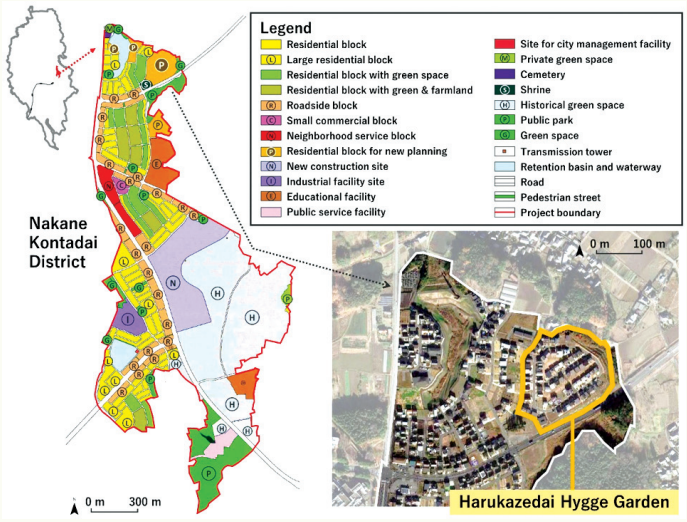


Source: Created by the authors.

5.3.2 Harukazedai Hygge Garden

Located about 4 kilometers from the city center, Harukazedai Hygge Garden is situated on a small hill adjacent to rural settlements. As part of the urban development projects along the Tsukuba Express railway by the Urban Renaissance Agency (UR Agency), the Land Adjustment Project was conducted in Nakane Kontadai District during 2004–2018. The 189.9 hectares of land were redeveloped with the aim to attract residents interested in an accessible countryside living environment in Tsukuba City (Figure 5.6). Located on one of the "residential block for new planning" sites, Harukazedai Hygge

Figure 5.6: Location and Zoning of the Land Readjustment Project in Nakane Kontadai District (left) and Satellite Image of Harukazedai Hygge Garden Project after the Development (right)



m = meter.

Source: Created by the authors.

Garden was introduced to create a residential district where the surrounding satoyama landscapes were spatially integrated (UR Agency 2019).

The project's total area is 33,290 square meters, including 75 housing plots. Emphasizing the importance of local production and consumption, the project strictly uses timber harvested exclusively within the prefecture and commissions local building contractors for housing construction. Notably, the project designates 30% of the area (or 11,463 square meters) as common spaces, including common yards, garden spaces, and slope forests.

Actively incorporating the area's existing satoyama landscape, the Hygge Garden's living environment has been formed and maintained by several guidelines and community-based programs. First, the district is under the city-approved Landscape Agreement and Building Agreement that provide guidelines for maintaining a cohesive townscape with abundant green space (Tsukuba City 2022). Residents must follow house guidelines such that large fences and signs do not exist, the houses retain lower heights, and they share the same building heights, eave lengths, roof materials, and setbacks.

Second, all owners maintain the common green space via their management association. The "Satoyama Common" spaces connect the private areas of individual houses with outdoor public spaces and facilitate daily interactions and oversight among neighborhood residents. Once a month, the owners gather for a cooperative cleanup. Each house has a garden space where owners can plant vegetables and trees under the guidelines. In addition, the owners engage in slope forest conservation by monitoring the local species and weeding. As a result, the green spaces of residential areas provide not only aesthetic landscapes but also opportunities for building a community via a management routine among the owners.

Third, several owners have installed woodstoves in their houses, collecting fuelwood by participating in local satoyama forest management activities. Tsukuba Firewood Club was founded in 2008 by Tsukuba Environmental Forum, a non-profit organization that has been operated by environmental conservation grants and management contract fees (Tsukuba Environmental Forum 2022). The club is run by a collective of 30 woodstove owners from all across the city involved in satoyama forest management in the region.[1] The members carry out various firewood production activities, including cutting, chopping, and drying firewood. Members receive respective quantities of firewood based on how many hours they have participated that year. According to a resident who is also a club member, while he started participating without any former knowledge in satoyama management, the activities enabled him to meet new people with similar interests and gain satoyama-related knowledge (Figure 5.7).

[1] This information is based on an in-person interview with the residents of the Hygge Garden conducted by Akane Bessho on 3 June 2022.

Figure 5.7: Model House with Firewood Storage in the Hygge Garden

Note: The south side of the house is facing the "Satoyama Common" spaces.

Source: Authors.

5.3.3 Gokigen Farm

The movement called noufuku-renkei (a collaboration between agriculture and welfare) has been gaining ground across Japan in recent years (Council for the Promotion of Collaboration between Agriculture and Welfare 2021). The concept aims to revitalize local agriculture and generate health promotion and occupational training for vulnerable populations, including the elderly and persons with disabilities (Hamada 2018). The recent study by Bessho et al. (2022) shows that during the pandemic, many of these organizations—being able to use outdoor spaces with lower infectious risks—continued their agricultural activities and secured sources of income for persons with disabilities in the neighborhood.

Tsukuba Agri Challenge, a nonprofit organization established in 2011, is one of the early projects driven by the concept of noufuku-renkei in the area (Tsukuba Agri Challenge 2022). Operating three farm bases within the city, the organization was founded by a Tsukuba City Council member and the current representative director, who realized the need to address limited employment opportunities for persons with disabilities in the community after their graduation from special-needs schools; this was in conjunction with the increase in abandoned farmlands and lack of local farm successors appearing within the community. The farms are registered as the Type B Support Center for Continuous Employment, designed for persons with disabilities who have difficulties being employed by general companies and who have difficulties working under employment contracts even with support (National Institute of Population and Social Security Research 2019). In addition to the earnings from its business, the organization is financially supported by donations, training benefits from the municipality, and private grants.

The organization states that its mission is to "make a lively (gokigen) society with persons with disabilities" and to "create a farm that is operated by disability care professionals and is open to the local community" (Tsukuba Agri Challenge 2022). In doing so, the organization views agricultural activities as key accessible nodes that would provide nature-based learning and recreation and promote locals to encounter persons with disabilities living in the same community. The organization works with people,

particularly with mental illnesses and intellectual disabilities, whom the organization staff refers to as "farm staff" to emphasize equal relationships. As of 2022, the organization operates a diversified agricultural business that includes organic vegetable cultivation, poultry farming, and rice farming on separate farms across the city. The organization also operates communal living assistance facilities, or group homes, where farm staff with disabilities can live together, receiving care support and freshly harvested produce from the fields. The organization operates shuttle cars between Tsukuba Station, farm sites, and group homes for farm staff.

The organization's primary services to residents are organic vegetable delivery services and community garden programs, both of which are supported by farm staff with and without disabilities (Figure 5.8). The farm uses no pesticides or chemical fertilizers for production. It delivers vegetables and eggs to local customers. The organization owns three farm bases, all close to residential areas, across the city. For the community garden program, residents sign up for their plots of 43 square meters of farmland, and on weekends they receive weekly farming workshops from the staff. On weekdays farm staff with and without disabilities take responsibility for maintaining the plots. The community garden hosts harvest festivals and seasonal events for the residents and farm staff to interact via food and agriculture.

Figure 5.8: Community Garden Plots at Gokigen Farm

Source: Authors and Gokigen Farm.

According to the community garden program manager, the number of applications for garden plots has increased after the COVID-19 outbreak due to rising awareness of healthful foods and living conditions.[2] The manager explained that participants include not only people with small children but also workers from various professions who are interested in agriculture. These professionals—volunteers and recreational gardeners—have been engaging in small-scale place-making activities within the farm space. For instance, a participant who is an architect by trade engages as a chicken coop volunteer, a local environmental science researcher has recently proposed starting beekeeping in the garden space for his experiment, and a worker of an international aid agency has been providing lectures to farmers in developing countries using videos taken at Gokigen Farm.

[2] This information is based on an in-person interview with the community garden manager conducted by Akane Bessho on 4 June 2022.

5.4 Discussion: Directions for Retrofitting the Asian Megacity Outskirts

5.4.1 Connecting Dispersed Cities with Greener Modes of Transportation

This chapter first explained the intercity out-migration pattern in a megacity region before and after the COVID-19 pandemic. Before the COVID-19 pandemic, the Great East Japan Earthquake in 2011 raised awareness of Japan's vulnerability to urban congestion. The government responded by making efforts to mitigate urban concentration, including promoting remote working and increasing the accessibility to public transportation in the megacity outskirts. As a result, after the COVID-19 pandemic, some people in Tokyo's 23 wards moved to less densely populated, affordable, yet still accessible outskirt cities for better living amenities. As more people are expected to incorporate "hybrid" work styles, intercity transportation systems must be reinvented for the post–COVID-19 society.

It should be noted that the Greater Tokyo Area is one of the megacity regions with an advanced public transportation system (Figure 5.2). Other Asian megacity regions, including Greater Jakarta in Indonesia, the National Capital Region Delhi in India, and the Dhaka Metropolitan Area in Bangladesh, still face transportation issues at various levels depending on their stages of economic growth and urban development (Jain, Korzhenevych, and Hecht 2018; Ahmed, Nahiduzzaman, and Hasan 2018; Arfanuzzaman and Dahiya 2018). The issue stems from the growing number of intercity commuting trips and the lack of an adequate transportation system, resulting in a longer travel time and distance. Moreover, most commuters select private vehicles (e.g., cars and motorcycles) over public transport (e.g., trains and buses), and the current urban expansion severely increases emissions and environmental impacts. In response to these issues, megacities began promoting the shift from motorization to greener modes of transportation, such as trains, via transportation master plans (JICA 2019). Another essential action for transportation is to implement policies that promote a system for making "shared mobility" accessible for everyone within the community (Ghosh 2020; Machado et al. 2018). As Gokigen Farm operates on-demand shared rides for farm staff from different areas, in a similar vein, efforts to retrofit the communities of the outskirts should ensure the accessibility of workers without private vehicles.

5.4.2 Identifying and Restoring Natural Environments within Megacity Regions

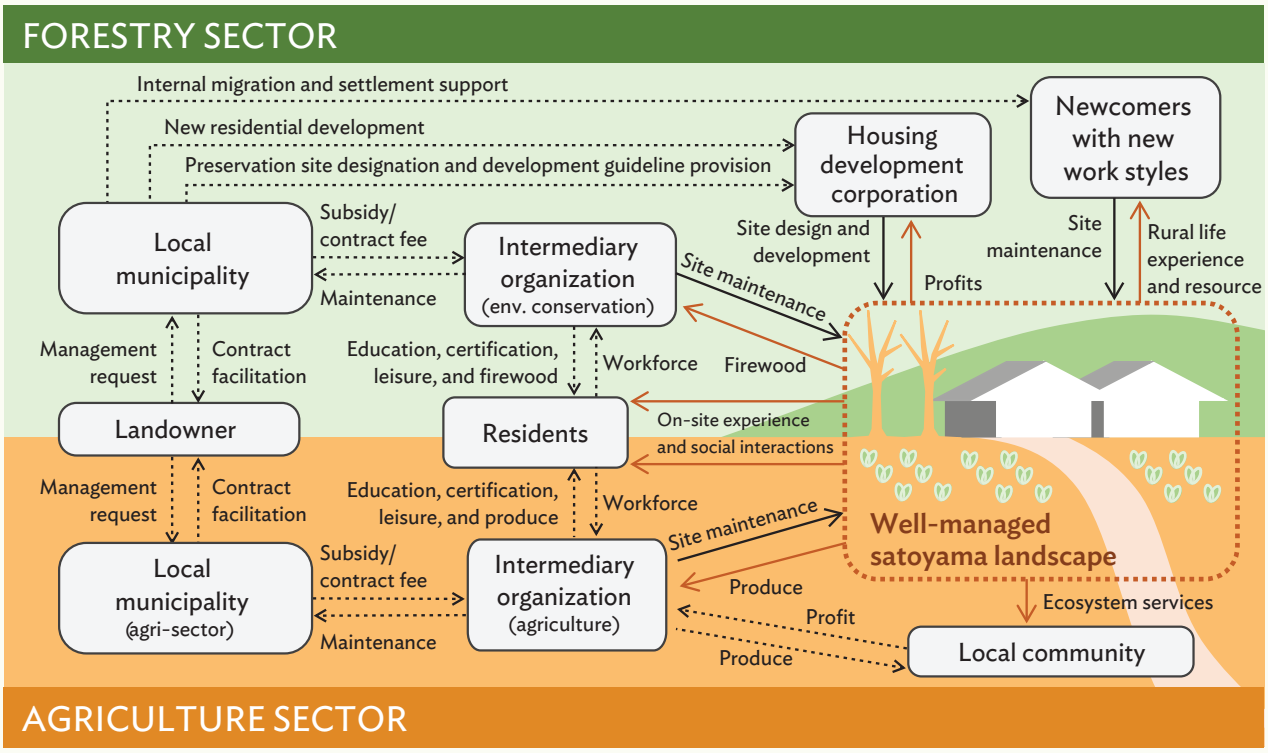
As explained in Section 5.3.1, the municipalities and citizen groups have worked to protect the remaining satoyama landscapes in the outskirt regions of the Greater Tokyo Area. These landscapes, even though situated near residential and commercial areas, serve as important cultural and ecological hubs for residents. In many Asian megacities, the urban development phase varies, as the degree of land use conflicts between rural land use and urban land use. Among megacities undergoing somewhat "uncontrolled growth," including Greater Jakarta in Indonesia and Metro Manila in the Philippines, the loss of green space has been a serious concern for decades (Fatma and Deguchi 2016; Muhamad Nor et al. 2021). Fatma and Deguchi (2016), showing the alarming level of green space loss in Greater Jakarta, called for ways to enhance comprehensive planning and monitoring capabilities considering green spaces. They pointed out that such efforts are still found inadequate in many municipalities undergoing the rapid population inflow and associated urban development. Regarding farmlands, Thailand's Bangkok Metropolitan Region has somewhat succeeded in protecting the rural landscapes as agricultural and conservation zones (Dou, Nagasawa, and Patanakano 2013). The dichotomic discourse of the land use conflict between environmental preservation and economic growth should consider the third way in which well-managed natural environments contribute to the development of less dense and livable residential districts for workers with new work values and styles.

5.4.3 Developing a Management Scheme of Workplace-Making with Nature

By taking Tsukuba City as a case area, this chapter explored existing projects that incorporate satoyama landscapes in creating a residential block and a workplace for diverse residents in the community. The management schemes of the two projects demonstrate the successful use case of commons management, which is a distinct feature of satoyama landscapes, compared with agroforestry in many Asian countries, which uses the same land for both forestry and agriculture. Kumar and Takeuchi (2009) explain that while agroforestry lands are privately owned and managed by agroforestry holdings with the aim to increase productivity by intensive management, a satoyama landscape is characterized by community management of a community-owned, local government–owned, or privately owned land that is often underutilized.

In the case of Hygge Garden, residents were involved in satoyama forest management activities as a group, and the group promoted environmental education and woodstoves. The motivation for ecological conservation was emphasized over economic benefits. While Gokigen Farm presented the basis for environmental (i.e., promotion of local agriculture) and economic benefits (i.e., sustainable job creation for residents and persons with disabilities), its economic benefits catered to the local community as a whole rather than a particular company. Existing commons research positions resource overuse and overconsumption as critical risks when implementing commons management among citizens. In the case of the two projects in Tsukuba, the "tragedy of the commons" was avoided, mainly due to the low economic dependency on natural resources. The Tsukuba Firewood Club members, each with their

Figure 5.9: Satoyama Landscape Management Scheme



Source: Created by the authors.

occupations outside the group, joined the recreational activities. The club was operated by a nonprofit organization that received environmental protection grants and management contract fees. Gokigen Farm, as a registered Type B Support Center for Continuous Employment, received training benefits from the municipality and private entities. Thus, for other cities to encourage people with new work arrangements and implement this commons approach for workplace-making with nature, they must pursue a financially sustainable governance system that involves a range of stakeholders and considers welfare and housing (Figure 5.9). Moreover, the local municipality plays a crucial role in providing internal migration and settlement support for newcomers with new work values and styles.

5.5 Conclusion

This chapter provided an overview of the current discussion on the recent out-migration pattern within a megacity region driven by remote working in Japan and explored technology-supported emerging lifestyles in the Greater Tokyo Area of Japan. By introducing the Harukazedai Hygge Garden project, developed as a satoyama-oriented residential block, and Gokigen Farm, founded to promote employment and interaction among diverse residents in Tsukuba City, the chapter explored management approaches for "workplace-making with nature."

Based on the key findings, the chapter discussed how the outskirts of other Asian megacities could be retrofitted for the post–COVID-19 work style by considering policies that promote (i) connecting dispersed cities with greener modes of transportation, (ii) identifying and restoring natural environments within megacity regions, and (iii) developing management schemes of workplace-making with nature.

Future research should consider the following perspectives. Firstly, studies must address the different post-migration experiences and needs expressed between hybrid workers, remote workers, and workers living in more than one location in the post–COVID-19 era. Secondly, as the chapter focused solely on the internal out-migration phenomena, the rural-to-urban migration pattern and adaptation process should also be explored. Finally, planners of Asian megacities should identify livelihood models practiced in the outskirt regions that are environmentally sustainable and foster a sense of stewardship and trust amongst the locals. By understanding these models' key spatial and managerial characteristics, planners may envision a residential model for new types of workers in the post–COVID-19 era.

References

Ahmed, S., K. M. Nahiduzzaman, and M. M. U. Hasan. 2018. Dhaka, Bangladesh: Unpacking Challenges and Reflecting on Unjust Transitions. *Cities* 77: 142–157.

Ahrendt, D. et al. 2022. Fifth Round of the Living, Working and COVID-19 E-Survey: Living in a New Era of Uncertainty. Eurofound. https://www.eurofound.europa.eu/publications/report/2022/fifth-round-of-the-living-working-and-covid-19-e-survey-living-in-a-new-era-of-uncertainty (accessed 8 August 2022).

Arfanuzzaman, Md. and B. Dahiya. 2019. Sustainable Urbanization in Southeast Asia and Beyond: Challenges of Population Growth, Land Use Change, and Environmental Health. *Growth and Change* 50: 725–744.

Bessho, A. et al. 2022. Differences in the Valuation of Ability and Aptitude in the Employment of Persons with Disabilities amongst Organizations Managing Agricultural Activities from the Perspective of Realizing an Inclusive Society. *Journal of the City Planning Institute of Japan* 57(1): 157–164.

City of Tsukuba. 2016. Tsukuba Green Master Plan. https://www.city.tsukuba.lg.jp/kankobunka/kouen/1001697.html (accessed 8 August 2022).

Council for the Promotion of Collaboration between Agriculture and Welfare. 2021. Vision for the Collaboration between Agriculture and Welfare [in Japanese]. https://www.maff.go.jp/j/nousin/kouryu/attach/pdf/kourei-40.pdf (accessed 8 August 2022).

Dou, R., R. Nagasawa, and B. Patanakano. 2013. Urbanization and Its Influences on the Suburban Landscape Changes in Bangkok Metropolitan Region, Thailand. *Journal of the Japanese Agricultural Systems Society* 29(2): 29–39.

Duraiappah, A. K. et al. 2012. Satoyama-Satoumi Ecosystems and Human Well-Being: Socio-Ecological Production Landscapes of Japan. Tokyo: United Nations Publications.

Fachriansyah, R. 2020. Coronavirus Means Working from Home for Many. But Some Say It's Easier Said than Done. *Jakarta Post*. 11 November. https://www.thejakartapost.com/news/2020/04/08/coronavirus-means-working-from-home-for-many-but-some-say-its-easier-said-than-done.html (accessed 8 August 2022).

Fatma, D. and A. Deguchi. 2016. Planning Implementation for Mitigating Loss of Green Areas in Peripheral Urbanized Areas of Greater Jakarta: Case Study of Tangerang Selatan. *Urban and Regional Planning Review* 3: 85.

Ghosh, G. 2020. Characteristics of Shared Mobility in Bangalore, India. In S. Syngellakis, ed. *Urban Transport XXVI*. Southampton: WIT Press.

Hamada, K. 2018. Current Status, Challenges, and Prospects of Welfare Agriculture: Toward a New Form of Agriculture "Nou-nariwai" through Collaboration between Agriculture and Welfare. *Agriculture and Horticulture* 93(9): 793–798.

Henderson, T. 2022. The Pandemic Prompted People to Move, but Many Didn't Go Far. Stateline. 23 March. https://www.pewtrusts.org/en/research-and-analysis/blogs/stateline/2022/03/23/the-pandemic-prompted-people-to-move-but-many-didnt-go-far (accessed 8 August 2022).

Hiratsuka, M. et al. 2020. Dynamics of Secondary Forest and Its Perspective under the Satoyama System in Saitama Prefecture, Japan. *Journal of Forest Research* 25(1): 51–57.

Imamori, M. 1995. Satoyama: In Harmony with Neighboring Nature. Tokyo: Shincho-Sha [in Japanese].

Ishihara, K. et al. 2005. A Study on Developmental Process in Satoyama Preservation Activities by Civic Groups. *Journal of the Japanese Institute of Landscape Architecture* 68(5): 617–622.

Jain, M., A. Korzhenevych, and R. Hecht. 2018. Determinants of Commuting Patterns in a Rural-Urban Megaregion of India. *Transport Policy* 68: 98–106.

Japan International Cooperation Agency (JICA). 2019. JABODETABEK Urban Transportation Policy Integration Project Phase 2 in the Republic of Indonesia. Coordinating Ministry for Economic Affairs Republic of Indonesia. https://openjicareport.jica.go.jp/pdf/12356366.pdf (accessed 8 August 2022).

Kang, B., J. Won, and E. J. Kim. 2021. COVID-19 Impact on Residential Preferences in the Early-Stage Outbreak in South Korea. *International Journal of Environmental Research and Public Health* 18(21): 11207.

Kumar, B. M. and K. Takeuchi. 2009. Agroforestry in the Western Ghats of Peninsular India and the Satoyama Landscapes of Japan: A Comparison of Two Sustainable Land Use Systems. *Sustainability Science* 4(2): 215–232.

LaBerge, L. et al. 2020. How COVID-19 has Pushed Companies over the Technology Tipping Point—and Transformed Business Forever. McKinsey & Company. https://www.mckinsey.com/business-functions/strategy-and-corporate-finance/our-insights/how-covid-19-has-pushed-companies-over-the-technology-tipping-point-and-transformed-business-forever (accessed 8 August 2022).

Ministry of the Environment, Japan. 2010. National Action Plan for the Conservation and Sustainable Use of Socio-Ecological Production Landscapes (Satochi-satoyama) [in Japanese]. https://www.env.go.jp/press/12944.html (accessed 8 August 2022).

Machado, C. A. S. et al. 2018. An Overview of Shared Mobility. *Sustainability* 10(12): 4342.

Matsushita, K. 2021. Workations and Their Impact on the Local Area in Japan. In M. Ore, O. Dvouletý, and V. Ratten, eds. *The Flexible Workplace: Coworking and Other Modern Workplace Transformations*. Switzerland: Springer Nature.

———. 2022. Reconfiguring Workplaces in Urban and Rural Areas: A Case Study of Shibuya and Shirahama, Japan. In M. Will-Zocholl and C. Roth-Ebner, eds. *Topologies of Digital Work. Dynamics of Virtual Work*. London: Palgrave Macmillan. https://doi.org/10.1007/978-3-030-80327-8_7

Metropolitan Intercity Railway Company. 2022. Sightseeing [in Japanese]. https://www.mir.co.jp/en/ (accessed 8 August 2022).

Ministry of Internal Affairs and Communications, Japan. 2021. Information and Communication in Japan [in Japanese]. https://www.soumu.go.jp/johotsusintokei/whitepaper/ja/r03/pdf/index.html (accessed 8 August 2022).

Mori, T. 2021. The Coronavirus Pandemic and the Increase of Teleworking in Eight Countries: From Telework to Flexplace Systems. Nomura Research Institute Report. Tokyo: Nomura Research Institute. https://www.nri.com/en/knowledge/report/lst/2021/cc/0216_1 (accessed 8 August 2022).

Morimoto, Y. 2011. What is Satoyama? Points for Discussion on Its Future Direction. *Landscape and Ecological Engineering* 7(2): 163–171.

Mouratidis, K. 2021. How COVID-19 Reshaped Quality of Life in Cities: A Synthesis and Implications for Urban Planning. *Land Use Policy* 111: 105772.

Muhamad Nor, A. N. et al. 2021. Evolution of Green Space under Rapid Urban Expansion in Southeast Asian Cities. *Sustainability* 13: 12024.

National Institute of Population and Social Security Research. 2019. Policy for People with Disabilities. In *Population and Social Security in Japan*. Tokyo: National Institute of Population and Social Security Research. http://www.ipss.go.jp/s-info/e/pssj/pssj2019.pdf

Office for National Statistics. 2022. Is Hybrid Working Here to Stay? https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/employmentandemployeetypes/articles/ishybridworkingheretostay/2022-05-23 (accessed 8 August 2022).

Parker, K., J. M. Horowitz, and R. Minkin. 2022. COVID-19 Pandemic Continues to Reshape Work in America. Pew Research Center. https://www.pewresearch.org/social-trends/2022/02/16/covid-19-pandemic-continues-to-reshape-work-in-america/ (accessed 8 August 2022).

Sakuno, H. 2016. The Increase of Migrants into Local Areas and Regional Correspondence: What Does "Return to the Country" Mean for Local Areas? *Annals of the Association of Economic Geographers* 64(4): 324–345.

Sato, A. 2013. Teleworking and Changing Workplaces. *Japan Labor Review* 10(3): 56–69.

Shimpo, N. 2021. Urban Ecological Life in a Metropolitan Area—An Insight from Satoyama Conservation Activities in the Greater Tokyo Area. *Landscape and Ecological Engineering* 1–11.

Spinuzzi, C. 2012. Working Alone Together: Coworking as Emergent Collaborative Activity. *Journal of Business and Technical Communication* 26(4): 399–441.

Statistics Bureau, Ministry of Internal Affairs and Communications. 2015. Results of Population Census 2015 [in Japanese]. https://www.mlit.go.jp/report/press/toshi03_hh_000090.html (accessed 8 August 2022).

Statistics Bureau of Japan. 2022. Annual Report on Internal Migration in Japan Derived from the Basic Resident Registration 2021 [in Japanese]. https://www.stat.go.jp/data/idou/2021np/jissu/youyaku/index.html#a1 (accessed 8 August 2022).

Tsukuba Environmental Forum. 2022. About [in Japanese]. https://tef298.sakura.ne.jp/about/#outline (accessed 8 August 2022).

Takeuchi, K. et al., eds. 2008. Satoyama: The Traditional Rural Landscape of Japan (Second Edition). Berlin/Heidelberg : Springer Science and Business Media.

Terada, T. 2012. Conservation and Utilization of Satoyama Woodlands. *Journal of the Japanese Institute of Landscape Architecture* 76(1): 22–27.

Tokyo Chamber of Commerce and Industry. 2020. Questionnaire on Telework Implementation Status [in Japanese]. https://www.tokyo-cci.or.jp/page.jsp?id=1023286 (accessed 8 August 2022).

Tokyo Metropolitan Government. 2022. Results of Telework Implementation Rate Survey June 2022 [in Japanese] https://www.metro.tokyo.lg.jp/tosei/hodohappyo/press/2022/07/11/06.html (accessed 8 August 2022).

Tsukuba Agri Challenge. 2022. About Gokigen Farm [in Japanese]. https://gokigenfarm.com/aboutus (accessed 8 August 2022).

Tsukuba City. 2022. Landscape Agreement [in Japanese]. https://www.city.tsukuba.lg.jp/jigyosha/machinami/machinami/1002099.html (accessed 8 August 2022).

UR Agency. 2019. Nakane Kontadai Specific Land Readjustment Project [in Japanese]. https://www.ur-net.go.jp/takuchi/archive/lrmhph00000110wa-att/nakanekondadai.pdf (accessed 8 August 2022).

Vivan, S. 2020. This Works Best: Bengalureans Are Moving out of the City to Work Remotely in the Lap of Nature. *Bangalore Mirror*. 13 July. https://bangaloremirror.indiatimes.com/bangalore/others/this-works-best-bengalureans-are-moving-out-of-the-city-to-work-remotely-in-the-lap-of-nature/articleshow/76930528.cms (accessed 8 August 2022).

Yokohari, M. and J. Bolthouse. 2011. Keep It Alive, Don't Freeze It: A Conceptual Perspective on the Conservation of Continuously Evolving Satoyama Landscapes. *Landscape and Ecological Engineering* 7(2): 207–216.

CHAPTER 6

Geospatial Futures for Social Impact: Big Data and Location Intelligence for Urban Resilience

Shreyas Bharule and Satoshi Miyazawa

6.1 Introduction

Understanding the critical relationship between how cities are laid out and how people move around them enables policy makers and city managers to develop effective urban response policies and rationally plan their resource allocation (Aljoufie et al. 2011; Baud et al. 2014; Kamrowska-Załuska 2021; Koumetio Tekouabou et al. 2021). Human mobility data combined with artificial intelligence technology could help decision makers more efficiently address problems in urban development (Diran et al. 2021). With the development of information and communication technology and the increasing popularity of mobile phones globally, the related data is widely used in human mobility studies because it offers comprehensive coverage and high accuracy.

The coronavirus disease (COVID-19) pandemic has unveiled several caveats in data deficiency across the world. During the same time period, the world has seen a spike in data-related and data-dependent systems powered by transformative data analysis techniques and methods (Alsunaidi et al. 2021; Farooq et al. 2021; Wu et al. 2020). Recently, with increasing global smartphone penetration, more information on human mobility has become available through smartphone GPS data (Alsunaidi et al. 2021; Kanamori et al. 2022; Kose et al. 2021). Geospatial data-driven innovations are expected to become commonplace in the future. As the world is emerging from the unexpected shocks of the pandemic, we see that the year 2021 will remain a cornerstone for data-driven decision making. In other words, geospatial data-based decision making is here to stay, and in the past few years, it has earned its citizenship.

Evidence-based informed decision making is at an all-time high among governments and industries. As our spatial forms of cities become increasingly complex, location data becomes crucial to making a plan for future societies (Baud et al. 2021; Nakanishi et al. 2021). Given the pandemic experience, it may be safe to assume that the dependency on geospatial data will increase for purposes such as evidence collection, mapping, estimation, evaluation, planning, construction, development, implementation, and decision making. However, some technological advancements are susceptible to being outdated, and incompatibilities often arise as drawbacks and snags over time (Diran et al. 2021; Li, Chen, and Shang 2022). Nevertheless, we observe indications that technical and interdisciplinary integration would be a way forward.

Given this background, this chapter discusses big data and location intelligence with a case study of travel patterns during COVID-19 in Japan. We draw policy implications from the case study to discover future avenues for involving location intelligence as a tool in evidence-based policy making for urban resilience.

6.2 Big Data, Its Evolution, and Challenges in Big Data Collection

Big data is extensive, complex data sets that originate from a growing number of data sources. These data sets are so massive that traditional data processing software such as Microsoft Excel and IBM SPSS cannot handle them. Although processing them is a challenge, these enormous volumes of data can be used to address issues through business solutions that have not been resolved before.

At the outset, big data was organized around its three *Vs*, large *volumes* of data that contain a diverse *variety* which, with time, is generated and collected at increasing *velocity*. Recently, six other *V*s and one *C* have been added to define big data (Bharule, Zhang, and Shibasaki 2022; Li, Chen, and Shang 2022):

- truthfulness and meaningfulness of data as veracity,
- infrequency as validity,
- extracting value from the collected data,
- replicability in the form of visualizations,
- processability in a virtual cloud platform,
- data variability, and
- complexity, purely in computation form.

Although the concept of big data is still emerging, the origins of large data sets go back to the 1970s. This was when the world of organized data in the first data centers emerged. The development of the relational database further consolidated the concept. Finally, around 2005, researchers started investigating just how much data users generated through social networking services, video streaming services, and other online platforms and services.

In parallel to these developments, the data organization and storage systems were also evolving. For example, Hadoop, an open-source framework explicitly created to store and analyze large data sets, was developed around the same time (Apache Hadoop 2022). Development of open-source frameworks such as Hadoop and Spark was essential for the growth of big data because these frameworks make data storage cheaper and enhance the ease of engaging with big data sets.

The volume of big data is at an all-time high, and so is the dependency on it for decision making. Users of the devices, platforms, web, and internet-connected systems in general are still generating significant amounts of data valuable to approach challenges with renewed and data-informed approaches. However, entities other than people are engaging with these systems.

With the advent of smartphones and several types of sensors that communicate in the form of the Internet of Things, all connected to the cloud and the internet, researchers in the artificial intelligence and machine learning domain have observed a primary goal of gathering data on various parameters and indicating performance or other insights. Artificial intelligence and machine learning has churned out diversity and cross-operability over and across various forms, formats, and platforms.

With improvement in data resolution, more complex challenges emerge. As data sets become massive, both in types and in real-time frequency, the probability of recording inadequate quality or unorganized data in significant volumes increases. These flaws add to the difficulty in drawing meaningful insights from collected data. The data type, volume, and frequency are all linked together and make data science intricate. The complexity of collecting real-time data or maintaining the freshness of the data is an

emerging challenge. A parallel challenge is developing analytics systems to scale and enrich collected data. Moreover, pattern recognition algorithms need to be revived to draw meaningful insights.

In the times of COVID-19, technologies such as pattern recognition have evolved and assisted in action plans to contain the disease's spread. In addition, technologies such as cloud computing have revealed the elastic scalability of artificial intelligence and machine learning systems via big data and improved their applications through advanced computing and interoperability. Such scalability is vital in analyzing and supporting demands in various services. In this chapter, we focus on the scalability of big data to solve challenges that hinder future development, particularly the use of geospatial data such as people flow data in advising decision making.

People flow data includes information about the number of people entering and exiting a space, the direction and speed of their movement, and any patterns or trends that can be observed over time. People flow data can be used to optimize the design and management of physical spaces, improve crowd management and security, and enhance the overall experience of people moving through a given area. The data can be collected through various methods, including manual counting, video surveillance, or through the use of sensors and other automated technologies.

6.3 Location Intelligence

Through the internet, billions of devices are connected to the sensor networks and other Internet of Things networks. As a result, businesses and decision makers have access to unprecedented amounts of business data and numerous geospatial data sets. Location intelligence comes from visualizing and analyzing volumes of data generated from location technology and is employed to empower holistic planning, prediction, and problem-solving. Seeing all relevant data within the location context—on an interactive map, smartphone application, or dashboard—provides distinctive insights.

The data illustrated in this chapter, "LocationMind xPop" data, refers to people flow data collected by individual location data sent from mobile phones. The data is collected with users' consent through applications provided by NTT Docomo, Inc.[1] The data is processed collectively and statistically in order to conceal private information. Original location data is GPS data (latitude, longitude) sent in a minimum period of about 5 minutes and does not include the information to identify an individual (LocationMind Inc. 2021, 2022). As a part of the Digital Transformation initiative of the Japanese Government, several organizations rely on geographic information system (GIS) technologies to create location intelligence and location intelligent systems.

6.4 Case of Golden Week in Japan

The COVID-19 pandemic has disturbed international travel and affected domestic tourism worldwide. There are three long vacation periods in Japan: the Japanese New Year in January, Golden Week in May, and Obon in August. Of these, Golden Week is arguably the most awaited vacation period in Japan. It is perhaps the only time when most Japanese families are all on vacation at the same time. As a result, discounted rail travel campaigns, cheaper lodging, and vacation packages that take tourists to remote areas are often sold out. In addition, the vacation period makes for a shock to the transportation

[1] "LocationMind xPop" Data refers to people flows data collected by individual location data sent from mobile phone under users' consent, through Applications provided by NTT DOCOMO, INC. Those data is processed collectively and statistically in order to conceal the private information. Original location data is GPS data (latitude, longitude) sent in about a minimum period of 5 minutes and does not include the information to specify individual.

infrastructure as the travel patterns change. Despite these difficulties, such movement of passengers translates into much economic activity for the visited areas.

In 2019, including the weekends and other holidays, the Golden Week vacation period reached a record of 10 consecutive days. However, in 2020, the Golden Week vacation lasted for only 5 days. At that time, due to the COVID-19 situation, to contain the spread of the disease, the government agencies strongly discouraged travel between prefectures, and several prefectures were in a state of emergency as the number of infections was increasing. Fearing infection, many people canceled their travel plans. Similarly, amid the pandemic, the Golden Week of 2021 required a nationwide refrain from travel between prefectures. The following section asks, "What impact did this situation have on the number of travelers in Japan?"

6.4.1 Countrywide Observation: Travel Patterns during Golden Week 2019, 2020, and 2021

Since the 2019 and 2020 Golden Week periods were different, we focused on the average number of people traveling daily. We used statistical data loaded in LocationMind xPop to see how each prefecture was affected in Japan (LocationMind Inc. 2021).

First, compared to Golden Week 2020, which was right after the government declared the first state of emergency, Golden Week 2021 saw an average increase of 65% in the number of travelers per day nationwide. In addition, there was a significant increase in visitors to Okinawa Prefecture (+806.2%) in the south and Hokkaido (+436.0%) in the north, which had seen a substantial decrease in visitors in a similar analysis in 2019.

Comparing 2021 with 2019, the year before the spread of the infection, reveals interesting results. As all of Japan was still strongly affected by the virus and new infections emerged daily in 2021, Golden Week saw an average decrease of 42% in the number of travelers per day nationwide compared to 2019. All prefectures saw a decline of at least 30%. Among all 47 prefectures, Ibaraki Prefecture neighboring Tokyo was the least affected and saw a 29.9% decline in travelers. In contrast, in the northeastern part of the country, Akita Prefecture was the most affected and observed a 64.4% decline, closely followed by Yamagata Prefecture with a 64% decline in travelers.

The comparison indicates that even a year after the initial declaration of the state of emergency, the call for refraining from travel was still effective in persuading people to stay at home to lower the number of infections. Another major observation was a comparatively modestly declining number of visitors in all prefectures close to major metropolitan areas. The prefectures neighboring Tokyo that were least affected were Ibaraki (decline of 29.9%), Saitama (decline of 30.7%), and Gunma (decline of 33.4%); Gifu, neighboring Nagano, saw a decline of 36.2%. This shows that while tourists visited prefectures neighboring and relatively close to metropolitan areas, the tourist population declined more with an increased distance from metropolitan areas.

Although Golden Week 2021 saw a marked increase in the number of visitors compared to the previous year, that increase is minimal compared to the number of visitors in 2019 before the spread of the infection. The number of daily visitors during Golden Week 2021 was around 42% lower than during Golden Week 2019. None of the prefectures has returned to the pre-pandemic levels of tourist activity. Even in prefectures such as Okinawa and Hokkaido, which are distant from metropolitan areas and had been popular vacation destinations, the impact of the significant decrease in tourists due to the pandemic remained strong.

6.4.2 Countrywide Observation: Travel Patterns during Golden Week 2020, 2021, and 2022

By declaring a state of emergency, the Government of Japan strongly discouraged people from traveling beyond the boundary of their prefectures. While Golden Week 2020 and 2021 required voluntary refrain from travel, 2022 was a year without any emergency declarations or restrictions in any region.[2] Because the duration of days in Golden Week varies from year to year, in 2021, it was 5 days, while in 2022, including the weekends, it was 10 days.

Considering this difference in the length of the vacation period, a general expectation was that the number of people moving during Golden Week in 2022 would be higher. Therefore, rather than evaluating the total number of people moving during the Golden Week period, the analysis focused on the average number of people moving daily during that period (LocationMind Inc. 2022).

When compared to 2021, Golden Week 2022 saw a 19% increase on average in the number of visitors per day nationwide. The remote islands of Okinawa saw a decrease of 9% from the previous year, while the same analysis highlighted in the previous section had shown a significant 806% increase.[3] Hokkaido marked a 436% increase in 2021 and an additional 17% increase in 2022. The prefectures of the Tohoku region along the western coast of Japan and the Shikoku region along the southern coast showed a significant increase. On the other hand, six prefectures where the number of visitors decreased compared to 2021 were Okinawa, Kagoshima, Miyazaki, Oita, Shimane in southern Japan, and Yamanashi to the southwest of Tokyo, each showing a slight decrease of 9% or less.

The analysis also determines whether there was an upward trend in the number of visitors between 2020 and 2022. In 2020, as a result of COVID-19, a state of emergency was declared as a non-pharmacological intervention for all prefectures. Compared with the 2020 figures, the number of visitors per day for Golden Week 2022 increased by an average of 97% nationwide. Prefectures that saw the most significant increases were Okinawa (727%), Hokkaido (527%), and Nagano (259%). Compared to 2020, there were no prefectures where the number had decreased. Even Ibaraki, which had the lowest rate of increase, had a 66% increase in the number of visitors. The analysis indicated an increase of over 100% in overall movement between prefectures. The increase in the overall movement was observed for 32 prefectures.[4]

Observing the trends in 2020 and 2021, the number of Golden Week travelers increased in 2022, with the flow of people recovering sufficiently. Is it safe to say that in 2022, the flow of travelers had recovered to pre-COVID-19 levels?

Compared to 2019, nationwide, there is a difference of 31% on average in the inter-prefecture travel during Golden Week 2022.[5] There were no travel restrictions in 2022 after the state of emergency was lifted. Even so, inter-prefecture travel did not recover as much as before the spread of COVID-19. Compared to the Tokyo metropolitan area (−23%) and the Kinki region (−31.3%), regions collectively formed by several prefectures such as the Tohoku region, Chugoku region, and Shikoku region show more significant decreases of 46%, 43%, and 45%, respectively.

---

[2] In 2021, a state of semi-emergency was applied to Miyagi, Saitama, Chiba, Kanagawa, Aichi, Ehime, and Okinawa, and a state of emergency was applied to Tokyo, Kyoto, Osaka, and Hyogo (Government of Japan n.d.).

[3] For a visual representation, see Golden Week Movements 2019–2022, Japan: https://doi.org/10.6084/m9.figshare.22004075.v2.

[4] For a visual representation, see Golden Week Movements 2019–2022, Japan: https://doi.org/10.6084/m9.figshare.22004075.v2.

[5] For a visual representation, see Golden Week Movements 2019–2022, Japan: https://doi.org/10.6084/m9.figshare.22004075.v2.

In summary, although several prefectures did not observe recovery, there was a significant recovery trend in Golden Week 2022 compared to the earlier 2 years. Furthermore, considering the trend since 2020, inter-prefecture travel is on the rise. However, the number of visitors did not recover to the level of 2019 before the spread of COVID-19. Therefore, even though people were free to travel, the impact of the pandemic was still evident in 2022 because people voluntarily refrained from traveling.

6.5 Discussion and Implications

The chapter has discussed the case of the Golden Week vacation period in Japan. We analyzed smartphone GPS data to illustrate changes in inter-prefectural movement due to COVID-19 between 2019 and 2022. The results indicate a significant decrease in the inter-prefectural movement during the state of emergency in 2020. Following this, in 2021, there was a significant increase in travel as the state of emergency was suspended. Given that there were no travel restrictions and people resumed routine activities with precautions, Golden Week 2022 was expected to see a return to high volumes of inter-prefecture travel as in pre-COVID-19 times. However, the analysis indicates that compared to 2019, fewer trips were taken in 2022.

In regions such as Tohoku, Chugoku, and Shikoku, where the number of visitors declined, cutdowns made in the frequency of railway services, soaring fuel prices, and a decline in family-run businesses located in the shopping arcades may be some of the factors affecting people's movements. Even so, the critical observation from the analysis is a year-over-year increase in inter-prefecture travel.

Along with precautions and public safety guidelines, the government published information on the changing trends in people flow online (Government of Japan n.d.) https://corona.go.jp/dashboard/. That practice was later discontinued and replaced with a dashboard of nationwide trends. As international travel was suspended and the government urged citizens to refrain from domestic travel for vacations, a more significant component of the Japanese service industry economy, the tourism industry, was badly hit. As a result, the prefectures heavily dependent on tourism were the worst hit due to the change in travel patterns.

The analysis not only shows the nationwide trend but also outlines the inter-prefecture people movement highlighting the pattern changes in each prefecture in a year-over-year comparison. Therefore, it reveals prefectures that remained active and inactive during and after the state of emergency. To counter this challenge, we recommend that the municipalities, in this case tourist destinations, need to adopt data-driven geospatial tools and inculcate evidence-based decision making and policy formulation.

Geospatial information has multisectoral implications and usage. Therefore, there is a need for a systematic framework to formulate tools like a people flow dashboard. People flow trends can help decision makers prepare for forecasted demand for post–COVID-19 recovery and can also help efficiently address the problems faced in urban development. Geospatial tools can provide temporal trends in data to allow city managers to analyze the impact of urban development and help create cleaner, more livable, and more sustainable smart cities through informed policy making.

Many organizations are planning to create advanced geospatial artificial intelligence that can link, interact with, and integrate into other types of artificial intelligence, algorithms, data storage systems, and databases. Despite the variations in their innovative ideas, they share a common goal of highlighting the importance of using evidence-based information for decision making, which will become increasingly essential not only for institutions but also for other entities such as local governments and municipalities.

Since the advent of COVID-19, countries' and governments' decision making has been based on compelling evidence. One such piece of evidence has been the understanding of "hourly people flow" more than the understanding of origin-destination flows over large distances. Today, with the increasing complexity of the living environment, demand is growing for accurate reporting on navigation, traffic, and weather. This increasing demand for accurate, real-time, and trustworthy geospatial data in future societies is bound to grow with technological evolution, systematic adoption, and integration in the decision making frameworks to maximize the social value and improve the quality of life globally.

References

Aljoufie, M. et al. 2011. *Urban Growth and Transport: Understanding the Spatial Temporal Relationship*. 116(14): 315–328. https://doi.org/10.2495/UT110271

Alsunaidi, S. J. et al. 2021. Applications of Big Data Analytics to Control COVID-19 Pandemic. *Sensors* 21(7): 2282. https://doi.org/10.3390/s21072282

Apache Hadoop. 2022. *Apache Hadoop Homepage*. https://Hadoop.Apache.Org/

Baud, I. et al. 2014. Digital and Spatial Knowledge Management in Urban Governance: Emerging Issues in India, Brazil, South Africa, and Peru. *Habitat International* 44: 501–509. https://doi.org/10.1016/j.habitatint.2014.09.009

Baud, I. et al. 2021. The Urban Governance Configuration: A Conceptual Framework for Understanding Complexity and Enhancing Transitions to Greater Sustainability in Cities. *Geography Compass* 15(5). https://doi.org/10.1111/gec3.12562

Bharule, S., H. Zhang, and R. Shibasaki. 2022. Introduction. In H. Zhang, X. Song, and R. Shibasaki, eds. *Big Data and Mobility as a Service*. Elsevier. https://doi.org/10.1016/B978-0-323-90169-7.00001-4

Diran, D. et al. 2021. *Artificial Intelligence in Smart Cities and Urban Mobility*. European Parliament. https://www.europarl.europa.eu/RegData/etudes/BRIE/2021/662937/IPOL_BRI(2021)662937_EN.pdf

Farooq, R. et al. 2021. Bibliometric Analysis of Coronavirus Disease (COVID-19) Literature Published in Web of Science 2019–2020. *Journal of Family and Community Medicine* 28(1): 1. https://doi.org/10.4103/jfcm.JFCM_332_20

Government of Japan. n.d. Website of the Office for COVID-19 and Other Emerging Infectious Disease Control. https://corona.go.jp/en/

Kamrowska-Załuska, D. 2021. Impact of AI-Based Tools and Urban Big Data Analytics on the Design and Planning of Cities. *Land* 10(11): 1209. https://doi.org/10.3390/land10111209

Kanamori, R. et al. 2022. Changes in Social Environment Due to the State of Emergency and Go To Campaign during the COVID-19 Pandemic in Japan: An Ecological Study. *PLOS ONE* 17(4): e0267395. https://doi.org/10.1371/journal.pone.0267395

Kose, U. et al. 2021. *Data Science for COVID-19*. Elsevier. https://doi.org/10.1016/C2020-0-01677-4

Koumetio Tekouabou, S. C. et al. 2021. Reviewing the Application of Machine Learning Methods to Model Urban Form Indicators in Planning Decision Support Systems: Potential, Issues and Challenges. *Journal of King Saud University: Computer and Information Sciences* 34(8, B): 5943–5967. https://doi.org/10.1016/j.jksuci.2021.08.007

Li, C., Y. Chen, and Y. Shang. 2022. A Review of Industrial Big Data for Decision Making in Intelligent Manufacturing. *Engineering Science and Technology, an International Journal* 29: 101021. https://doi.org/10.1016/j.jestch.2021.06.001

LocationMind Inc. 2021. We Use the LocationMind xPop© Dashboard to Visualize COVID-19 Impact on Travel in Japan. Tokyo: LocationMind Inc. https://locationmind.com/news/657-e/

____. 2022. Analysis Report: Golden Week 2022 People Flow is Recovering, but Still Short of Pre-COVID-19 Levels. Tokyo: LocationMind Inc. https://locationmind.com/news/2022gwanalysisreport-e/

Nakanishi, M. et al. 2021. On-Site Dining in Tokyo during the COVID-19 Pandemic: Time Series Analysis Using Mobile Phone Location Data. *JMIR MHealth and UHealth* 9(5): e27342. https://doi.org/10.2196/27342

Wu, J. et al. 2020. Application of Big Data Technology for COVID-19 Prevention and Control in China: Lessons and Recommendations. *Journal of Medical Internet Research* 22(10): e21980. https://doi.org/10.2196/21980

PART III

Strategies and Impacts on the Urban Economy

PART III SUMMARY

Sakshi Pandey

The world has been immensely impacted by the coronavirus disease (COVID-19) pandemic. Various aspects of society such as health care, socioeconomic factors, governance, and public life have experienced massive pressure from the pandemic. These impacts were quite often mediated not only through government response strategies to alleviate the spread of the virus but also through a wide range of public behaviors in adhering to government measures. Part III of this book, Strategies and Impacts on the Urban Economy, focuses on the economic impact of the COVID-19 pandemic on urban areas and strategies to be adopted to deal with similar volatile situations in the future.

Most countries implemented containment measures such as lockdowns, quarantines, and social distancing to contain the spread of the virus. During the lockdowns imposed due to the first wave of the COVID-19 pandemic, there were several media reports of citizens flouting the lockdown rules. Investigation revealed that people broke the rules mostly so that they could spend time outdoors in natural environments. This exemplifies the role of the natural environment as a panacea for the mental stress created by pandemics. River ecosystems are perhaps the greatest natural feature of any city. Efficient management of urban rivers, therefore, is strongly correlated with crisis management during pandemics like COVID-19.

Chapter 7 by Shinde et al. ponders the multiple challenges faced by urban rivers such as river pollution, drying up of river stretches, encroachment of rivers into floodplains, and biodiversity losses. These challenges come from various urban development activities, due to which cities have inadvertently short-changed the rivers. Managing an urban river, especially a degraded one, requires several transformational solutions that may have to be implemented over long and sustained periods in order to reap optimal benefits.

This chapter recommends the city master plan as an effective instrument to address typical river-related challenges in Indian cities. The authors describe a set of tools and avenues within master plans that can be used to tackle these challenges. It also showcases the example of the Urban River Management Plan for Kanpur, where these tools and avenues have been used to inform the master plan of the city.

Chapter 8 by Sharma and Rai aims to understand the impact of COVID-19 on micro, small, and medium-sized businesses (MSMEs) in India and find ways to enhance resilience and promote their sustained growth using a primary survey of 225 small firms in Dehradun and the National Capital Region. Restrictions on mobility and the closure of the majority of the business activities caused several disruptions in supply chains, as well as the closure of workplaces, a decrease in labor supply, and an increase in unemployment.

The chapter concludes that around 90% of the firms under study experienced a decline in their turnover, mainly due to restrictions on economic activities, a decrease in demand, a shortage of workers, and disruption of supply chains. Furthermore, the reduction in employment was around 25%, mainly in the informal work segment. Approximately 87% of firms believed that the revision in the MSME definition was beneficial. The support measures by the government were found to be insufficient and have limited relevance to the MSME sector in its revival. However, most firms suggested that support measures should continue for a long time. Further, financial assistance to small businesses may help them survive, but for revival and sustained growth, the government should focus on enhancing demand. The study suggests that there is a need to encourage and train small firms to plan for business uncertainties in advance for the resilient and sustained growth of the MSME sector.

Chapter 9 by Trang examines the tactics used by Vietnamese households in urban areas to deal with the pandemic's impact. Social distancing measures or restricted mobility significantly impacted the Vietnamese economy. For instance, unemployment increased significantly, as did the share of the population temporarily barred from the labor force, and businesses closed.

The study uses secondary data analysis from the Viet Nam COVID-19 High-Frequency Phone Survey of Households to examine the income-generating and expenditure-cutting strategies employed by households during the most recent pandemic waves. According to the findings, cutting down on food and nonfood consumption was the most common coping strategy among families. However, urban households were less likely to reduce their food and nonfood consumption. It has been demonstrated that having a broad family network provides stability in the pandemic. Generally, many households choose to rely on financial assistance from family and friends as the second most reported coping strategy. However, the study finds out that urban and poor households are not associated with a higher probability of seeking support from friends and family, borrowing from friends and family, taking a loan from a financial institution, decreasing food and nonfood consumption, relying on savings, or putting more effort into their current jobs. Saving and migrating is essential since it enables households to moderate their shocks. The chapter points out that no significant difference is observed between urban and rural households in employing these strategies. Besides, urban households put more effort into their current jobs to sustain themselves through COVID-19 as a coping strategy. Understanding how the COVID-19 pandemic will affect household spending and saving decisions is critical for economic recovery once the calamity is over.

To summarize, it is evident that restriction measures to contain COVID-19 infections resulted in unprecedented disruption to people's daily lives, economic activities, and well-being. The World Bank, in its 2020 development report, stated that the pandemic's economic impacts were especially severe in emerging economies, where income losses revealed and exacerbated some preexisting economic fragilities. Similarly, income losses caused by the pandemic were greater for smaller businesses, informal enterprises, and businesses with limited access to formal credit. Therefore, it becomes crucial to monitor the current situation to develop appropriate policy strategies so that the pandemic response can be optimized in the future.

CHAPTER 7

Healthy Urban Rivers as a Panacea for Pandemic-Related Stress: How to Manage Urban Rivers

Victor R. Shinde, G. Asok Kumar, Dheeraj Joshi, and Nikita Madan

7.1 Introduction

In 2019–2020, the coronavirus disease (COVID-19) pandemic brought the world to a standstill. The rate at which the pandemic spread prompted many governments across the world to impose stringent lockdowns, including curfew-like situations (e.g., India). Given the uncertainty of the damage that the pandemic would cause, and that there was no immediate cure at hand, the initial response of citizens was to religiously follow the lockdown rules. However, over time, when there seemed to be no clear way forward, there were several media reports of citizens flouting the lockdown rules. In the United States, upon closer investigation, it was found that people ignored the rules mostly to spend time outdoors in natural environments, such as hiking in forests or strolling beside a river. Bustamante et al. (2022) highlighted that among urban residents, depression and anxiety were inversely associated with the number of neighborhood parks. Their analysis in the United States revealed that diverse engagement in green spaces boosted physical, mental, and social well-being. In the United Kingdom, Cui et al. (2022) reported that public parks and gardens were most frequently visited during the lockdown period. Researchers found a similar situation in India as well. Bherwani et al. (2021) suggested that access to urban open and green spaces with suitable precautionary measures such as social distancing and personal hygiene would have improved individuals' resilience during the pandemic.

Literature abounds with examples of the natural environment's role as a panacea for the mental stress created by pandemics such as COVID-19. The rate of disease outbreaks (including pandemics) is likely to increase because of climate change (Stewart-Ibara 2022; Alcayna et al. 2022; Pley et al. 2021; Sadeghieh et al. 2021, among others). Because river ecosystems are perhaps the greatest natural feature of any city, the efficient management of urban rivers is strongly correlated to crisis management during pandemics and outbreaks of diseases like COVID-19. However, the state of urban rivers in many countries, especially in the developing world, is declining because of development pressures. Reversing this trend through long-term management approaches is vital to ensure that urban rivers continue to offer an avenue for the alleviation of pandemic-induced stress.

Historically, rivers have been widely considered the cradle of civilization. They have been at the center of human settlements, mostly because they provide water for drinking, agriculture, navigation, and other basic requirements. Almost all the great civilizations developed and flourished along rivers. These include the Mesopotamian civilization along the Tigris and Euphrates rivers, the Egyptian civilization along the Nile River, the ancient Chinese civilization along the Yangtze River, and the Indus Valley civilization along the Indus River. It made good sense for these civilizations to settle along the banks of rivers. After all, at that time, agriculture was the primary form of activity for sustenance, for which water from rivers was vital. Gradually, the river became the heart of all domestic, economic, social, cultural, and religious activities in these civilizations. The situation changed with improvements in technology, and it became possible to transport water to locations far from the rivers through structures like canals and aqueducts, something that the Roman civilization demonstrated impressively. Somewhere down the line, the options of livelihoods also changed. With the advent of the Iron Age and the Bronze Age, river-based livelihoods began to take a back seat. All these factors somehow led to the estrangement of rivers and cities, which is evident in so many places even today.

Cities and rivers are interdependent in various ways. In addition to several social and religious advantages, rivers provide cities with a wide range of ecosystem services that in turn provide a means of sustenance for many people. Some of these ecosystem services include assured water supply for residential, commercial, and agricultural uses; riverine resources such as fish; flood mitigation; and carbon sequestration (Li et al. 2022; Basak et al. 2021; Kaiser et al. 2020; etc.). However, it is equally important for cities to follow good practices for rivers to maintain their natural profile and character and to be able to continue to provide ecosystem services. While rivers have upheld their role in this relationship, cities have not always been able to keep up with their responsibilities. This can lead to the indiscriminate exploitation of rivers without regard for their carrying capacity.

Rivers, today, are facing multiple challenges, such as river pollution, drying up of river stretches, encroachment of rivers into floodplains, and biodiversity losses. These challenges come from various urban development activities, due to which cities have inadvertently short-changed the rivers (e.g., Yin, Islam, and Ju 2021). For instance, a small stretch of 22 kilometers of the Yamuna River in Delhi contributes to 70% of the total pollution in the river (Patel, Mondal, and Ghosh 2020). Similarly, the last 120-kilometer-long stretch of the Sabarmati River, before its confluence with the Arabian Sea, consists of only liquid waste and sewage from the industries in Ahmedabad and other nearby towns.

The health of a city depends on the health of its rivers. It is, therefore, imperative that cities must incorporate the rivers in their development plans, ensuring that their natural properties and functions are not disturbed. This will benefit the rivers in the long term and help in extracting their optimal social, economic, and environmental benefits.

7.2 Challenges for River Management in Indian Cities

7.2.1 Urban Flooding because of the Restriction of Natural and Storm Water Channels

The restriction of river channels and natural drains is mostly due to encroachment caused by extensive development within the floodplains. This is a classic problem found in many Indian cities. What happens when development encroaches on a water channel? A river needs space to spread laterally as it flows for it to perform its natural functions. There are several functions, but the most relevant one in the context of this chapter is the regulation of fluvial flooding. When cities attempt to encroach on this lateral space, also called floodplains, the river's ability to regulate flooding is severely compromised. This usually results in a loss of both life and property. Furthermore, channelization and excessive concretization in the river zone confine the river, which disturbs the entire geomorphology and ecology of the river.

7.2.2 Pollution

Pollution is perhaps the most severe concern for Indian rivers. Pollution from various sources, be it domestic sewage, industrial effluents, agricultural runoff, or solid waste dumping, is taking a toll on the rivers (Patel, Mondal, and Ghosh 2020). Floral offerings and waste generated by religious activities add to the problem. In many cases, large stretches of rivers have turned into flowing sewers. As cities heavily depend on these rivers, river pollution poses serious health issues. More importantly, it is not just rivers but the entire riparian ecosystem that is heavily affected.

7.2.3 Over-Abstraction of Water

As cities grow, they need more water to meet the various demands. The problem is that in the quest to satisfy these demands, cities often bite the hand that feeds them. In other words, they indiscriminately exploit rivers and underground aquifers to the point where these resources become critically endangered. In some cases, cities cause irreversible damages that lead to undesirable changes in the hydromorphology and the natural hydrological regimes of the water channels.

7.2.4 Degrading Lakes, Ponds, and Wetlands

Water bodies such as lakes, ponds, and wetlands not only offer social and environmental benefits but also help in maintaining groundwater levels. They are an important source for groundwater recharge, supplementing groundwater levels and, thus, reducing the stress on rivers. However, pollution and encroachment has led to their dilapidation in many cities (e.g., Neelavannan et al. 2022; Kumar et al. 2018). Increasing urbanization has negatively impacted these already vulnerable ecosystems. It has caused a decline in the number of catchment basins, depletion in the water quality, and loss of natural flora and fauna.

7.2.5 Depleting Green Cover

Green cover is critical vis-à-vis the management of rivers. It helps in preventing the erosion of riverbanks as well as augmenting groundwater levels. Moreover, it serves as a thriving habitat for biodiversity. Unfortunately, with increasing urbanization, the areas dedicated to "green spaces" in cities has significantly reduced. These areas have been replaced with impermeable built environments known as "grey infrastructure." This green-grey debate in cities has led to increased frequency of flooding and raised temperature in urban areas. (e.g., Dinda, Chatterjee, and Ghosh 2021).

7.2.6 Weak Citizen-River Connection

In the early days, rivers were the epicenter of society with regard to religion, culture, recreation, and livelihoods. The connection between citizens and rivers is crucial to provide an identity for the rivers, assigning them a societal value. It infuses a sense of ownership of the rivers in the citizens, with several long-term benefits. This citizen-river connection is still strong in some cities; however, large cities seem to have lost this connection.

7.2.7 Piecemeal Governance

Various government agencies, such as those responsible for pollution control, irrigation and flood control, groundwater, forestry, horticulture, public works, and tourism, must coordinate and work in tandem for the holistic management of rivers. Similarly, nongovernment organizations, religious bodies, citizen groups, and other non-state actors must also contribute to the effort. Regrettably, coordination and communication is severely lacking among these stakeholders, who display a "silo" mentality.

7.2.8 Vulnerability to Climate Change

Climate change has undoubtedly affected water bodies and water channels. Increasing temperatures, varying levels of precipitation, and extreme weather events have increased the risk of floods, droughts, and cyclones. This change has led to the drying up of several streams and a surge in waterborne diseases. Therefore, climate resilience must play a critical role in urban river planning.

7.3 Significance of Master Plans for Urban Rivers in India

A master plan is a dynamic long-term planning document that provides a conceptual layout to guide the future growth and development of a city. It can play an important role in determining the shape of the urban environment.

Restoration of riverine ecosystems in cities is a complex endeavor involving multiple sectors, stakeholders, and disciplines. Often, cities display a reactive attitude toward the restoration of ecosystems, which means cities act after the problem has already occurred. However, in the urban context, a proactive attitude is required; cities must find preventative measures for problems before they occur. To establish these measures, the planning stage is the most feasible place to begin. River-sensitive urban planning is a panacea for most of the critical challenges faced by rivers and the most efficient way to restore the citizen-river connection. Asnake, Worku, and Argaw (2021) argue that integrating river restoration initiatives into legislation, proclamations, urban planning practices, and other working documents is crucial for the long-term success of river restoration operations.

Reasons master plans are most relevant in this regard among the various plans implemented by the Indian system are the following:

- Most of the issues faced by rivers can be attributed to the anthropogenic activities taking place in cities. Hence, the actions cities take are vital for the preservation and rejuvenation of rivers. Master plans are developed for cities and outline the long-term strategy that a city intends to take.
- The restoration of degraded rivers is not a quick process. It requires sustained efforts over a long period of time. Hence, master plans, which are typically designed for a 20–30-year period, are ideal solutions for the implementation of long-term actions for the management of rivers.
- The various stakeholders concerned with river management usually operate with a silo mentality. They need to work together for the holistic management of rivers.
- A master plan is designed for the entire city and includes the various planning sectors. It has the ability and authority to bring together different agencies to work toward a common goal.
- The citizens of a city are encouraged to not only support but also to have a say in the development of a master plan. This inculcates a sense of responsibility among citizens to protect and rejuvenate the rivers.
- Master plans are legally binding, which makes river-related interventions easier to implement.

7.4 Master Plans and Urban River Management

Conventionally, the master plans of cities have been primarily associated with land use planning, making the connection between built and open spaces, social settings, and their surrounding environments. However, in recent years, master plans have begun to move away from being a purely land use–based plan to emerge as a strategic enabler to influence the direction that a city will take to make it more vibrant, livable, and productive. For example, the Los Angeles General Plan 2035 (Department of Regional Planning, Los Angeles County 2022) has marked "significant ecological areas" to conserve genetic and physical diversity within Los Angeles County by designating biological resource areas that can sustain themselves in the future. Kim, Jung, and Oh (2019) highlight the role of master plans in shaping a city's thermal environment in the age of climate change. Likewise, the Andhra Pradesh Capital Region Perspective Plan 2050 (Andhra Pradesh Capital Region Development Authority 2015) talks about a shift toward renewable energy, green certifications for buildings, and

zero waste philosophies, among other conventional content. From these examples, it is clear that the far-reaching implications of land use are finally being recognized, making it necessary to expand the role of a traditional, narrowly focused tool to encompass biodiversity, energy use, climate change, human health, food security, and water security.

7.4.1 Creating a Supporting Environment for River Consideration in Master Plans

A precursor to integrating river consideration into a master plan is creating the required supporting environment through two aspects. The first is to clarify the ambition of the city in this regard by setting out a broad vision of how the city views its connection with the river within the plan period. The second is to create a robust knowledge and information baseline of the river and its interaction with the city, which will help inform river-specific strategies. After creating this supporting environment, the master plan instruments and tools can be used to incorporate sustainable river health management into the city's larger long-term vision.

The master plan vision for the river. The first step in developing river-sensitive master plans for a city is to define and clarify the city's vision for the river and how it perceives the river in its development landscape. This will help in creating value for the river in the plan. As the adage goes, "What we value, we take care of." Hence, creating value for the river sets the stage for river-specific considerations in the plan, which can include aspects such as the management of water quality, provision of public access to the river to strengthen the citizen-river connection, protection of cultural values associated with the river, sustainable utilization of the river tourism potential, management of risks associated with natural hazards, and conservation of the natural ecosystem. From experiences around the world, an ideal visioning exercise is thoroughly inclusive, reflecting the needs and aspirations of different stakeholders, particularly including those that have traditionally been left out. This helps in making river management a "people's mandate" and helps build collective ownership around river-related initiatives. For example, the Master Plan for New Orleans 2030 (City of New Orleans 2010) envisions New Orleans as "a city that celebrates its relationship with water and uses water-management strategies to provide amenities to neighborhoods wherever possible."

The master plan must also acknowledge that an urban river stretch is a part of the larger river basin. Given that most river basins have some form of plans (e.g., a river basin management plan or integrated river management plan), the planning strategies of the city master plans must forge synergies with these overarching plans.

Developing the river baseline. Developing a baseline for the river involves ascertaining the status quo of the condition of the river, its interaction with the city, and its contextual setting within the region. The objective is to understand the base reality—including the issues and challenges—which will then help in devising specific strategies to address the shortcomings. The regional context is particularly important because rivers do not follow administrative boundaries. Hence, a city located downstream may suffer from impacts caused by upstream cities. As part of the baseline preparation, such aspects that will help in identifying the relevant planning interventions need to be investigated thoroughly.

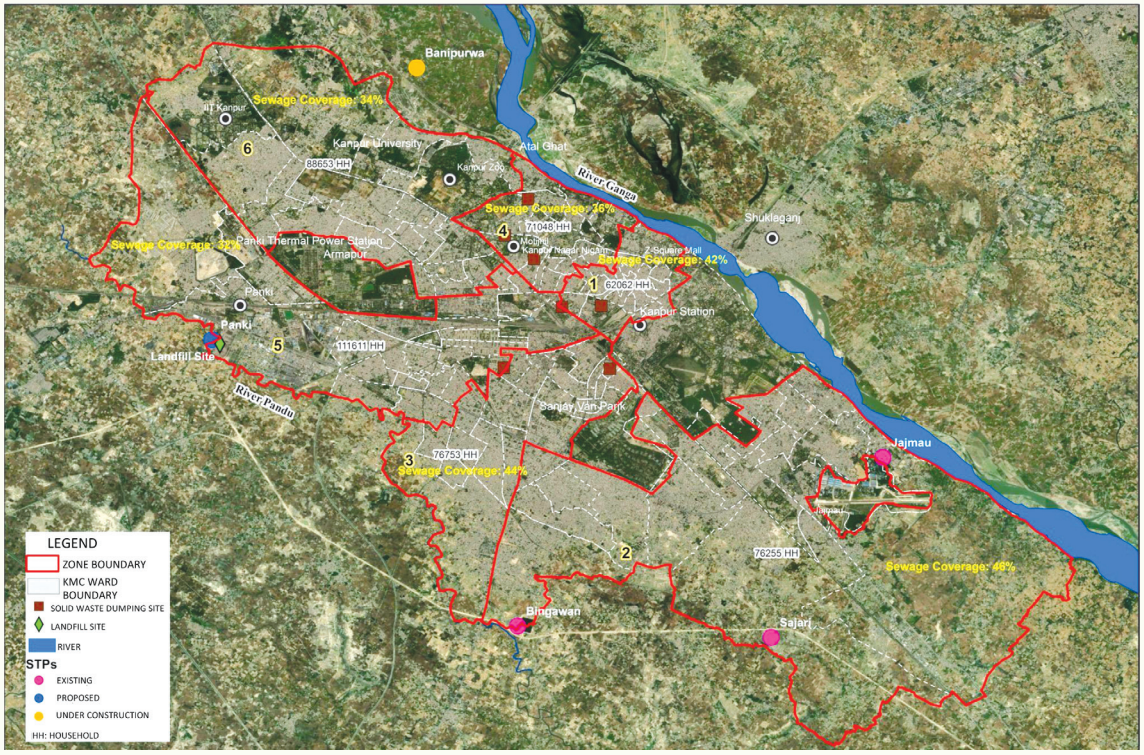
In addition to the regional context, it is also important to study the various urban sectors that have an impact on the river. These include sectors such as agriculture, industry, tourism, transport, water supply and wastewater management, and solid waste management. Studying these sectors will help in understanding the interactions of the river with these sectors and highlight those aspects that would need to be addressed through the master plan.

Ideally, the contents of the river baseline should include the following aspects:

- Regional context. Upstream implications for the river,
- Physical features. Length and direction of the river course (both current and historic), existing land cover adjacent to the river (ideally in 1 kilometer on each side), width and depth of river, groundwater depth, soil type and condition, etc.,
- Topography. Contours, gradients, river zone delineation, floodplain delineation, drainage pattern in the city, etc.,
- Demography. Spatially disaggregated population density, location of unauthorized/slum settlements, demographic profile of the city, etc.,
- Physical infrastructure. Locations of sewerage infrastructure, sewered and non-sewered areas, community/public toilets, solid waste collection centers, water supply systems, sewage outfall, solid waste dumping sites, etc.,
- Spatial planning. Planning zones, ward boundaries, land use, use zones/use premise, etc.,
- Stakeholder mapping. Agencies involved with river management, functions and responsibilities of these agencies, ownership of land in the river zone,
- Environmental assets. Area and location of water bodies, forests, wetlands, parks, protected areas/eco-sensitive zones, flora and fauna, etc.,
- Social aspects. Religious and cultural establishments (especially along the river), crematoria, dhobi ghats (laundry places), boating locations, riverfront access locations, other recreational areas, etc., and
- Economy. Details of water use sectors, river-related economy, etc.

In line with contemporary needs, it is best to develop the baseline on a geographic information system (GIS) platform to ensure that the baseline can be updated periodically and be made widely available digitally to a wide range of stakeholders. For example, Figure 7.1 presents the baseline of the sewage and sanitation situation in the city of Kanpur, while Figure 7.2 presents the status of water bodies in the city.

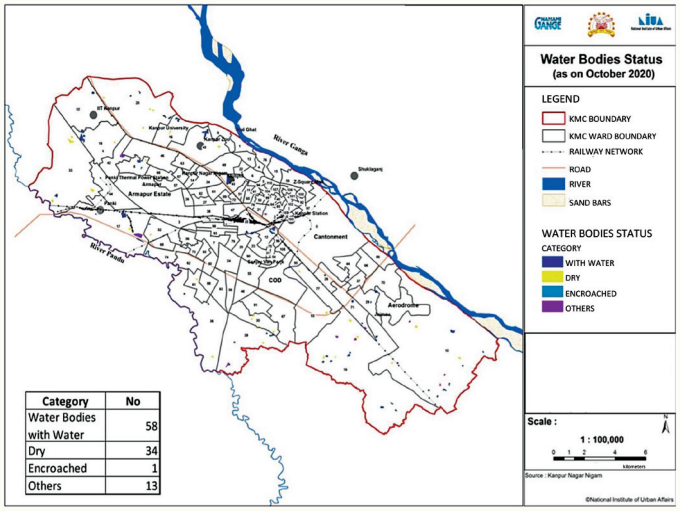
Figure 7.1: Baseline for Sewage and Sanitation Management in Kanpur City, India



KMC = Kanpur Municipal Corporation.

Source: NIUA and NMCG (2021).

Figure 7.2: Baseline for Water Bodies in Kanpur City, India



KMC = Kanpur Municipal Corporation.

Note: The water bodies with area above 1 acre have been used in this map. The water bodies mapped by KMC have been reassessed using 2019 Sentinel Satellite Image, with further ground-truthing and categorization using Google Image of October 2020. The water bodies under the category "others" are the ones that are partially dry having open spaces or buildings or industries nearby.

Source: NIUA and NMCG (2021).

7.4.2 Master Plan Tools and Instruments for River Management

A city prepares its master plan once in 20–30 years, typically through an inclusive process. This plan defines the development trajectory of the city and includes those elements and features that are of most importance to the city. Given the significance of a river for a city, the master plan must acknowledge this significance and apply strategies to integrate river management into the overall development landscape. Several planning instruments and tools within a master plan can be used for this purpose.

This section highlights these tools along with practical examples of how these have been used in the Urban River Management Plan for Kanpur City in India (NIUA and NMCG 2021), which feeds into the draft Master Plan for Kanpur 2041.

Localizing national policies and initiatives. Policies set the framework for directing development in line with the overall vision and objectives of the planning document. Strong planning policies ensure controlled development that is carefully designed without deteriorating the existing landscape while ensuring that the local needs are well addressed. The policies in turn lead to specific strategies and projects for different areas.

Several national and state policies in India have direct implications on river management. Some of these allied policies/supporting policies include the National Policy on Faecal Sludge and Septage Management (Ministry of Urban Development 2017, for sanitation waste management); Swachh Bharat Mission (2014, for toilets and solid waste management); Jal Shakti Abhiyan (Ministry of Jal Shakti 2019, for water bodies rejuvenation, water conservation, afforestation, and groundwater recharge); Draft National Forest Policy (Ministry of Environment, Forest and Climate Change 2018, for forest management); Draft National Water Policy (Ministry of Water Resources 2012, which has considerable river-related clauses); National Water Mission (Department of Water Resources 2011, for climate change–related implications); Street Vendors Act (Government of India 2014, for riverfront markets); Draft National River Policy (Tarun Bharat Sangh and Jal Biradari 2011); and National Biodiversity Action Plan (Ministry of Environment, Forest and Climate Change 2019). The state-level interventions include the River Regulation Zone policy by different states.

The master plan should devise specific localized strategies for customized implementation of these policies at a city scale, wherever possible. For example, the National Water Policy (Ministry of Water Resources 2012) advocates that "Conservation of rivers, river corridors, water bodies and infrastructure should be undertaken in a scientifically planned manner through community participation." This policy direction may be directly adopted in master plans.

Likewise, the massively popular initiative called "Catch the Rain" under India's National Water Mission propagates forward-looking reforms, such as large-scale rainwater harvesting, creating a GIS-based database of water bodies, preparation of scientific water conservation plans, and urban wastewater reuse. Master plans must leverage these progressive directions and align their strategies accordingly.

The Urban River Management Plan for Kanpur (NIUA and NMCG 2021) recommends the following directions from the various national plans and policies for the proposed Master Plan for Kanpur 2041:

- Rainwater harvesting structures are to be mandatory for all new construction with a plot area of 300 square meters or more.
- All existing groundwater users—commercial, industrial, infrastructural, and bulk users—are to be charged based on the quantity used, for limiting its use.

- Prohibit the pollution of ponds, rivers, wells, etc.; ban direct recharge from open areas into aquifers for pollution monitoring.
- Commercial, industrial, infrastructural, or bulk users withdrawing ground water above a determined threshold are to be mandated to recycle water for purposes as may be suitable.
- Revive and rejuvenate rivers, ponds, wells, etc.

Town-specific sectoral strategies. In addition to localizing national/state policies, cities may also consider developing their own policies/strategies that are not necessarily covered under other policy instruments. In such cases, a city has all the flexibility to decide on the nature, scope, and extent of these strategies in line with its indigenous requirements. Examples of such strategies include citizen engagement strategy, blue-green continuum strategy (interlinking the blue and green spaces in a city), and strategy for urban forestry. A specific strategy for development of a riparian stretch all along the river (wherever possible) may form a part of the master plan as well. Likewise, given the urgent need to address climate change concerns, sectoral strategies could also include proliferating the use of ecosystem-based adaptation under the larger ambit of nature-based solutions in order to achieve the dual objectives of river management and climate change adaptation.

The Urban River Management Plan for Kanpur (NIUA and NMCG 2021) advocates an elaborate strategy for enhancing the riparian buffer along both the rivers in the city (Ganga and Pandu) to be included in the proposed Master Plan for Kanpur 2041. The strategy includes the following:

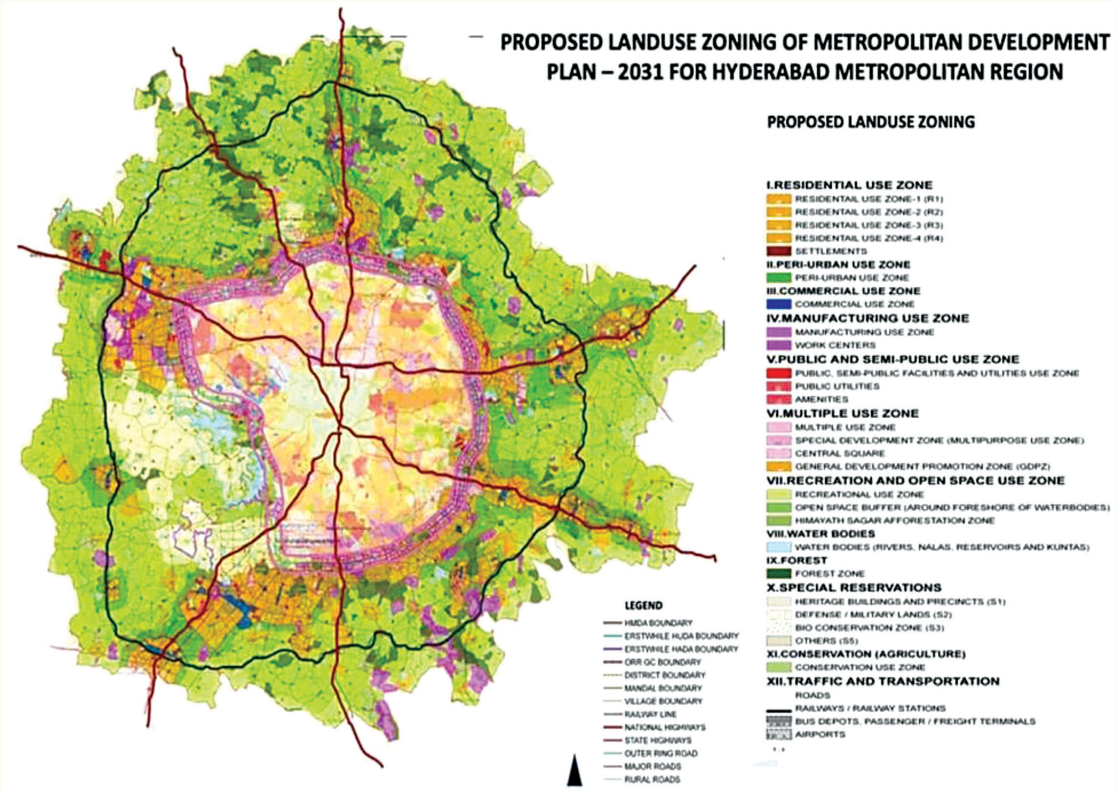
- Earmark a fringe of 15–30 meters for the buffer, wherever possible.
- Assign an appropriate land use for the riparian buffer.
- Clarify land ownership in the buffers.
- Direct the concerned agency to develop a riparian planting action plan using native species.

Land use assignment. Land use planning has traditionally been the core function of the master plan. With improvement in knowledge about the tangible and intangible benefits that the environmental assets of a city can provide, it is important that the land use planning also reflects this. For example, the Draft National Land Utilisation Policy (Department of Land Resources 2013) states that "land is required for development of essential infrastructure and for urbanization, while at the same time there is also a need to protect land under environmentally sensitive zones and land which provides ecosystem services." When it comes to river cities, spatial planning of the waterfront can directly help protect the ecological, amenity, economic, and cultural values.

In almost all states of India, a master plan is a statutory land use plan, approved and adopted by the local authority, with precise and definite proposals notifying stakeholders of the way land parcels are affected. These plans have enough control over land through various associated techniques like land acquisition, land pooling, land reservations, transferable development rights, and guided land developments. These can direct the physical development of a city by ensuring the best possible use of each land parcel. For all river cities, the land use planning within the river's zone of influence, without disturbing the natural ecology of the area, is of utmost importance.

Land use planning involves allocating different land use types within the city to allow for systematic urban development. Each land use category can be further subdivided into land use zones. Land use zones can be further divided into land use premises. Land use premises can be permitted across different land use zones. Finally, for each use premise, there are certain use activities that can be permitted. Figure 7.3 presents a typical land use map.

Figure 7.3: Land Use Map for Hyderabad City, India



Source: UNESCO and UNESCO i-WSSM (2021).

For proper management of the land adjacent to a river, planners must undertake a complete exercise of delineation of the river influence zone. Appropriate land uses and use zones must be assigned for this delineated area within the master plan, with a focus on maintaining the natural sanctity of the area. Specific eco-sensitive areas can be earmarked for conservation. A clear identification of permissible and restricted activities is also required for regulating controlled use of the river space without disturbing its natural character. In addition, the planning document must specify the definitions and parameters for delineation of the river space, as well as allocation of various use zones with use restrictions (permitted, conditionally permitted, or prohibited).

The Urban River Management Plan for Kanpur (NIUA and NMCG 2021) recommends the following for the proposed Master Plan for Kanpur 2041:

- A clearly defined land use category should be established for the river and its floodplains, within the existing and proposed land use tables.
- Both the Ganga and Pandu rivers and their floodplains could be clearly marked in the land use plan as well, under the appropriate land use category.

Development control regulations. Development control regulations are intended to limit the type and extent of development in a particular area. Regulations like height restrictions, floor area ratio, minimum setbacks, and ground coverage are a part of master plans in the form of building bylaws

or architectural controls. For river cities, once the river zone or floodplain is demarcated, specific development controls should be identified for the sub-zones falling within this eco-sensitive area. Different considerations can be made for restrictions within that zone. For example, in an area prone to flooding, there can be regulations on minimum plinth levels, prohibition of the construction of basements, and minimum levels of approach roads, among others. Likewise, in the belt adjacent to the river, there can be regulations on floor area ratio and ground coverage to ensure that the visual corridor to the river is maintained.

The Urban River Management Plan for Kanpur recommends the following development control regulations for the proposed Master Plan for Kanpur 2041:

- Any new development/redevelopment of the area must follow the development control regulations for the river zone.
- The concerned agency should prepare a phased strategy for restoring the river zone.
- Demarcate the "no development zone" and "interactive zone" for regulating all development within the flood plains of both the rivers.
- Enlist the prohibited, regulated, and permissible activities within each of these zones.
- Devise a phased strategy for the relocation of prohibited activities.

Norms and standards. Norms are used as a tool to ensure consistency in planning. Norms for standardized development within the river zone can help facilitate restricted and regulated growth within the area. For example, there are norms for minimum buffers within river zones, minimum required environmental flows, and the permissible extent of channelization.

Standards, from a river point of view, are tools to ensure that the quality of the riverine resources does not suffer because of urban development. Standards could be quantitative or qualitative values. For example, there are standards for river water quality, groundwater quality, and the richness of riparian biodiversity.

The Urban River Management Plan for Kanpur (NIUA and NMCG 2021) makes the following recommendations regarding norms and standards for the proposed Master Plan for Kanpur 2041:

- A buffer of 75 meters as a "no development and construction zone" is to be maintained around water bodies (lakes/ponds), as per the revenue records. The minimum size of water bodies/ lakes applicable in this context is to be decided by local stakeholders.
- A buffer of 50 meters for primary, 35 meters for secondary, and 25 meters for tertiary drains (measured from the edge of drains) is to be maintained.
- Alternatively, the plan may direct a competent authority to identify and establish adequate buffer standards (as per requirement and land availability analysis) for water bodies and drains within the city.

Recommendations and directions. A master plan is also very well placed to make recommendations on current and emerging aspects that need to be addressed. It has the authority to provide tangible directions to various agencies to act in this regard. For example, climate change is likely to alter river flows, thereby disturbing the ecology that depends on them. Similarly, in view of depleting rivers and groundwater, it is becoming increasingly evident that water demand management is the only way forward for large urban areas to meet their water demand. In river cities, specific recommendations for the floodplains should be framed with a focus on conservation of the natural river environment. Recommendations could also be along the lines of strengthening the cultural connection with rivers, given that historically rivers have been the center of cultural and religious activities.

The Urban River Management Plan for Kanpur (NIUA and NMCG 2021) makes the following recommendations and directions for the proposed Master Plan for Kanpur 2041:

- Completely prohibit the dumping of solid waste in or around the river zone or any other eco-sensitive sites by imposition of strict penalties through local bodies.
- Strengthen the waste collection system from the unauthorized sector along the rivers.
- Promote public awareness campaigns.

Special projects. Master plans have the authority to propose special projects that have high impact and are necessary for the city. They also help in enhancing the land value of adjoining properties. For such projects, it will be important to detail the modalities related to the implementation, administration, management, and funding. Special projects related to the river include ghat development, cleanup projects, the development of eco-recreational sites, installing eco-tourism infrastructure, flood protection measures, and artificial recharge structures, among others. Such projects can be identified within master plans along with an action plan for implementation while directing agencies for developing a detailed project report.

The Urban River Management Plan for Kanpur (NIUA and NMCG 2021) makes the following recommendation regarding special projects for the proposed Master Plan for Kanpur 2041:

- Rejuvenate the existing fly ash pond in the river zone and redevelop it after adequate treatment (for recreational or other uses).

7.5 Conclusion

The COVID-19 pandemic has unexpectedly highlighted the significance of urban rivers in the overall coping strategy for alleviating the stress created by the pandemic. Even before the pandemic, green spaces (typically found near riverbanks) were instrumental in alleviating mental distress, anxiety, and depression and led to greater well-being and healthier cortisol profiles (Barton and Rogerson 2017). The pandemic has only accentuated this role. As Bustamante et al. (2022) suggest, the therapeutic potential of outdoor and greenspaces should be considered for interventions during future epidemics. Given that the frequency and occurrence of such instances is likely to increase in the future, considering climate change concerns, it is important to have robust and sustainable measures for managing urban rivers.

Managing an urban river, especially a degraded one, requires several transformational solutions that may have to be implemented over long and sustained periods in order to reap the optimal benefits. Many such solutions are often started with great enthusiasm but get derailed over time because of a lack of a long-term institutional mechanism required to support the overall outcome. A master plan is a good instrument to address this challenge. This chapter has described a set of tools and avenues within master plans that can be used to address typical river-related challenges in cities.

It is important to highlight that the challenges faced by urban rivers are dynamic in nature and will change from time to time. One such example is to manage a river under changing climate regimes. It is well established that water is the primary medium through which the effects of climate change are manifested. Therefore, by their very nature, rivers are vulnerable to climate change impacts, such as changes in the flow, biotic quality, and the sediment load. Master plans will need to account for these anticipated changes in the future and provide adequate planning responses. Likewise, there are several rivers that have changed their natural courses in recent years. For example, the Ganga River stretch near the city of Patna in India has deviated by almost a kilometer from its natural course. Under

such a circumstance, it becomes challenging to demarcate the floodplain and provide the necessary regulations.

A practical perspective in urban river management is to naturalize the immediate vicinity of the river zone, especially if it is heavily concretized. This means moving toward nature-based solutions as a means to complement (if not replace) hard infrastructural options. Some of the naturalizing elements include soft scaping, creating green buffers, removing unnecessary concrete, and adopting green infrastructural solutions. To a large extent, this approach will require reforms in development control regulations, such as restrictions on floor area ratio, ground coverage, and height restrictions on buildings. It is vital that the land ownership in these areas is carefully ascertained (which incidentally is a challenge in several cities) to avoid legal complications while the plan is being implemented.

Next, it is vital that river-sensitive master plans create an enabling environment for introducing (or reigniting) the human and water relationship (e.g., through concepts like biophilic design, which emphasizes human connection to the natural world). Historically, natural river edges have been detached from citizens because urban planning has failed to adequately consider them (Redzuan and Latip 2016). However, in the current age, a core indicator of success for riverfront projects is public access to the water edge (Timur 2013).

Finally, the implementation of the master plan is not always in sync with the directions provided in the plan. It is important that ground realities are factored in with the help of a mechanism that allows for course correction at periodic intervals. Usually, master plans are reviewed every 5 years, which can offer an ideal opportunity for these course corrections to be adopted. River cities are special. The planning of such cities needs to reflect this aspect so that these cities remain special in the future as well.

References

Alcayna, T. et al. 2022. Climate-Sensitive Disease Outbreaks in the Aftermath of Extreme Climatic Events: A Scoping Review. *One Earth* 5(4): 336–350.

Andhra Pradesh Capital Region Development Authority. 2015. Andhra Pradesh Capital Region Perspective Plan (2050). Draft Perspective Plan – 2050 for APCRDA. https://crda.ap.gov.in/apcrdav2/views/masterplansDraft.aspx (accessed 22 June 2022).

Asnake, K., H. Worku, and M. Argaw. 2021. Integrating River Restoration Goals with Urban Planning Practices: The Case of Kebena River, Addis Ababa. *Heliyon* 7(7): e07446.

Barton, J. and M. Rogerson. 2017. The Importance of Greenspace for Mental Health. *BJPsych International* 14(4): 79–81.

Basak, S. M. et al. 2021. Social Benefits of River Restoration from Ecosystem Services Perspective: A Systematic Review. *Environmental Science and Policy* 24: 90–100.

Bherwani, H. et al. 2021. Investigation of Adoption and Cognizance of Urban Green Spaces in India: Post COVID-19 Scenarios. *Current Research in Environmental Sustainability* 3: 100088.

Bustamante, G. et al. 2022. Mental Health and Well-Being in Times of COVID-19: A Mixed-Methods Study of the Role of Neighborhood Parks, Outdoor Spaces, and Nature among US Older Adults. *Health and Place* 76:102813.

City of New Orleans. 2010. Master Plan for New Orleans 2030. https://nola.gov/nola/media/City-Planning/Master-Plan-Chapter-1-FINAL-ADOPTED.pdf (accessed 22 June 2022).

Cui, N. et al. 2022. Using Social Media Data to Understand the Impact of the COVID-19 Pandemic on Urban Green Space Use. *Urban Forestry and Urban Greening* 74: 127677.

Department of Water Resources. 2011. National Water Mission. Ministry of Jal Shakti, India. http://nwm.gov.in/ (accessed 22 June 2022).

Department of Land Resources. 2013. National Land Utilisation Policy, Draft. Ministry of Rural Development, India. https://smartnet.niua.org/sites/default/files/resources/draft_national_land_utilisation_policy_july_2013.pdf (accessed 22 June 2022).

Department of Regional Planning, Los Angeles County. 2022. Los Angeles General Plan 2035. https://planning.lacounty.gov/generalplan/generalplan (accessed 22 June 2022).

Dinda, S., N. D. Chatterjee, and S. Ghosh. 2021. An Integrated Simulation Approach to the Assessment of Urban Growth Pattern and Loss in Urban Green Space in Kolkata, India: A GIS-Based Analysis. *Ecological Indicators* 121: 107178.

Government of India. 2014. Street Vendors Act. https://legislative.gov.in/sites/default/files/A2014-7.pdf (accessed 22 June 2022).

Kaiser, N. N., C. K. Feld, and S. Stoll. 2020. Does River Restoration Increase Ecosystem Services? *Ecosystem Services* 46(C): 101206.

Kim, H., Y. Jung, and J. I. Oh. 2019. Transformation of Urban Heat Island in the Three-Center City of Seoul, South Korea: The Role of Master Plans. *Land Use Policy* 86: 328–338.

Kumar, S. et al. 2018. Runoff Characterization and Pollutant Load Estimation of Nainital Lake, India. *Environmental Nanotechnology, Monitoring and Management* 10: 394–398.

Li, T. et al. 2022. Integrating River Health into the Supply and Demand Management Framework for River Basin Ecosystem Services. *Sustainable Production and Consumption* 33: 189–202.

Ministry of Environment, Forest and Climate Change, India. 2018. National Forest Policy, Draft. http://moef.gov.in/wp-content/uploads/2019/05/Inviting-comments-from-concerned-Ministries-on-Draft-National-Forest-Policy-2018.pdf (accessed 22 June 2022).

Ministry of Environment, Forest and Climate Change, India. 2019. *Implementation of India's National Biodiversity Action Plan*. http://nbaindia.org/uploaded/pdf/IndiaNationalBiodiversityActionPlan2019.pdf (accessed 22 June 2022).

Ministry of Jal Shakti, India. 2019. Jal Shakti Abhiyan. https://jsactr.mowr.gov.in/ (accessed 22 June 2022).

Ministry of Urban Development, India. 2017. National Policy on Faecal Sludge and Septage Management. http://amrut.gov.in/upload/newsrelease/5a5dc55188eb0FSSM_Policy_Report_23Feb.pdf (accessed 22 June 2022).

Ministry of Water Resources, India. 2012. National Water Policy. http://jalshakti-dowr.gov.in/sites/default/files/NWP2012Eng6495132651_1.pdf (accessed 22 June 2022).

Neelavannan, K. et al. 2022. Microplastics in the High-Altitude Himalayas: Assessment of Microplastic Contamination in Freshwater Lake Sediments, Northwest Himalaya (India). *Chemosphere* 290: 133354.

NIUA and NMCG. 2021. Urban River Management Plan for Kanpur. New Delhi: National Institute of Urban Affairs and National Mission for Clean Ganga. https://niua.in/waterandenvironment/wp-content/uploads/2022/03/URMP-Kanpur.pdf (accessed 16 December 2022).

Patel, P. P., S. Mondal, and K. S. Ghosh. 2020. Some Respite for India's Dirtiest River? Examining the Yamuna's Water Quality at Delhi during the COVID-19 Lockdown Period. *Science of the Total Environment* 744: 140851.

Pley, C. et al. 2021. Digital and Technological Innovation in Vector-Borne Disease Surveillance to Predict, Detect, and Control Climate-Driven Outbreaks. *The Lancet Planetary Health* 5(10): 739–745.

Redzuan, N. and N. S. A. Latip. 2016. Principles of Ecological Riverfront Design Redefined. *Journal of Creative Space* 4(1): 29–48.

Sadeghieh, S. et al. 2021. Zika Virus Outbreak in Brazil under Current and Future Climate. *Epidemics* 37: 100491.

Stewart-Ibara, A. 2022. Climate Change and Infectious Diseases: Research and Policy Actions Needed to Address an Inequitable Health Crisis. *One Earth* 5(4): 333–335.

Swachh Bharat Mission. 2014. Guidelines for Swachh Bharat Mission – Urban. http://swachhbharaturban.gov.in/writereaddata/SBM_Guideline.pdf (accessed 22 June 2022).

Tarun Bharat Sangh and Jal Biradari. 2011. National River Policy, Draft. http://tarunbharatsangh.in/wp-content/uploads/2013/06/National_River_Policy_-Final_Draft_y_Tarun_Bharat_Sangh.pdf (accessed 22 June 2022).

Timur, U. P. 2013. Urban Waterfront Regenerations. Advances in Landscape Architecture, Intech Open. http://cdn.intechopen.com/pdfs/45422/InTech-Urban_waterfront_regenerations.pdf

UNESCO and UNESCO i-WSSM. 2021. *The Role of Sound Groundwater Resources Management and Governance to Achieve Water Security (Series III)*. Global Water Security Issues (GWSI) Series – No. 3. Paris: UNESCO Publishing.

Yin, H., M. S. Islam, and M. Ju. 2021. Urban River Pollution in the Densely Populated City of Dhaka, Bangladesh: Big Picture and Rehabilitation Experience from Other Developing Countries. *Journal of Cleaner Production* 321(19): 129040.

CHAPTER 8

The Pandemic and Indian MSMEs: Lessons for Strengthening Resilience

Akhilesh K. Sharma and Sushil K. Rai[1]

8.1 Introduction

Micro, small, and medium-sized enterprises (MSMEs) contribute to generating employment, promoting technological innovation, maintaining social stability, and accelerating industrial development and economic growth by producing diverse products and offering a variety of services to cater to the needs of local and international markets (Singh, Kumar, and Rathi 2019). In comparison to large enterprises, the MSME sector creates more employment and promotes industrialization in rural and remote areas with less capital investment. The sector reduces regional imbalances in terms of industrialization, growth, and distribution of national income and wealth. Apart from being critical for the supply chain management of an economy, MSMEs play a pivotal role in the generation of demand through providing employment to millions of people. During and after any external crisis (e.g., public health emergencies, natural calamities), MSMEs help to sustain the economy and maintain delivery of goods and services (McCall 2020; Burton et al. 2011).

The sudden spread of the coronavirus disease (COVID-19) in early 2020 severely affected all economic activities at the global level. Given the absence of a vaccine, most of the countries adopted containment measures such as lockdowns, quarantines, and social distancing to curb the spread of COVID-19. These measures resulted in a decrease in business activity mainly through restrictions on mobility, closure of workplaces, the flight of workers, shrinkage in demand because of economic uncertainty, and disruption in global supply chains (Kuebart and Stabler 2020; Cacciapaglia, Cot, and Sannino 2020). The pandemic generated demand and supply shocks to the global economy from which the world is still struggling to recover. The current crisis is different from the global financial crisis of 2008 because in this crisis, firms are facing not only issues related to the supply of capital but also the disruption of the entire global supply chain along with the continuous decrease in demand for products and services, including a significant increase in unemployment.

Although the pandemic has affected all firms irrespective of their size, lockdowns and other containment measures have more severely affected MSMEs than larger firms. In fact, MSMEs are most vulnerable to such unexpected situations because they have fewer assets, lower capital reserves, and lower productivity (OECD 2020; Bartik et al. 2020; Prasad et al. 2015). MSMEs, especially micro enterprises, are facing more challenges at every stage of business activity from production to distribution. Given the high level of informality and diversity in the sector, most of the governments have been struggling to enact appropriate and effective policies to address the current crisis (Kuebart and Stabler 2020; Haleem, Javaid, and Vaishya 2020; Nicola et al. 2020).

In India, 63.39 million MSMEs are engaged in a variety of economic activities. More than 99% of those MSMEs are micro enterprises. The growth of the MSME sector is important for the Indian economy

[1] The paper this chapter is based on was presented in the ADBI Paper Development Workshop on Rethinking Cities for Resilience and Growth in the Post–COVID-19 World, held on 19 May 2022. The authors are thankful to the discussants and reviewers, particularly Keshab Das and Kyoko Takahashi, for their valuable input. Other versions of the paper have been published as ISID Working Paper No. 243 (Sharma and Rai 2022), and as an article in the Journal of Small Business Strategy (Sharma and Rai 2023).

because this sector employs 111 million workers, accounting for around 45% of total employment, and contributes around 40% to total output produced, around 30% of total gross domestic product (GDP), and approximately 50% of total exports from India. The key major challenges faced by MSMEs include lack of finances, delayed payments, high informality, lack of a skilled workforce, lack of awareness about government policies and support programs, obsolete technologies, and low productivity (RBI 2019; Maheshkar and Soni 2021; Sharma 2021, 2022a). During the pandemic, the effect of these constraints further aggravated and affected the revival of MSMEs in India as well as around the globe.

Considering the impact of COVID-19, the Government of India announced various measures to revive and support MSMEs under the Atmanirbhar Bharat (self-reliant India) package announced in May 2020. These measures include an emergency credit lending scheme, subordinate debt scheme, equity infusion through the MSME fund of funds scheme, employees' provident fund support for small businesses, and disallowance of global tenders up to ₹2 billion. Along with putting emphasis on local industries, markets, and supply chains, the stimulus package covers all sections of the economy including agriculture, cottage industries, MSMEs, large firms, workers, and the poor. The Reserve Bank of India also took some initiatives in order to increase liquidity in the financial market, to reduce the burden of timely loan repayment, and to encourage individuals and industries for borrowing from banks at cheaper rates (Sharma 2022b). Also for supporting the sector, there were existing schemes for MSMEs, including the Prime Minister's Employment Generation Programme, Credit Guarantee Fund Trust for Micro and Small Enterprises, and Trade Receivables Discounting System (TReDS).

After relaxation in lockdown and containment measures, many MSMEs struggled to resume operation, suffering from further economic losses that kept many on the brink of closing permanently (Lu et al. 2020). Though economies are showing recovery after facing recession in 2020, researchers predict that such pandemics may occur more frequently in the future (McKee and Stuckler 2020). Therefore, there is a need to understand the impacts of the current pandemic on MSMEs and their coping strategies in order to develop a framework for resilience and to achieve sustained growth against future pandemics. This chapter uses a primary survey of 225 small firms located in Dehradun and the National Capital Region to understand the impact of COVID-19 on MSMEs in India and to discover ways to enhance their resilience and promote their sustained growth.

8.2 Literature Review

The COVID-19 virus, identified first in the People's Republic of China in December 2019, spread across the world in the early months of 2020. To curb the spread of the virus, most countries adopted containment measures such as lockdowns, quarantines, and social distancing, which resulted in restrictions on mobility and the closure of the majority of business activities (Lonergan and Chalmers 2020). These measures led to disruptions in supply chains, closure of workplaces, a decreased labor supply, and increased unemployment (Ernst & Young 2020). Millions of people lost their jobs and millions more were in fear of losing their jobs. Uncertainty about economic revival compelled people to spend less, which resulted in the decline in demand for goods and services. Therefore, the pandemic and its containment measures caused both demand and supply shocks to the economies across the world (del Rio-Chanona et al. 2020; Guerrieri et al. 2020; Bekaert, Engstrom, and Ermolov 2020; Sharma 2022b). It affected millions of people and all firms irrespective of their size. Since MSMEs are more vulnerable to such hazards in comparison to large firms due to lack of financial and human resources (Bartik et al. 2020; Prasad et al. 2015; Shafi, Liu, and Ren 2020), the majority of MSMEs were severely affected by the outbreak of the pandemic and containment measures. Small firms faced challenges such as insufficient financial liquidity, supply chain disruption, and reduction in sales revenue and profit (Tairas 2020; Shafi, Liu, and Ren 2020; Wijaya 2020). Measures of distress appear more severe for the smallest firms. In addition to this, MSMEs were also facing a shortage of working capital mainly

due to financing being paused by financial institutions. These factors led to an increase in operational costs for MSMEs during the pandemic.

On the demand side, the decline in public consumption because of lockdowns and the increase in the price of goods were responsible for an increase in inventory of finished goods and carrying cost of firms (Lemi, Bogale, and Mengesha 2020). Most MSMEs were unable to resume work even after containment measures relaxed mainly because of the inability of employees to return to work, stringent local lockdown policies, the reduced market demand, and a shortage of personal protective equipment/materials like masks and hand sanitizer (Lu et al. 2020). These resulted in the decline in profits and sales of MSMEs. Therefore, the demand-side effects posed a more severe threat to the performance of MSMEs (Juergensen, Guimón, and Narula 2020; Aftab, Naveed, and Hanif 2021; Nordhagen et al. 2021).

From the supply side, MSMEs faced logistical issues that prevented them from utilizing their typical capacity (Juergensen, Guimón, and Narula 2020). Many MSMEs, operating far below their capacity, headed toward becoming unviable as businesses. Financial management and the supply chain disruption were the two major issues that affected MSMEs very badly (Ratnasingam et al. 2020). Other major challenges they encountered include shortages of goods, transportation blockages, limited operations, and employee layoffs (Aftab, Naveed, and Hanif 2021). At the same time, MSMEs were also facing a paucity of cash flows. Access to financing also decreased during the pandemic due to high business uncertainty. Market, financial, and personnel risks were considered by MSMEs as the three most significant risks before and after the COVID-19 crisis (Cepel et al. 2020).

Firms with stronger cash positions emerged more strongly during the COVID-19 crisis (Roper and Turner 2020). Cash-rich firms had a competitive edge over other firms through investment during the crisis and recovery phase, which gave them a considerable advantage in both the short and long run. Adoption of digital technology by the MSME sector also proved to be a competitive advantage during the outbreak of the pandemic (Akpan, Soopramanien, and Kwak 2020; Papadopoulos, Baltas, and Balta 2020; Gregurec, Tomičić Furjan, and Tomičić-Pupek 2021). Utilization of information technology and social media also helped MSMEs to develop and sustain their business during and after the pandemic (Suwarni and Handayani 2021; Purba et al. 2021).

A few studies in the Indian context also suggest that MSMEs are hardest hit by the pandemic (e.g., ILO 2020; MicroSave 2020; EIG 2020). Around 26% of small businesses were shut in April 2020 while around 73% reported a decline in customer footfall and 44% reported a decline in the volume of supplies (MicroSave 2020). Other impacts due to the lockdowns and pandemic include increase in transport cost, cost of supplies, nonavailability of credit from suppliers, decline in firm income, and increase in household expenditure of firm owners. Paucity of funds and inadequate technical skills of employees are the most significant barriers for MSMEs' resilience after the pandemic (Gupta and Singh 2022). The lack of functional flexibility is the most crucial barrier to evolving a resilient supply chain of MSMEs in the post-pandemic era (Banerjee et al. 2022).

The above brief discussion clearly highlights that the pandemic has severely affected small firms globally as well as nationally. The MSME sector, which generates millions of jobs and contributes significantly to the inclusive and sustainable development of most of the economies, is highly vulnerable and lacks resilience. Common suggestions for the resilient and sustained growth of MSMEs during and after the pandemic have focused mainly on financial and operational support along with a shift from traditional business models to more innovation-led technology-friendly models. What these suggestions are missing is financial planning for small businesses from the beginning so that they can be resilient and face business uncertainty when it arises. Specifically, MSMEs need long-term planning for financial

resources so that they can address any challenges arising from economic shocks and sustain their growth. This chapter describes a study that is a small attempt in this direction. It discusses the issue of pandemic impact for Indian MSMEs and suggests the ways this sector can develop its resilience and sustained growth during any future economic shocks.

8.3 Research Methodology

The present study aims to (i) understand the impact of COVID-19 on MSMEs, (ii) assess the efficacy of government policies in reviving MSMEs, and (iii) find out ways to enhance the resilience of the sector and promote its sustained growth. It is mainly based on primary data collected through a telephonic survey of 225 small firms in India located in Uttarakhand and the National Capital Region using a semi-structured questionnaire during October 2020 through March 2021. The National Capital Region comprises the national capital territory of Delhi and some neighboring districts in the states of Uttar Pradesh, Haryana, and Rajasthan. As per the 73rd round survey of non-agricultural enterprises conducted by the National Sample Survey Organisation, around 22% of the country's MSMEs are located in these states (i.e., Delhi, Uttar Pradesh, Haryana, Rajasthan, and Uttarakhand). Out of the 225 firms we surveyed, around 42% were located in Dehradun, Uttarakhand, while the remaining 58% were located in the National Capital Region.

In sector-specific terms, 163 of the firms were engaged in manufacturing activities while 62 were engaged in service activities. Major activities of these firms include manufacture of food products, manufacture of rubber and plastic products, manufacture of pharmaceutical medicinal chemical and botanical products, accommodation services, food and beverage service activities, and specialized construction activities. Further, among these firms, 16.00% were micro enterprises, 49.78% were small enterprises, and 34.22% were medium-sized enterprises according to the new definition of MSMEs, as shown in the next section, where we present and analyze the findings. All firms were registered firms. Therefore, the sample firms represent only the formal sector. The lack of data on firms in the informal sector can be a major limitation of this study.

8.4 Findings and Analysis

8.4.1 Implications of the Change in the Definition of MSMEs

One of the major policy initiatives for the MSME sector under the Atmanirbhar Bharat package, announced in May 2020 to support and revive the sector after it had been severely affected by the pandemic, was a revision to the definition of MSMEs. The new criteria define MSMEs in terms of the firms' investment in plants and machinery and their turnover excluding export value. These criteria went into effect on 1 July 2020. The previous criteria defined MSMEs in terms of the firms' investment in plants, machinery, and equipment, with separate investment ranges for manufacturing and service activities for each category of MSMEs (Table 8.1).

The increase in investment limit for plants, machinery, and equipment meant that many enterprises were recategorized among the categories, i.e., micro, small, medium, and large. The immediate implication of this revision in the MSME definition is that it enables a few large firms to be categorized as MSMEs and avail the benefits of policy initiatives under the Atmanirbhar Bharat package (Sharma 2022b). Our sample of 225 firms shows this effect. If we categorize the sample firms as per the old MSME definition, 61 are large firms, 39 are medium-sized, and 125 are small (Table 8.2). However, as per the new definition, 77 are medium-sized enterprises, 112 are small, and 36 are micro. Comparing these different categorizations of the same sample clearly indicates that with the revised definition,

Table 8.1: Revision in Definition of Micro, Small, and Medium-Sized Enterprises

MSME Category	Criteria of Old MSME Definition		Criteria of New MSME Definition	
	Investment in plants, machinery, and equipment		Investment in plant and machinery, and equipment	Turnover
	Manufacturing	Service		
Micro enterprises	<= ₹2.5 million	<= ₹1 million	<= ₹10 million	<= ₹50 million
Small enterprises	> ₹2.5 million and <= ₹50 million	> ₹1 million and <= ₹20 million	> ₹10 million and <= ₹100 million	> ₹50 million and <= ₹500 million
Medium-sized enterprises	> ₹50 million and <= ₹100 million	> ₹20 million and <= ₹50 million	> ₹100 million and <= ₹500 million	> ₹500 million and <= ₹2,500 million

MSME = micro, small, and medium-sized enterprises.

Source: Notification by the Ministry of MSMEs, Government of India dated 26 June 2020 and MSME Development Act 2006.

some large firms have become eligible to be categorized as MSMEs and avail benefits meant for the revival and growth of the MSME sector. Studies have observed similar findings based on Annual Survey of Industries data (Sharma 2022b) and the Centre for Monitoring Indian Economy's database (Nagraj and Vaibhav 2020).

Table 8.2: Implications of Change in Definition of Micro, Small, and Medium-Sized Enterprises

Enterprise Categories	MSME Definition Criteria		
	Old Criteria	New Criteria	Percentage Change in the Number of Enterprises
Micro enterprises	0 (0.00)	36 (16.00)	16.00
Small enterprises	125 (55.56)	112 (49.78)	–5.78
Medium enterprises	39 (17.33)	77 (34.22)	16.89
Large enterprises	61 (27.11)	0 (0.00)	–27.11
Total	225 (100.00)	225 (100.00)	

MSME = micro, small, and medium-sized enterprises.

Note: Numbers in parentheses indicate the percentage of the total sample.

Source: Primary survey.

Out of the 225 firms, 87.11% were of the opinion that the revised definition of MSMEs is beneficial for the sector while the remaining 12.89% of firms told us that they were uncertain about its implication. For many enterprise owners, the revised definition may allow them to increase the size of firms and increase the output level while availing the benefits of MSME supporting schemes even at higher levels of investment and turnover. Since for MSME categorization, turnover excludes export value, the

revised definition may encourage MSMEs to focus more on foreign markets. Small firms may also be able to access more credit; since turnover is linked with goods and service tax returns, it may provide a realistic measure to financial institutions for assessing firms' credit requirements and ability to repay loans. With increased investment, firms can increase their productivity and competitiveness without losing their MSME categorization under the revised definition. Further, an increase in turnover can allow firms in the MSME sector to take advantage of economies of scale.

8.4.2 Effect of Lockdown on Activities of MSMEs

The Government of India introduced a sudden and strict lockdown on 25 March 2020 in order to curb the spread of the virus. Although there was some relaxation for essential activities, the lockdown disrupted all economic activities across the country. Around 29% of the MSMEs under study reported that their businesses collapsed due to the lockdown (Table 8.3). Production and distribution activities of around 11% of firms were halted while production activities of around 29% were decreased. Clients of about 7% of firms cancelled orders while around 53% of firms were facing a decrease in demand and about 14% of firms were facing reductions in exports. Interestingly, nearly 4% of firms reported that their demand had increased. About 36% of firms reported an erratic supply of raw materials while almost 14% of firms reported a decrease in imported raw materials. Around 17% of firms reported an increase in the price of raw materials and delays in payments.

Table 8.3: Effect of Lockdown on Firms' Activities

Major Effects on Firm's Activities	% of Total Firms
No demand/Collapse of businesses	29.33
Production and distribution activities closed	10.67
Decrease in production activities	29.33
Orders canceled	7.11
Decrease in demand	52.89
Reduction in export	14.22
Increase in demand	3.56
Delay in payments	17.33
Erratic supply of raw materials	36.44
Decrease in imported raw materials	13.78
Increase in price of raw materials	17.33

Source: Primary survey.

Disruptions in the activities of MSMEs had severe implications for their turnover and employment. More than 90% of firms reported that their turnover decreased in 2020–2021 (Table 8.4). Around 17% of MSMEs faced up to 25% reduction in their turnover due to the lockdown and other precautionary measures. Further, nearly 53% of firms reported more than 50% decline in their turnover. These declines indicate the severity of business disruptions caused by the lockdown. Our findings are similar to those of other studies assessing the impact of the pandemic on the performance of MSMEs (e.g., Rathore and Khanna 2020; Tairas 2020; Shafi, Liu, and Ren 2020; Wijaya 2020).

Table 8.4: Impact of Lockdown on Turnover of Firms under Study

Impact on Turnover	No. of Firms	% of Total Firms
Increase in turnover	7	3.11
No change in turnover	15	6.67
Decrease in turnover	203	90.22
Up to 25% decline in turnover	38	16.89
26–50% decline in turnover	46	20.44
51–75% decline in turnover	90	40.00
More than 75% decline in turnover	29	12.89
Total firms	225	100.00

Source: Primary survey.

Table 8.5: Average Change in Turnover of Micro, Small, and Medium-Sized Enterprises (%)

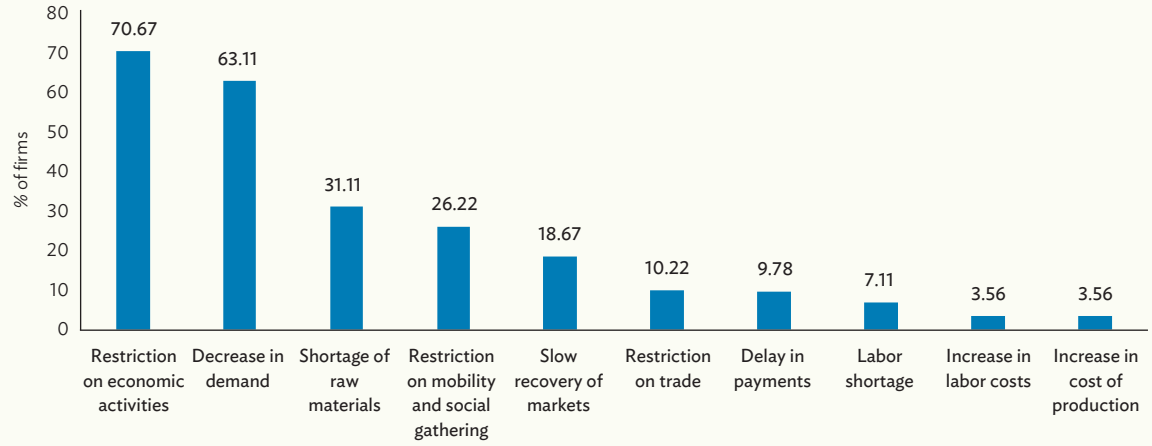
	Average Change	Standard Deviation	Min. Value	Max. Value
Micro enterprises	–43.47	20.10	–75.00	–20.00
Small enterprises	–60.75	20.86	–87.50	–16.67
Medium enterprises	–31.91	32.02	–80.00	25.00

Source: Primary survey.

Among the MSMEs under study, the highest decline in turnover was observed in small enterprises at around 61% and micro enterprises around 43% (Table 8.5). The maximum value of percentage change in turnover is positive in the case of medium enterprises only. This indicates that despite the average 32% reduction in turnover for medium-sized enterprises, some of them observed an increase or no change in turnover in 2020–2021. As also observed in Table 8.4, nearly 10% of all enterprises surveyed experienced an increase or no change in turnover. Such enterprises were engaged in human health activities and the manufacture of apparel. Firm owners who experienced either an increase in turnover, no change in turnover, or less reduction in turnover reported that they tried to quickly adopt e-commerce platforms and they also had some savings to invest for that purpose. Some enterprises switched to other economic activities such as production of masks and sanitizer and home delivery of their products. These moves show that such firms had flexibility in their production process and the resources needed for it, particularly financial resources. The comparative success of these firms demonstrates a key lesson for enhancing the resilience of MSMEs.

Figure 8.1 depicts the 10 main reasons for the decline in turnover in MSMEs. Apart from the restrictions on economic activities, which were part of the lockdown, a decrease in demand was the main reason for the decline in turnover. The decrease in demand might have arisen due to job losses and uncertainty in recovery. Relief packages should therefore focus on addressing demand shortages during such economic shocks. Since policy measures under the Atmanirbhar Bharat package focus mainly on credit flow to the MSME sector (Sharma 2022b), our findings also highlight the limitations of policy measures announced to support small businesses and recovery of the economy during the pandemic.

Figure 8.1: Major Causes for Decline in Turnover of Firms



Source: Primary survey.

8.4.3 Effect of the Pandemic on Firms' Employment

As observed in Figure 8.1, a shortage of labor was one of the top 10 reasons for the decline in the turnover during the pandemic. The firms under study employed a total of 34,762 people in 2019–2020, which fell to 26,154 people in 2020–2021, indicating a decline of around 25% in the employment due to the pandemic and lockdown (Table 8.6). The employment of informal workers declined by 47.15%, and surprisingly, the employment of formal workers increased by 12.58% and family workers increased by 4.87% during the period. Firm owners stated that economic activities were restricted due to strict lockdown and other containment measures. There was uncertainty about reopening of the economic activities. The lockdown and uncertainty about reopening of economic activities caused a massive flight of informal workers from their workplaces to homes in villages (Srivastava 2020). Along with reduction in business activities, migration might be the main reason for the decrease in employment in the informal worker segment.

Table 8.6: Impact of COVID-19 on Types of Employment

Type of Workers	No. of Persons Employed		Change (%)
	2019–2020	2020–2021	
Family workers	452	474	4.87
Formal workers	12,635	14,225	12.58
Informal workers	21,675	11,455	-47.15
Total workers	34,762	26,154	-24.76

Source: Primary survey.

While many workers returned to their villages, some of the informal workers residing near work sites or having homes in urban centers were available for work but at slightly higher wages, given the scarcity of workers. Around half of the firms under study reported an increase in formal employment by an average of 7 employees per firm. These enterprises primarily belong to medium and small enterprises. In order to meet business commitments, orders taken before lockdown and fresh orders coming in

during lockdown, firm owners offered workers formal employment at relatively lower formal wages. The government was also willing to contribute the employer's share of the Employees' Provident Fund of employees for a few months during the pandemic. For firms, the need of the hour was to employ a few formal employees to manage the scarcity of workers, to meet business commitments, and to explore new opportunities during the pandemic, if their financial conditions allowed. Overall, this arrangement was beneficial for both workers and employers. Workers gained certainty in employment with other benefits while employers got committed employees. The increase in formal employment during the pandemic is an unusual phenomenon in the labor market. Although the share of formal employment is smaller in the total employment of MSMEs, this phenomenon highlights two important things: (i) there is a higher level of trust and commitment between employer and employee in the case of formal employment and (ii) government incentives can promote formal employment in the MSME sector.

8.4.4 Constraints to the Revival of MSMEs during the Pandemic

Major constraints faced by MSMEs in their revival during the pandemic include lack of demand, working capital issues, lack of skilled workers, and disrupted supply of raw materials, as described by the owners of firms. As discussed earlier, imposition of a sudden lockdown disrupted business activities severely, particularly in the case of MSMEs. Many firms closed while many were operating at a low scale. This development led to the increase in unemployment and reduction in income. Consequently, there was a decline in the intermediate demand as well as final consumption demand. Although the economy started showing signs of improvement with the gradual relaxation in the lockdown, commercial demand for products and services was very low. Some firm owners expected that it may take at least 2–3 years to return to the level of January 2020. Uncertainty in the market and low demand were the serious challenges in the revival of the sector. This situation also discouraged firms from borrowing from banks to make new investments.

Another important constraint for the revival of MSMEs was working capital issues. Due to delayed payments and difficulties in getting external finances, many firms were finding it difficult to meet their working capital requirements. The flight of laborers from urban and industrial centers led to a shortage of workers for the MSME sector. It also affected the efficiency of the existing workforce at the workplace; although some workers were available for employment, most of them lacked the required skills. Further, available workers were demanding higher wages, which led to increased labor cost.

Reduction in the supply of raw materials had worsened the disruption of supply chains, which had originated due to lockdown and restrictions on mobility. Because of hoarding, raw materials were available at higher prices, further increasing production cost. In some cases, the quality of raw materials was also very poor.

8.4.5 Efficacy of Government Policies in Revival of Industries and the MSME Sector

In order to understand the efficacy of government schemes during the pandemic, we asked questions about awareness, benefits received, and whether firms were satisfied for 10 selected government schemes (Table 8.7). We observed that firm owners had a high level of awareness about the government schemes. This finding may be due to the fact that all firms included in the study were registered firms. Further, the majority of them were being operated by young and educated people. Although the awareness level about the government schemes among firm owners was high, their performance in terms of receiving benefits was not very impressive except in the cases of a few schemes, viz. rescheduling of loan payments, initiatives under the Atmanirbhar Bharat package, public sector bank

loans in 59 minutes, and procurement and marketing support. Firms' satisfaction was low in the cases of a few schemes, viz. procurement and marketing support, TReDS, Micro Units Development and Refinance Agency (MUDRA) Yojana, rescheduling of loan repayments, and initiatives under the Atmanirbhar Bharat package.

Table 8.7: Government Schemes

S. No.	Name of Government Schemes	Awareness Level (% of total firms having awareness)	Benefits Received (of firms aware of scheme, % of firms that received benefits)	Satisfied (of firms that received benefits, % of firms that were satisfied)
1	Prime Minister's Employment Generation Programme	218 (96.89)	136 (62.39)	106 (77.94)
2	Credit Guarantee Fund Trust for Micro and Small Enterprises	211 (93.78)	115 (54.50)	83 (72.17)
3	Government e-Marketplace	204 (90.67)	90 (44.12)	30 (100.00)
4	Procurement and Marketing Support Scheme	169 (75.11)	123 (72.78)	8 (6.50)
5	Trade Receivables Discounting System (TreDS)	190 (84.44)	71 (37.37)	8 (11.27)
6	PSB Loans in 59 Minutes (MSME59)	225 (100.00)	194 (86.22)	186 (95.88)
7	MUDRA Yojana	211 (93.78)	16 (7.58)	8 (50.00)
8	Distressed Assets Fund (subordinate debt scheme for MSMEs	225 (100.00)	141 (62.67)	125 (88.65)
9	Rescheduling of Payments (term loans and working capital facilities)	225 (100.00)	225 (100.00)	132 (58.76)
10	Initiatives under Atmanirbhar Bharat	225 (100.00)	179 (79.56)	103 (57.54)

MSMEs = micro, small, and medium-sized enterprises; MUDRA = Micro Units Development and Refinance Agency, PSB = public sector bank.

Source: Primary survey.

The sudden lockdown imposition was highly inappropriate for the economy, as expressed by the majority of firm owners. Relaxation in interest payments and working capital support were much needed for MSMEs in their survival and revival during and after the pandemic. Government initiatives may only help firms to survive. The support the government offered was too small to handle the issues of the large and diverse MSME sector. In addition to the amount of relief being insufficient, there were serious challenges in the implementation of the announced initiatives given the huge informality in the MSME sector. Further, the initiatives would have been more helpful to business if the government had focused more on revival of the demand for products and services. A few firm owners suggested that the government should accelerate the pace of reviving the market at any cost via financial, technical, and marketing means.

8.5 Lessons for the Resilient and Sustained Growth of the Micro, Small, and Medium-Sized Enterprise Sector

Based on our interaction with owners of small firms, as discussed in this chapter, we may highlight the following lessons for the resilient and sustained growth of the MSME sector:

(i) The business models of small firms lack planning for business uncertainties. Unlike small firms, large firms have some planning for economic shocks and business uncertainties. Small firms lack financial and human resources. There is a need to encourage and train small firms to plan for business uncertainties in advance.
(ii) The resilience of a firm depends upon its financial resources and ability to invest in new technologies or business opportunities.
(iii) The COVID-19 pandemic has generated both demand and supply shocks. Financial assistance to small businesses may help them to survive, but for revival and sustained growth, governments should also focus on enhancing demand.
(iv) Government stimulus packages should address the local and sectoral needs of small firms.
(v) Governments should promote registration of small firms. Registered firms have better awareness about government schemes and access to them.

8.6 Conclusion and Policy Recommendations

The world has undergone an unprecedented recession due to the COVID-19 pandemic and its containment measures. MSMEs, informal workers, and weaker sections of society have been hardest hit. Economies, and particularly the MSME sector, are still struggling to revive themselves. In general, MSMEs face many challenges for their survival and growth including lack of finances, delayed payments, high informality, lack of a skilled workforce, lack of awareness about government policies and support programs, obsolete technologies, and low productivity. The pandemic has aggravated these constraints for MSMEs. By understanding the coping strategies of MSMEs during and after the pandemic, we may learn some useful lessons for future external shocks and crises such as pandemics. The present endeavor is a small attempt in this context.

Our findings show that the pandemic and lockdown has severely affected the MSME sector. The businesses of one third of firms collapsed while more than half of firms faced reductions in demand. Other impacts on small firms include erratic supply of raw materials, cancellations of previous orders, delay in payments, reduction in trade, increase in price of raw materials and production costs, and decrease in production activities. The employment in the MSMEs under study was reduced by around one fourth primarily in the case of the informal worker segment.

Revision in the MSME definition is a major step by the Government of India under the Atmanirbhar Bharat package. It has enabled some large firms to be categorized as MSMEs and avail benefits meant for the revival and growth of the MSME sector, which may affect access to government schemes for smaller firms, particularly micro enterprises. About other government initiatives to support the MSME sector in India, the study finds a high level of awareness among the firms under study, which might be due to their registration and being operated by young and educated persons. In terms of receiving benefits and satisfaction, their performance was not very impressive. Since the majority of MSMEs are unregistered, operate informally, and lack awareness, there is a need to increase the formalization of the sector as well as awareness about the government initiatives.

Major challenges faced by MSMEs in their revival during and after the pandemic include issues pertaining to working capital, delayed payments, shortage of workers, loan and repayments issues, lack of finances for investment in new opportunities, lack of demand for products and services, huge disruptions in supply of raw materials, and increase in cost of production. However, MSMEs that quickly adopted e-commerce platforms and had some savings to invest for this purpose were able to maintain their previous performance level or experienced an increase in turnover. Some enterprises switched to other activities such as production of masks and sanitizer and home delivery of products. Therefore, firms having financial resources and the flexibility to adopt new business models and explore new business opportunities may survive and maintain their growth during economic shocks. Our findings also emphasized that the resilience of a firm depends upon its financial resources and ability to invest in new technologies or business opportunities. There is a need to encourage and train small firms to plan for business uncertainties in advance. Mere financial assistance by the government during and after a crisis may help small businesses to survive, but for revival and sustained growth, governments should additionally focus on enhancing demand. Given the similar nature of MSMEs across world, these findings and policy suggestions may be applicable to other countries for the resilient and sustained growth of the MSME sector.

References

Aftab, R., M. Naveed, and S. Hanif. 2021. An Analysis of Covid-19 Implications for SMEs in Pakistan. *Journal of Chinese Economic and Foreign Trade Studies* 14(1): 74–88.

Akpan, I. J., D. Soopramanien, and D. H. Kwak. 2020. Cutting-Edge Technologies for Small Business and Innovation in the Era of COVID-19 Global Health Pandemic. *Journal of Small Business and Entrepreneurship* 1–11.

Banerjee, T. et al. 2022. Analyzing Organizational Barriers towards Building Postpandemic Supply Chain Resilience in Indian MSMEs: A Grey-DEMATEL Approach. *Benchmarking: An International Journal* (ahead-of-print).

Bartik, A. W. et al. 2020. *How Are Small Businesses Adjusting to COVID-19? Early Evidence from a Survey*. NBER Working Paper Series No. w26989. Cambridge, Massachusetts: National Bureau of Economic Research.

Bekaert, G., E. Engstrom, and A. Ermolov. 2020. Aggregate Demand and Aggregate Supply Effects of COVID-19: A Real-Time Analysis. Finance and Economics Discussion Series 2020-049. Washington: Board of Governors of the Federal Reserve System. https://doi.org/10.17016/FEDS.2020.049

Burton, D. et al. 2011. A Qualitative Study of Pandemic Influenza Preparedness among Small and Medium-Sized Businesses in New York City. *Journal of Business Continuity and Emergency Planning* 5(3): 267–279.

Cacciapaglia, G., C. Cot, and F. Sannino. 2020. Mining Google and Apple Mobility Data: Twenty-One Shades of European Social Distancing Measures for COVID-19.

Cepel, M. et al. 2020. The Impact of the COVID-19 Crisis on the Perception of Business Risk in the SME Segment. *Journal of International Studies* 13(3).

EIG. 2020. COVID-19 Impact Intense on MSMEs: Survey. *Financial Express*. 25 June. https://www.financialexpress.com/industry/covid-19-impact-intense-on-msmes-survey/2003744/ (accessed 18 August 2020).

Ernst & Young. 2020. Managing the Impact of COVID-19 on India's Supply Chains: Now, Next and Beyond. https://assets.ey.com/content/dam/ey-sites/ey-com/en_in/topics/government-and-public-sector/2020/09/managing-the-impact-of-covid-19-on-india-supply-chains.pdf

Gregurec, I., M. Tomičić Furjan, and K. Tomičić-Pupek. 2021. The Impact of COVID-19 on Sustainable Business Models in SMEs. *Sustainability* 13(3): 1098.

Guerrieri, V. et al. 2020. Macroeconomic Implications of COVID-19: Can Negative Supply Shocks Cause Demand Shortages? NBER Working Paper No. w26918. Cambridge, Massachusetts: National Bureau of Economic Research.

Gupta, A. and R. K. Singh. 2022. Managing Resilience of Micro, Small and Medium Enterprises (MSMEs) during COVID-19: Analysis of Barriers. *Benchmarking: An International Journal* (ahead-of-print).

Haleem, A., M. Javaid, and R. Vaishya. 2020. Effects of COVID-19 Pandemic in Daily Life. *Current Medicine Research and Practice* 10(2): 78–79.

ILO. 2020. ILO Monitor: COVID-19 and the World of Work. Sixth Edition: Updated Estimates and Analysis. https://www.ilo.org/wcmsp5/groups/public/---dgreports/---dcomm/documents/briefingnote/wcms_755910.pdf

Juergensen, J., J. Guimón, and R. Narula. 2020. European SMEs amidst the COVID-19 Crisis: Assessing Impact and Policy Responses. *Journal of Industrial and Business Economics* 47(3): 499–510.

Kuebart, A. and M. Stabler. 2020. Infectious Diseases as Socio-Spatial Processes: The Covid-19 Outbreak in Germany. *Tijdschrift voor economische en sociale geografie* 111(3): 482–496.

Lemi, K., M. Bogale, and W. Mengesha. 2020. The Effect of COVID-19 on Micro, Small and Medium Enterprises' Operation in Ethiopia. *Horn of African Journal of Business and Economics (HAJBE)* Special Issue I: 10–17.

Lonergan, M. and J. D. Chalmers. 2020. Estimates of the Ongoing Need for Social Distancing and Control Measures Post-"Lockdown" from Trajectories of COVID-19 Cases and Mortality. *European Respiratory Journal* 56: 2001483. https://doi.org/10.1183/13993003.01483-2020

Lu, Y. et al. 2020. The Perceived Impact of the Covid-19 Epidemic: Evidence from a Sample of 4807 SMEs in Sichuan Province, China. *Environmental Hazards* 19(4): 323–340.

Maheshkar, C. and N. Soni. 2021. Problems Faced by Indian Micro, Small and Medium Enterprises (MSMEs). *SEDME (Small Enterprises Development, Management & Extension Journal)* 48(2): 142–159. https://doi.org/10.1177/09708464211064498

McCall, B. 2020. COVID-19 and Artificial Intelligence: Protecting Health-Care Workers and Curbing the Spread. *Lancet Digital Health* 2(4): 166–167.

McKee, M. and D. Stuckler. 2020. If the World Fails to Protect the Economy, COVID-19 Will Damage Health Not Just Now but Also in the Future. *Nature Medicine* 26(5): 640–642.

MicroSave. 2020. Impact of COVID-19 Pandemic on Micro, Small, and Medium Enterprises (MSMEs). https://www.microsave.net/wp-content/uploads/2020/06/Impact-of-COVID-19-pandemic-on-micro-small-and-medium-enterprises-MSMEs-India-report-1.pdf

Nagraj, R. and V. Vaibhav. 2020. Revising the Definition of MSMEs: Who Is Likely to Benefit from It? *Indian Journal of Labour Economics* 63(S1): 119–126.

Nicola, M. et al. 2020. The Socio-Economic Implications of the Coronavirus Pandemic (COVID-19): A Review. *International Journal of Surgery* 78: 185–193.

Nordhagen, S., U. Igbeka, H. Rowlands, R. S. Shine, E. Heneghan, and J. Tench. 2021. COVID-19 and Small Enterprises in the Food Supply Chain: Early Impacts and Implications for Longer-Term Food System Resilience in Low- and Middle-Income Countries. *World Development* 141: 105405. https://doi.org/10.1016/j.worlddev.2021.105405

OECD. 2020. Tackling Coronavirus (COVID-19): SME Policy Responses. Paris: Organisation for Economic Co-operation and Development. https://www.oecd.org/coronavirus/policy-responses/coronavirus-covid-19-sme-policy-responses-04440101/

Papadopoulos, T., K. N. Baltas, and M. E. Balta. 2020. The Use of Digital Technologies by Small and Medium Enterprises during COVID-19: Implications for Theory and Practice. *International Journal of Information Management* 55: 102192.

Prasad, S. et al. 2015. Building Disaster-Resilient Micro Enterprises in the Developing World. *Disasters* 39(3): 447–466.

Purba, M. et al. 2021. The Effect of Digital Marketing and E-Commerce on Financial Performance and Business Sustainability of MSMEs during COVID-19 Pandemic in Indonesia. *International Journal of Data and Network Science* 5(3): 275–282.

Rathore, U. and S. Khanna. 2020. From Slowdown to Lockdown: Effects of the COVID-19 Crisis on Small Firms in India. https://ssrn.com/abstract=3615339 or http://dx.doi.org/10.2139/ssrn.3615339

Ratnasingam, J. et al. 2020. How Are Small and Medium Enterprises in Malaysia's Furniture Industry Coping with COVID-19 Pandemic? Early Evidences from a Survey and Recommendations for Policymakers. *BioResources* 15(3): 5951–5964.

RBI. 2019. *Report of Expert Committee on Micro, Small and Medium Enterprises*. Mumbai: Reserve Bank of India. https://dcmsme.gov.in/Report%20of%20Expert%20Committee%20on%20MSMEs%20-%20The%20U%20K%20Sinha%20Committee%20constitutes%20by%20RBI.pdf

del Rio-Chanona, R. M. et al. 2020. Supply and Demand Shocks in the COVID-19 Pandemic: An Industry and Occupation Perspective. *Oxford Review of Economic Policy* 36(S1): S94–S137.

Roper, S. and J. Turner. 2020. R&D and Innovation after COVID-19: What Can We Expect? A Review of Prior Research and Data Trends after the Great Financial Crisis. *International Small Business Journal* 38(6): 504–514.

Shafi, M., J. Liu, and W. Ren. 2020. Impact of COVID-19 Pandemic on Micro, Small, and Medium-Sized Enterprises Operating in Pakistan. *Research in Globalization* 2: 10018. http://dx.doi.org/10.1016/j.resglo.2020.100018

Sharma, A. K. 2021. Reigniting Sustainable Growth of MSMEs in the Aftermath of Covid-19 Pandemic. *ISID Policy Brief No. 21-02*. New Delhi: Institute for Studies in Industrial Development (ISID).

____. 2022a. Enhancing Credit Flow for Accelerating the Recovery of MSMEs: Some Policy Lessons. *ISID Policy Brief No. 22-04*. New Delhi: Institute for Studies in Industrial Development (ISID).

____. 2022b. Implications of Policy Initiatives for MSMEs amid Economic Disruptions Caused by Covid-19. *Vikalpa: The Journal for Decision Makers* 47(1): 7–18.

Sharma, A. K., and S. K. Rai 2022. Impact of Covid-19 on MSMEs in India: Evidence from a Primary Survey. ISID Working Paper No. 243. New Delhi: Institute for Studies in Industrial Development (ISID).

Sharma, A. K., and S. K. Rai 2023. Understanding the Impact of Covid-19 on MSMEs in India: Lessons for Resilient and Sustained Growth of Small Firms. *Journal of Small Business Strategy* 33(1):70–83.

Singh, M., P. Kumar, and R. Rathi. 2019. Modelling the Barriers of Lean Six Sigma for Indian Micro-Small Medium Enterprises: An ISM and MICMAC Approach. *The TQM Journal* 31(5): 673–695. https://doi.org/10.1108/TQM-12-2018-0205.

Srivastava, R. 2020. Labour Migration, Vulnerability, and Development Policy: The Pandemic as Inflexion Point? *Indian Journal of Labour Economics* 63: 859–883.

Suwarni, E. and M. A. Handayani. 2021. Development of Micro, Small and Medium Enterprises (MSME) to Strengthen Indonesia's Economic Post COVID-19. *Business Management and Strategy* 12(2): 19–34.

Tairas, D. R. 2020. COVID-19 Pandemic and MSMEs: Impact and Mitigation. *Jurnal Ekonomi Indonesia* 9(1): 67–80.

Wijaya, O. Y. A. 2020. The Impact of Covid-19 on Micro, Small and Medium Enterprises (MSMEs) in East Java Province, Indonesia and Strategies for Overcoming: Ad Interim. *Talent Development and Excellence* 12(2): 3454–3469.

CHAPTER 9

Urban Household Coping Strategies during the COVID-19 Pandemic in Viet Nam

Dang Huyen Trang

9.1 Introduction and Literature Review

Due to rapid contagion and severity, the World Health Organization (WHO) declared the coronavirus disease (COVID-19) as a pandemic on 11 March 2020 (WHO 2020). Since its outbreak, the COVID-19 pandemic has caused adverse shocks to the economy (Altig et al. 2020) and influenced many aspects of people's lives (Kansiime et al. 2021; Hanspal, Weber, and Wohlfart 2020; Bukuluki et al. 2020). Because of the uncertainty, many families are experiencing higher financial distress during the pandemic.

Government control measures included various restrictions such as lockdowns, social distancing, and closure of some specific institutions. These COVID-19–related measures have brought unprecedented disruption to people's daily lives, economic activities, and well-being. Thunström et al. (2020) found that control measures such as social distancing could save lives but impose high costs on society due to reduced economic activity. Strict policies that disrupt routines and cause uncertainty may also lead to negative effects and can seriously impact individuals' mental health or psychological status (Flesia 2020; Anderson et al. 2019; Grupe and Nitschke 2013). While governments worldwide have responded to this pandemic with different approaches to coping, most households and individuals have also applied their own strategies in dealing with relevant challenges caused by COVID-19's effects.

In Viet Nam, the government has applied wide-ranging policy apparatuses to control the infection with strict measures, including quarantine, isolation of suspected virus carriers, and voluntary isolation in the community (La et al. 2020; Quach and Hoang 2020). Between January and March 2020, Viet Nam temporarily suspended all flights from pandemic-affected areas or countries to Viet Nam. On 3 March 2020, the government issued several supporting tax policies to cope with the COVID-19 pandemic such as extending tax payment deadlines for value-added tax, corporate income tax, and personal income tax; reducing corporate income tax by 30%; exempting household and individual business taxes; and reducing 30% of value-added tax on some goods and services (Ministry of Finance 2021). On 1 April 2020, Viet Nam initiated its first nationwide lockdown to suppress the spread of COVID-19. The pandemic has generated a complex economic shock with its negative influence on the economic and non-economic dimensions of vulnerable households' well-being (De Stefani, Laws, and Sollaci 2022; UNDP 2021).

Clarke and Dercon (2009) and Dercon (2002) pointed out that households could utilize external resources such as insurance when facing shocks. However, according to Zimmerman and Carter (2003), insurance and financial markets might not be accessible to a large share of the population in developing countries. Because of being poor, households may take on a higher debt burden that they would find even harder to overcome. Therefore, rural households are not prone to shocks as they have limited market access (Tran 2014). Reducing consumption or relying on social networks are discussed in previous studies (Ashraf and Routray 2013; Echevin and Tejerina 2013; Kazianga and Udry 2006; Zimmerman and Carter 2003) of households dealing with shocks. In addition to coping with shocks, households could choose to use their available savings (Corbett 1988; Ellis 2000; DeLoach and Smith-Lin 2018; Doss et al. 2018). A family may respond to a shock by purchasing less food (Mahmud and Riley

2021). In another study, Del Ninno, Dorosh, and Smith (2003) found that households would borrow more to buy food in light of a shock. When rural households are hit by adversity, they are hesitant to sell livestock or assets to keep their consumption going (Fafchamps, Udry, and Czukas 1998; Kazianga and Udry 2006). Migration from urban to rural areas and increased family employment on farms could be necessary for households to sustain their jobs, income, and livelihood for their members (Fallon and Lucas 2002). Additionally, according to a study about the Vietnamese context by Waibel et al. (2020), rural households are frequently more robust to global shocks.

The literature highlights many different coping strategies that households in general or rural households in particular can use to face shocks. Meanwhile, studies reviewing urban households' coping strategies have been limited.

The study presented in this chapter reviews urban households' coping strategies in Viet Nam. Compared to their rural peers, the study reveals that urban households are more likely to use strategies such as borrowing from their friends and family, reducing their food consumption, and relying on their savings against doing nothing. In addition, urban households report investing more effort in their current job if they are an ethnic minority group. We find that urban households are less likely to rely on a loan from a financial institution as one of their responses to the COVID-19 shock. We do not find other significant results in solutions like growing own gardens or agriculture in urban areas even though they have been found in other studies (Galhena, Freed, and Maredia 2013; Lal 2020). We found no difference between urban and rural households in reducing nonfood consumption or seeking assistance from their friends and family.

This chapter makes two contributions to the related literature. First, it adds to the literature on households' strategies for coping with COVID-19 impacts. It is crucial to monitor the situation to develop an appropriate policy response to a similarly volatile situation in the future. This chapter complements this strand of literature by showing that urban households are finding different means to sustain their finances and consumption compared to their rural counterparts. Second, the chapter contributes to the literature studying the context of Viet Nam, with a focus on urban families. Few studies have investigated Vietnamese households' coping strategies in response to the pandemic. In exploring Vietnamese urban households' coping strategies during the COVID-19 pandemic, this chapter offers policy makers recommendations for policy development.

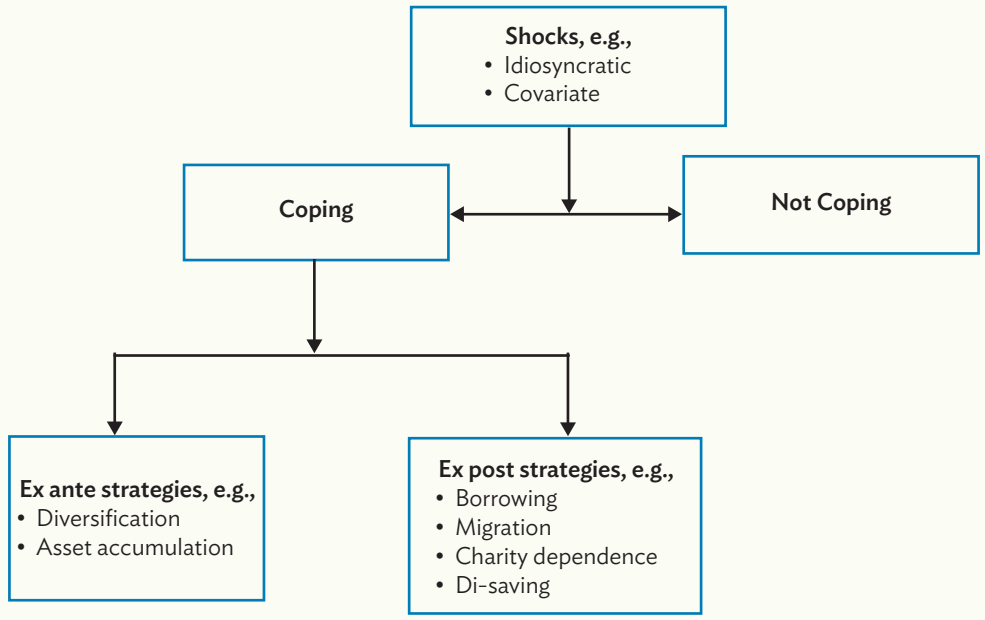
9.2 Background

On 22 January 2020, the first COVID-19 case was recorded in Viet Nam during the early stages of the pandemic (Phan et al. 2020). After Viet Nam declared an epidemic in early February, the government issued relevant health policies and took early action to mitigate the impact of COVID-19 in the country. These measures helped the country maintain low numbers of cumulative cases and deaths. The government emphasized quarantine to cover all travelers coming from or transited through the COVID-19–affected areas. Then, the government continued to adopt several control measures following the declaration by the WHO about the pandemic. Lockdowns and social distancing measures were implemented at the national and provincial levels between mid-April and early May. After 99 days without any new COVID-19 cases in the country, Da Nang city recorded a new case on 25 July 2020, which made the city return to the lockdown situation. Early 2021 witnessed Hai Duong, a northern province, enter the lockdown and travel restrictions. According to the WHO (2022), up to the end of March 2022, the cumulative cases in Viet Nam reached nearly 8 million and the cumulative deaths were more than 41 thousand.

9.3 Theoretical Framework

Figure 9.1 displays a conceptual framework about the relationship between shocks and households' adaptation with ex ante preparation or ex post strategies. OECD (2009) showed that households' ex ante practices include crop or income diversification and savings while their ex post coping strategies include borrowing, migration, dependence on intra-community charity, and sales of assets. In this chapter, we do not differentiate between ex ante and ex post strategies when analyzing urban households' coping choices.

Figure 9.1: Conceptual Framework for Coping Strategies



Source: Adapted from OECD (2009).

9.4 Data and Empirical Strategies

The study employs the data from the rounds of the Viet Nam COVID-19 High-Frequency Phone Survey of Households by the World Bank from June 2020 to March 2021. The survey uses a nationally representative household survey from 2018 as the sampling frame. The 2018 baseline survey includes 46,980 households from 3,132 communes (about 25% of total communes in Viet Nam). This monitoring data helps gather insights on household well-being as post-lockdown reopening unfolds and highlights the effects on the most vulnerable members of Vietnamese society. The first round of the Viet Nam household high-frequency phone survey was conducted between 5 June and 8 July 2020. Over 6,000 households were contacted from all provinces in the country. The survey was conducted over five rounds and was designed as a panel data survey—the same households were contacted repeatedly through the rounds. The fifth round was completed in March 2021, with approximately 4,000 households. Each round was conducted at a time when Viet Nam faced a new wave of COVID-19 and some restrictions such as social distancing or lockdown measures.

The data consists of a wide range of information, including changes in behaviors in response to the COVID-19 pandemic, health, education, employment, coping, and perceptions of the government's response. However, not all of the 6,000 participants participated through all these rounds, and the questionnaire was modified among these rounds. Therefore, the study will use the data from the second to the fifth round to make it consistent when the coping questions are included.

The percentage of people living in urban areas has increased by 10 percentage points in the past 20 years, reaching 34.4% in 2019. According to the 2019 Population and Housing Census, there were 33,059,735 people in urban areas and 63,149,249 people in rural areas (GSO 2019). Though the poverty rate in Viet Nam's urban areas was low by national standards, the poor and vulnerable have faced difficulties in the city. This situation indicates that urban households are likely to experience adverse impacts of COVID-19 and must apply coping strategies.

As shown in the summary statistics displayed in Table 9.1, the most used coping strategy in Vietnamese households is to reduce food and nonfood consumption. About 50% of the households reduced meals when hit by COVID-19. In addition, one in five households borrows from family and friends. About 7% of the households take loans from financial institutions. Other households seek support from their savings, put more effort into their current job, or migrate to rural areas.

Table 9.1: Descriptive Table

Variable	Description	Obs.	Mean	Std. Dev.	Min.	Max.
urban	1 = Yes, 0 = No	16,299	0.30	0.46	0	1
region	1, 2, 3, 4, 5, 6 = Region Region 1: Red River Delta Region 2: Midlands and Northern Mountainous Areas Region 3: Northern and Coastal Central Region Region 4: Central Highlands Region 5: Southeastern Area Region 6: Mekong River Delta	16,299	3.02	1.69	1	6
ethnic	1 = Major, 0 = Minor	16,299	0.77	0.42	0	1
B40	1 = Yes, 0 = No	16,299	0.44	0.50	0	1
hhsize	Number of members	16,299	4.03	1.68	1	18
assist	Received (nonfinancial) assistance from friends and family	5,059	0.05	0.21	0	1
borrow	Borrowed from friends and family	5,059	0.21	0.41	0	1
loan	Took a loan from a financial institution	5,059	0.07	0.26	0	1
food	Reduced food consumption	5,059	0.51	0.50	0	1
nonfood	Reduced nonfood consumption	5,066	0.49	0.50	0	1
saving	Relied on savings	5,066	0.05	0.21	0	1
grow	Grew food for self-consumption	4,858	0.06	0.24	0	1
job	Put more effort into current jobs	4,858	0.05	0.23	0	1
working adult	Number of working-age adults currently working	3,922	1.25	1.01	0	8
wage work	Currently have a wage job	16,299	0.25	0.43	0	1
family biz	Current status of family business (1 = Open, 0 = Closed)	16,299	0.20	0.40	0	1
hhinc change	Income change compared to last year	16,202	2.25	0.58	1	3
covid threat	Perception of COVID-19 as a threat (1 = Yes, 0 = No)	12,422	0.75	0.43	0	1
inc shock	Felt affected by income shock (1 = Yes, 0 = No)	16,299	0.25	0.43	0	3
health shock	Felt affected by health shock (1 = Yes, 0 = No)	16,299	0.03	0.16	0	1
other shock	Felt affected by other shock (travel restriction, etc.)	16,299	0.05	0.21	0	1

Source: Author's calculations.

The study employs a linear probability model from the second to fifth survey round to explore urban households' coping strategies. Specifically, the model takes the following form.

$$P(Cop_{jt} = 1| X) = \alpha + \beta \text{ urban household}_t + \delta X_t + \varepsilon_t$$

On the left side, Cop_j indicates whether the household interviewed in survey round t has used the specific coping strategy j = 1, ..., 9. On the right side, there is a constant α. Particularly, the main indicator of an urban household is the dummy variable, *urban*, indicating whether the household interviewed in survey round t is living in the urban (= 1) or rural area (= 0). A set of household characteristics are controlled, including household size, region, poverty status, number of working-age adults currently working, whether there is a person in the household with a formal (wage) job, and whether their family business is open or closed.

In addition, we hypothesize that urban households could have different coping strategies compared to their peers in rural areas because of poverty and ethnicity. Then, to formally examine whether the differences in coping are due to these two reasons, we look for interaction effects between the urban variable and two hypothetical channels: the household poverty indicator (B40) and their ethnicity.

The study employs multinominal logit estimation to explore how the choices of coping strategies depend on households' demographic characteristics. Specifically, we use the response "do nothing" as the base category to analyze households' selection of coping strategies.

9.5 Findings

9.5.1 The Perception of COVID-19 as a Threat

Table 9.2 shows the perception of COVID-19 as a threat to urban households in the second to fifth rounds of the survey. The variable COVID-19 threat is categorized as "1" if households considered it a substantial or moderate threat. If COVID-19 is perceived as a non-threat in households' responses, its value will equal "0." Surprisingly, the coefficients for urban households are not significant. This result may indicate that COVID-19 is not considered a serious threat to urban households. However, households that either belong to an ethnic minority group or have many members are more likely to think of COVID-19 as a substantial or moderate threat. This difference could be due to the fact that more members in the households have to be sustained financially throughout the pandemic. Households residing in the Mekong Delta region also think of COVID-19 as a threat. Further, those households with a family business have the same opinion. This result could indicate that their business may be affected by COVID-19, so they consider it as a threat. Overall, those households living in the urban areas have equipped themselves with coping strategies.

Table 9.2: Perception of COVID-19 as a Threat

Variable	(1) covid_threat	(2) covid_threat	(3) covid_threat
urban	−0.0288	0.0478	0.0498
	(0.0259)	(0.0721)	(0.0751)
ethnic	0.1146***	0.1239***	0.1243***
	(0.0338)	(0.0359)	(0.0362)
urban_ethnic		−0.0818	−0.0828
		(0.0756)	(0.0751)
urban_B40			−0.0041
			(0.0516)
B40	0.0133	0.0141	0.0151
	(0.0232)	(0.0233)	(0.0261)
hhsize	0.0262***	0.0264***	0.0264***
	(0.0068)	(0.0068)	(0.0068)
Midlands and Northern Mountainous Areas	0.0165	0.0165	0.0164
	(0.0363)	(0.0363)	(0.0363)
Northern and Coastal Central Region	−0.0135	−0.0131	−0.0130
	(0.0307)	(0.0307)	(0.0307)
Central Highlands	−0.0516	−0.0511	−0.0511
	(0.0421)	(0.0420)	(0.0421)
Southeastern Area	−0.0385	−0.0376	−0.0378
	(0.0390)	(0.0391)	(0.0392)
Mekong Delta	−0.0594*	−0.0607*	−0.0606*
	(0.0338)	(0.0338)	(0.0337)
working_adult	−0.0181	−0.0181	−0.0180
	(0.0123)	(0.0123)	(0.0123)
wage_work	0.0207	0.0206	0.0207
	(0.0253)	(0.0253)	(0.0252)
family_biz	0.1320***	0.1318***	0.1319***
	(0.0243)	(0.0243)	(0.0242)
Constant	0.5428***	0.5342***	0.5332***
	(0.0479)	(0.0491)	(0.0503)
Observations	3,922	3,922	3,922
R-squared	0.034	0.034	0.034

Robust standard errors in parentheses

*** p < 0.01, ** p < 0.05, * p < 0.1.

Source: Author's calculations.

9.5.2 General Coping Strategies

As shown in Table 9.3, the regression analysis illustrates urban households' coping strategies. Compared to rural households, urban households are nearly five percentage points less likely to seek a loan from a financial institution (column 3). For other coping strategies, none of their coefficients are significant.

Table 9.3: Urban Households with General Coping Strategies

Variable	(1) assist	(2) borrow	(3) loan	(4) food	(5) nonfood	(6) saving	(7) grow	(8) job
urban	0.0153	0.0428	−0.0480***	0.0433	−0.0172	0.0325	−0.0214	−0.0131
	(0.0172)	(0.0390)	(0.0157)	(0.0541)	(0.0535)	(0.0260)	(0.0143)	(0.0194)
Midlands and Northern Mountainous Areas	0.0012	0.0531	−0.0033	−0.0379	−0.0022	−0.0359	−0.0371	−0.0025
	(0.0183)	(0.0569)	(0.0336)	(0.0727)	(0.0701)	(0.0243)	(0.0322)	(0.0286)
Northern and Coastal Central Region	0.0118	0.1203**	0.0086	0.0022	−0.0916	0.0204	−0.0023	−0.0518**
	(0.0204)	(0.0477)	(0.0284)	(0.0635)	(0.0621)	(0.0344)	(0.0243)	(0.0235)
Central Highlands	0.0106	0.0659	0.0873*	0.0353	0.0430	−0.0217	−0.0921***	0.0026
	(0.0270)	(0.0699)	(0.0507)	(0.0842)	(0.0807)	(0.0297)	(0.0229)	(0.0379)
Southeastern Area	−0.0115	0.0347	−0.0165	−0.0362	−0.0461	0.0438	−0.0491***	−0.0614**
	(0.0308)	(0.0583)	(0.0214)	(0.0843)	(0.0839)	(0.0514)	(0.0190)	(0.0266)
Mekong Delta	−0.0088	0.0763	−0.0063	−0.1120	−0.1171*	−0.0376*	−0.0311	−0.0148
	(0.0176)	(0.0520)	(0.0276)	(0.0690)	(0.0681)	(0.0211)	(0.0236)	(0.0326)
ethnic	0.0188	−0.0072	−0.0178	0.0465	0.0810	0.0128	−0.0885**	0.0292*
	(0.0141)	(0.0606)	(0.0365)	(0.0735)	(0.0717)	(0.0200)	(0.0346)	(0.0156)
B40	0.0036	0.0540	0.0114	−0.0454	−0.0698	−0.0250	0.0239	−0.0029
	(0.0124)	(0.0393)	(0.0225)	(0.0483)	(0.0478)	(0.0184)	(0.0166)	(0.0201)
hhsize	−0.0061	0.0206	0.0029	−0.0167	−0.0211	0.0049	−0.0142**	0.0033
	(0.0039)	(0.0134)	(0.0066)	(0.0169)	(0.0167)	(0.0058)	(0.0071)	(0.0068)
working_adult	−0.0116**	−0.0445**	−0.0012	0.0253	0.0347	0.0165	0.0165	0.0033
	(0.0054)	(0.0191)	(0.0120)	(0.0281)	(0.0271)	(0.0208)	(0.0116)	(0.0105)
wage_work	−0.0047	−0.0702*	0.0007	0.0009	0.0601	0.0083	0.0035	0.0437*
	(0.0200)	(0.0421)	(0.0169)	(0.0573)	(0.0564)	(0.0321)	(0.0197)	(0.0240)
family_biz	−0.0132	−0.1115***	0.0292	−0.0126	0.0579	0.0011	−0.0216	0.0251
	(0.0174)	(0.0364)	(0.0232)	(0.0538)	(0.0542)	(0.0247)	(0.0165)	(0.0247)
covid_threat	0.0150	0.0775*	0.0341	0.1472*	0.1423*	−0.0435	−0.0042	−0.0737*
	(0.0134)	(0.0397)	(0.0218)	(0.0772)	(0.0775)	(0.0399)	(0.0249)	(0.0392)
Constant	0.0473	0.0642	0.0340	0.4372***	0.4609***	0.0346	0.1934***	0.0776
	(0.0356)	(0.0827)	(0.0496)	(0.1213)	(0.1190)	(0.0729)	(0.0528)	(0.0481)
Observations	1,071	1,071	1,071	1,071	1,071	1,071	1,071	1,071
R-squared	0.019	0.049	0.028	0.024	0.037	0.044	0.054	0.033

Robust standard errors in parentheses.

*** p < 0.01, ** p < 0.05, * p < 0.1.

Source: Author's calculations.

There are some differences between the regions in which urban households are located. For the Midlands and Northern Mountainous Areas, we see no significant variation in households' coping strategies. For the Northern and Coastal Central Region, households tend to borrow from friends or family and do not put more effort into their current job. Meanwhile, we see a higher probability of communities in the Central Highlands choosing to get loans from a financial institution and not growing food for their own consumption. The Southeastern Area provides another picture: households there have about a five-percentage-point-lower probability of growing food for their consumption and a six-percentage-point-lower probability of putting more effort into their current job. When it comes to the Mekong Delta, households are less likely to both reduce their nonfood consumption and depend on their savings.

Considering other household characteristics, we also record some differences of urban households compared to rural ones. For instance, urban households from the majority group have a lower probability of growing for their consumption but have a higher probability of focusing on their jobs. In addition, urban households with at least one adult at working age would be less likely to ask for assistance from their friends or family. Likewise, they are also less likely to borrow from friends or family when they have at least one person currently working or have a family business. In the meantime, their perception of COVID-19 as a threat will increase their probability of borrowing, reducing food and nonfood consumption, and not putting more effort into their current jobs.

9.5.3 Coping Strategies in Terms of Poverty and Ethnicity

To investigate further evidence of causes for differences in coping strategies, the study adds an interaction dummy. This variable is generated by adding the household location – urban dummy with the poverty and ethnicity into the regressions.

Table 9.4 shows that after the interaction term is included in the regression, none of the coefficients for the poverty channel is significant. These results could indicate that living in an urban area and not being poor is not associated with a probability of seeking support from friends or family, borrowing, taking loans, reducing consumption, relying on savings, or putting more effort into current jobs.

Table 9.4: Urban Households with Coping Strategies via Poverty Channel

Variable	(1) assist	(2) borrow	(3) loan	(4) food	(5) nonfood	(6) saving	(7) grow	(8) job
urban	0.0027	0.0455	−0.0416**	0.0699	0.0033	0.0477	−0.0247	−0.0283
	(0.0198)	(0.0458)	(0.0186)	(0.0656)	(0.0651)	(0.0361)	(0.0151)	(0.0237)
urban_B40	0.0476	−0.0104	−0.0240	−0.1004	−0.0774	−0.0574	0.0127	0.0576
	(0.0400)	(0.0880)	(0.0336)	(0.1067)	(0.1041)	(0.0471)	(0.0370)	(0.0431)
ethnic	0.0138	−0.0062	−0.0153	0.0570	0.0891	0.0188	−0.0899***	0.0232
	(0.0127)	(0.0618)	(0.0373)	(0.0741)	(0.0720)	(0.0199)	(0.0346)	(0.0148)
B40	−0.0092	0.0568	0.0178	−0.0184	−0.0490	−0.0096	0.0205	−0.0184
	(0.0128)	(0.0451)	(0.0296)	(0.0556)	(0.0556)	(0.0216)	(0.0196)	(0.0213)
hhsize	−0.0061	0.0206	0.0029	−0.0168	−0.0212	0.0049	−0.0142**	0.0034
	(0.0039)	(0.0134)	(0.0066)	(0.0169)	(0.0166)	(0.0058)	(0.0071)	(0.0067)
Midlands and Northern Mountainous Areas	0.0020	0.0529	−0.0037	−0.0396	−0.0035	−0.0368	−0.0369	−0.0016
	(0.0181)	(0.0568)	(0.0336)	(0.0727)	(0.0699)	(0.0244)	(0.0321)	(0.0281)
Northern and Coastal Central Region	0.0115	0.1204**	0.0088	0.0029	−0.0911	0.0207	−0.0024	−0.0521**
	(0.0202)	(0.0478)	(0.0284)	(0.0632)	(0.0621)	(0.0344)	(0.0244)	(0.0235)
Central Highlands	0.0075	0.0666	0.0889*	0.0419	0.0481	−0.0179	−0.0929***	−0.0012
	(0.0269)	(0.0702)	(0.0509)	(0.0840)	(0.0806)	(0.0293)	(0.0234)	(0.0375)
Southeastern Area	−0.0092	0.0342	−0.0177	−0.0411	−0.0499	0.0410	−0.0484***	−0.0586**
	(0.0300)	(0.0588)	(0.0214)	(0.0839)	(0.0838)	(0.0497)	(0.0183)	(0.0259)
Mekong Delta	−0.0104	0.0766	−0.0055	−0.1086	−0.1146*	−0.0357*	−0.0315	−0.0167
	(0.0181)	(0.0521)	(0.0278)	(0.0690)	(0.0683)	(0.0210)	(0.0235)	(0.0336)
working_adult	−0.0118**	−0.0445**	−0.0010	0.0258	0.0351	0.0167	0.0164	0.0030
	(0.0054)	(0.0191)	(0.0121)	(0.0278)	(0.0269)	(0.0207)	(0.0115)	(0.0103)
wage_work	−0.0059	−0.0699	0.0013	0.0035	0.0621	0.0098	0.0032	0.0423*
	(0.0195)	(0.0426)	(0.0169)	(0.0570)	(0.0562)	(0.0326)	(0.0195)	(0.0237)

continued on next page

Table 9.4 *continued*

Variable	(1) assist	(2) borrow	(3) loan	(4) food	(5) nonfood	(6) saving	(7) grow	(8) job
family_biz	−0.0146	−0.1112***	0.0299	−0.0096	0.0602	0.0028	−0.0220	0.0234
	(0.0181)	(0.0361)	(0.0234)	(0.0535)	(0.0539)	(0.0242)	(0.0165)	(0.0245)
covid_threat	0.0144	0.0776*	0.0344	0.1484*	0.1432*	−0.0428	−0.0043	−0.0744*
	(0.0135)	(0.0397)	(0.0218)	(0.0777)	(0.0781)	(0.0401)	(0.0249)	(0.0394)
Constant	0.0585	0.0617	0.0284	0.4135***	0.4427***	0.0211	0.1964***	0.0912**
	(0.0356)	(0.0858)	(0.0513)	(0.1247)	(0.1222)	(0.0780)	(0.0537)	(0.0464)
Observations	1,071	1,071	1,071	1,071	1,071	1,071	1,071	1,071
R-squared	0.022	0.049	0.028	0.026	0.038	0.046	0.054	0.036

Robust standard errors in parentheses.

*** p < 0.01, ** p < 0.05, * p < 0.1.

Source: Author's calculations.

Table 9.5 illustrates that households residing in urban areas will be less likely to borrow as a coping strategy toward COVID-19. However, if these households belong to the Kinh majority group, they are more likely to borrow than other ethnic minority groups are. In contrast, those in the majority group are less likely to reduce their food consumption.

Table 9.5: Urban Households with Coping Strategies via Ethnicity Channel

Variable	(1) assist	(2) borrow	(3) loan	(4) food	(5) nonfood	(6) saving	(7) grow	(8) job
urban	−0.0068	−0.1535***	−0.0002	0.2829**	−0.0028	−0.0128	−0.0823**	−0.0354
	(0.0135)	(0.0568)	(0.0872)	(0.1241)	(0.1591)	(0.0165)	(0.0393)	(0.0260)
urban_ethnic	0.0230	0.2042***	−0.0497	−0.2493*	−0.0150	0.0471	0.0634	0.0232
	(0.0203)	(0.0687)	(0.0886)	(0.1341)	(0.1670)	(0.0334)	(0.0422)	(0.0332)
ethnic	0.0171	−0.0223	−0.0142	0.0649	0.0821	0.0093	−0.0932**	0.0275*
	(0.0146)	(0.0637)	(0.0384)	(0.0764)	(0.0746)	(0.0212)	(0.0368)	(0.0163)
B40	0.0034	0.0519	0.0119	−0.0428	−0.0697	−0.0255	0.0232	−0.0032
	(0.0124)	(0.0393)	(0.0227)	(0.0483)	(0.0478)	(0.0184)	(0.0165)	(0.0200)
hhsize	−0.0061	0.0207	0.0029	−0.0167	−0.0211	0.0050	−0.0142**	0.0033
	(0.0039)	(0.0134)	(0.0066)	(0.0169)	(0.0167)	(0.0058)	(0.0071)	(0.0068)
Midlands and Northern Mountainous Areas	0.0015	0.0550	−0.0038	−0.0402	−0.0023	−0.0354	−0.0365	−0.0023
	(0.0184)	(0.0568)	(0.0334)	(0.0726)	(0.0701)	(0.0242)	(0.0322)	(0.0287)
Northern and Coastal Central Region	0.0118	0.1198**	0.0087	0.0028	−0.0916	0.0203	−0.0024	−0.0518**
	(0.0204)	(0.0478)	(0.0284)	(0.0634)	(0.0621)	(0.0344)	(0.0243)	(0.0235)
Central Highlands	0.0108	0.0674	0.0869*	0.0334	0.0429	−0.0214	−0.0916***	0.0028
	(0.0270)	(0.0697)	(0.0509)	(0.0839)	(0.0807)	(0.0297)	(0.0228)	(0.0380)
Southeastern Area	−0.0118	0.0322	−0.0159	−0.0331	−0.0459	0.0432	−0.0498***	−0.0617**
	(0.0307)	(0.0584)	(0.0215)	(0.0846)	(0.0841)	(0.0512)	(0.0190)	(0.0267)
Mekong Delta	−0.0085	0.0795	−0.0071	−0.1159*	−0.1174*	−0.0369*	−0.0300	−0.0144
	(0.0178)	(0.0521)	(0.0277)	(0.0690)	(0.0682)	(0.0212)	(0.0237)	(0.0327)

continued on next page

Table 9.5 *continued*

Variable	(1) assist	(2) borrow	(3) loan	(4) food	(5) nonfood	(6) saving	(7) grow	(8) job
working_adult	−0.0116**	−0.0445**	−0.0011	0.0253	0.0347	0.0165	0.0165	0.0033
	(0.0054)	(0.0191)	(0.0120)	(0.0281)	(0.0272)	(0.0207)	(0.0116)	(0.0105)
wage_work	−0.0046	−0.0696*	0.0005	0.0002	0.0600	0.0085	0.0037	0.0438*
	(0.0200)	(0.0421)	(0.0169)	(0.0572)	(0.0564)	(0.0322)	(0.0198)	(0.0241)
family_biz	−0.0131	−0.1109***	0.0290	−0.0134	0.0578	0.0012	−0.0214	0.0252
	(0.0174)	(0.0364)	(0.0232)	(0.0539)	(0.0543)	(0.0246)	(0.0165)	(0.0247)
covid_threat	0.0150	0.0775*	0.0341	0.1472*	0.1423*	−0.0435	−0.0042	−0.0737*
	(0.0134)	(0.0396)	(0.0218)	(0.0770)	(0.0776)	(0.0399)	(0.0249)	(0.0392)
Constant	0.0487	0.0763	0.0311	0.4224***	0.4601***	0.0374	0.1972***	0.0790
	(0.0354)	(0.0840)	(0.0510)	(0.1225)	(0.1202)	(0.0723)	(0.0535)	(0.0487)
Observations	1,071	1,071	1,071	1,071	1,071	1,071	1,071	1,071
R-squared	0.019	0.051	0.028	0.026	0.037	0.044	0.055	0.033

Robust standard errors in parentheses.

*** p < 0.01, ** p < 0.05, * p < 0.1.

Source: Author's calculations.

9.5.4 Relative Probabilities of Coping Strategies

In Table 9.6, we have chosen to use a "do nothing" response as the baseline category to compare other coping strategies adopted by urban households.

Table 9.6: Relative Probabilities of Coping Strategies Adopted by Urban Households

Variable	(1) assist	(2) borrow	(3) loan	(4) food	(5) nonfood	(6) saving	(7) grow	(8) job
urban	2.386	2.896**	0.633	2.897*	1.490	2.717*	0.618	1.129
	(2.138)	(1.505)	(0.392)	(1.603)	(0.615)	(1.406)	(0.509)	(0.639)
Midlands and Northern Mountainous Areas	0.321	0.408	0.910	2.022	0.602	0.0383***	0.175**	0.605
	(0.308)	(0.264)	(0.820)	(1.449)	(0.265)	(0.0388)	(0.121)	(0.355)
Northern and Coastal Central Region	1.231	1.939	1.731	4.794**	0.714	1.451	0.643	0.218**
	(1.088)	(1.072)	(1.278)	(3.335)	(0.309)	(1.026)	(0.389)	(0.148)
Central Highlands	4.497	3.265	7.885**	1.125	3.363**	1.868	0***	3.018
	(4.650)	(2.506)	(6.919)	(1.409)	(1.929)	(1.786)	(0)	(2.241)
Southeastern Area	0***	0.896	0.387	0.520	0.383*	0.760	0.0327***	0.0783**
	(0)	(0.696)	(0.401)	(0.487)	(0.199)	(0.508)	(0.0404)	(0.0939)
Mekong Delta	0.572	1.942	1.774	3.029	0.630	0.290*	0.363	0.582
	(0.587)	(1.115)	(1.404)	(2.168)	(0.287)	(0.210)	(0.288)	(0.373)
ethnic	0.643	0.298**	0.401	0.641	0.791	0.885	0.144***	1.372
	(0.524)	(0.176)	(0.307)	(0.467)	(0.343)	(0.885)	(0.0813)	(0.739)
B40	2.093	1.390	1.598	2.014	1.054	0.690	2.216	1.065
	(1.315)	(0.571)	(0.985)	(0.988)	(0.336)	(0.391)	(1.124)	(0.578)
hhsize	0.591**	1.143	0.950	0.888	0.895	1.014	0.696*	1.034
	(0.151)	(0.210)	(0.180)	(0.156)	(0.117)	(0.182)	(0.146)	(0.199)

continued on next page

Table 9.6 *continued*

Variable	(1) assist	(2) borrow	(3) loan	(4) food	(5) nonfood	(6) saving	(7) grow	(8) job
working_adult	0.643*	0.347***	0.715	0.705	0.778	1.059	1.089	0.844
	(0.171)	(0.0942)	(0.246)	(0.195)	(0.153)	(0.326)	(0.346)	(0.232)
wage_work	4.407*	1.091	2.730	2.604	2.060	2.189	2.361	4.989***
	(3.603)	(0.656)	(1.676)	(1.863)	(0.958)	(1.443)	(1.527)	(2.981)
family_biz	0.0886**	0.193***	1.236	0.630	0.894	0.942	0.437	1.450
	(0.0949)	(0.0970)	(0.785)	(0.325)	(0.306)	(0.484)	(0.286)	(0.860)
covid_threat	5.094**	2.670*	5.452*	23.67***	2.850**	1.271	2.518*	0.659
	(3.494)	(1.343)	(5.358)	(26.01)	(1.175)	(0.859)	(1.371)	(0.324)
Constant	0.562	1.248	0.131	0.0181***	5.320**	0.248	5.665	0.439
	(1.005)	(1.282)	(0.205)	(0.0273)	(4.065)	(0.421)	(6.029)	(0.453)
Observations	1,045	1,045	1,045	1,045	1,045	1,045	1,045	1,045

Robust standard errors in parentheses.

*** p < 0.01, ** p < 0.05, * p < 0.1.

Source: Author's calculations.

With our calculations, the relative probability of choosing the "assistance" strategy for urban households is more than double (2.386314) the corresponding relative probability for rural households. However, this predictor is not significant, so we could conclude that there is no difference between urban and rural households in choosing the "assistance" strategy. Other than the location of households, such predictors as region, household size, whether there is a working-age adult in a household, whether an adult is currently working, whether a household has a family business, and their perception of COVID-19 as a threat would significantly affect households' choices of coping strategies. Likewise, we do not observe a significant difference of relative probability between urban and rural households when it comes to the selection of taking a loan from a financial institution, reducing their nonfood consumption, growing food for self-consumption, and putting more effort into their current job.

On the other hand, for the strategies including borrowing, reducing food consumption, and relying on savings, the relative probability of being obtained by urban households is nearly three times higher than the corresponding relative probability for rural peers. Then, along with the location of households, some other predictors including ethnicity, whether an adult is currently working, whether a household has a family business, and their perception of COVID-19 as a threat would significantly affect households' choices of coping strategies.

9.6 Discussion

The study examined urban households' COVID-19 coping strategies in Viet Nam. We found that despite the COVID-19 pandemic having posed environmental, social, economic, and health threats to the world, the perception of COVID-19 as a severe threat is not statistically significant in urban households. Instead, households with bigger household sizes or in ethnic minority groups have an apparent fear of COVID-19. Additionally, households residing in the Mekong Delta region or having a family business think of COVID-19 as a threat. These differing views on the threat of the virus could be explained by the fact that different socioeconomic characteristics of the household, types of shocks, location, and ability to recover would make households adopt various coping levels and strategies (Shoji 2008; Rayamajhee and Bohara 2019; Lippold et al. 2020; Dawson and Golijani-Moghaddam 2020).

Along with the government's measures such as social distancing, quarantine, isolation, and lockdowns to contain the pandemic, urban households in Viet Nam have their own coping strategies. These households have needed to adopt various coping strategies to deal with the "new normal" situation. The regression results indicate that urban households in Viet Nam are less likely than rural ones to take a loan from a financial institution. However, with relative probabilities of choosing strategies over doing nothing, urban households would borrow from their friends and family. This finding aligns with previous studies about the reliance on external loans. For instance, access to credit, such as borrowing, significantly reduces post-disaster recovery time for households (Francisco 2013).

As the coefficient is not statistically significant, we could not conclude urban households would reduce their nonfood consumption. This finding contrasts with one from Morduch (1995) that households cut down nonfood consumption to smooth their shocks. The results also show that the surveyed urban households in Viet Nam are not associated with a higher probability of growing food for their consumption than rural households. This means that our findings differ from those of studies about households turning to urban gardens and agriculture in light of shocks by Galhena, Freed, and Maredia (2013) and Lal (2020). Home gardens are helpful for urban households to receive fresh vegetables and fruits daily; they result in a richer and more balanced diet by boosting proteins, vitamins, and minerals. Specifically, during the spread of COVID-19, the purchase of food items could be affected due to delays or scarce resources. That situation could partly explain why we found that the relative probability of reducing food consumption was higher for urban households than their rural counterparts. In the context of the COVID-19 spread, it could be understood that due to some measures from the government such as isolation, quarantine, travel restrictions or lockdowns, and local market admission tickets,[1] urban households are not willing to go out frequently for shopping.

According to Rashid, Langworthy, and Aradhyula (2006), coping strategies also vary with a household's income level. Usually, it could be implied that due to being poor, these households already have low levels of food consumption and could not further reduce meals to cope with COVID-19. Additionally, these households tend to seek assistance from their family and friends. This existing practice could indicate that poor households have a vast social network to rely on in emergencies or difficulties. Nevertheless, when adding the interaction with the poverty channel, we find that urban and poor households are not associated with a higher probability of seeking support from friends and family, borrowing from friends and family, taking a loan from a financial institution, decreasing food and nonfood consumption, relying on savings, or putting more effort into their current jobs. This finding differs from a finding about social networks enabling households to handle shocks by Islam and Walkerden (2014).

The study also points out that households living in urban areas and belonging to ethnic minority groups will focus more on their current jobs as a coping strategy for the pandemic. This finding could be explained by the fact that they have a wage or regular job, and the wage or salary could contribute to sustaining their households' finances. Meanwhile, households that live in urban areas and are poor are less likely to put more effort into their jobs. This finding could imply that their jobs are not enough to support their households throughout the difficulties in the pandemic. In addition, they are in group B40,[2] which will need more substantial financial support to overcome the shocks. Nguyen (2020) finds that though the poverty rate in the urban areas is relatively low at 1.1%, the vulnerability rate is relatively high at 8.3%. In addition, the poverty rate and vulnerability

[1] *Tuoi Tre News* (2021).

[2] The B40 group refers to the bottom 40% of the population ranked by household consumption per capita.

rate of ethnic minority groups living in the same urban areas are higher than those of the Kinh group—the majority group. These differences could explain why there is a difference in the coping strategies between urban households generally and those of ethnic minorities or the B40 group.

The results indicate that the relative probability of relying on savings against doing nothing could be higher for urban households than for rural households. This finding agrees with other previous studies about the adoption of using household savings to moderate the effects of shocks. However, it should be noted that household savings may be insufficient to help maintain the financial situation of households in the long term. According to the World Bank (2021), bank deposit data indicate that household deposit growth over the medium term has been declining, meaning that Vietnamese households are saving less than before. Urban households may not touch their savings when those savings are not enough to face a serious situation over the long term.

Some regional stories could provide insights about urban households' coping strategies. No substantial variation is observed in household coping mechanisms in the Midlands and Northern Mountainous Regions. Meanwhile, households in the Northern and Coastal Central Region tend to borrow from friends or family and will be less likely to put more effort into their current job as a coping strategy. Households in the Central Highlands would be more likely to opt for financial institution loans rather than growing for their self-consumption. The Southeast Area paints a different picture, with households having a lower probability of growing food or putting more effort into their current work. Households in the Mekong Delta are less inclined to either reduce their nonfood consumption or depend on their savings.

9.7 Conclusion

In this chapter, we have studied the coping strategies of urban households during the COVID-19 pandemic in Viet Nam. The results show that urban households are less likely than their rural counterparts to borrow from a financial institution. In addition, they might put more effort into their current jobs if they belong to an ethnic minority group. However, we observed no difference between urban and rural households in seeking assistance from their friends and family or reducing their nonfood consumption.

Though a few studies have analyzed households' strategies for coping with COVID-19, no study has yet focused on the urban context. Therefore, this chapter has investigated urban households' coping strategies and figured out some potential reasons behind their mechanism. Even though urban households in Viet Nam do not consider COVID-19 a severe threat, they are particularly vulnerable to shocks. There is no difference in their coping strategies of using their savings compared to their peers in rural areas. It could be seen that they lack savings as a resource to choose from when facing shocks. In addition, they adapt to the shock with their own coping strategies that differ from those of rural households.

The insights about affected households' spending and saving decisions are relevant for policy makers concerned with suitable strategies to boost consumption and economic activity and prepare for future waves of COVID-19 as well as other pandemics. We recommend policy makers to pursue personal income tax cuts. Currently, the tax policy focuses on the corporate sector. In addition, to support households including those in urban areas, policy makers could consider cash transfer programs to financially assist those affected by similarly serious incidents. Job guarantee measures should also be considered when such threats as COVID-19 could make people lose their jobs. Because different stories are observed in urban households' coping strategies in the six regions under study, policy makers could consider launching suitable support measures or programs. For instance, households

from the Northern and Coastal Central Region tend to borrow from friends or family and those in the Central Highlands tend to get loans from a financial institution as their coping strategies. Thus, some financial support packages with low interest rates from the government could provide some assistance to their households during the struggling periods.

Because the researchers conducting the phone surveys did not have time to ask participants specifically about mental and physical health, we explored the coping strategies in terms of income expenditure areas. In addition to economic effects, the COVID-19 pandemic has been found to have detrimental psychological effects on communities (Kelvin and Rubino 2020; Asmundson and Taylor 2020). Further research could therefore focus on psychological coping strategies in urban households in Viet Nam.

References

Altig, D. et al. 2020. Economic Uncertainty before and during the COVID-19 Pandemic. *Journal of Public Economics* 191.

Anderson, E. C. et al. 2019. The Relationship Between Uncertainty and Affect. *Frontiers in Psychology.* 10: 2504.

Ashraf, M. and J. K. Routray. 2013. Perception and Understanding of Drought and Coping Strategies of Farming Households in North-West Balochistan. *International Journal of Disaster Risk Reduction* 5: 49–60.

Asmundson, G. J. G. and S. Taylor. 2020. Coronaphobia: Fear and the 2019-nCoV Outbreak. *Journal of Anxiety Disorders* 70.

Bukuluki, P. et al. 2020. The Socio-Economic and Psychosocial Impact of Covid-19 Pandemic on Urban Refugees in Uganda. *Social Sciences and Humanities Open* 2(1): 100045.

Clarke, D. and S. Dercon. 2009. Insurance, Credit and Safety Nets for the Poor in a World of Risk. DESA Working Papers 81. New York: United Nations, Department of Economics and Social Affairs.

Corbett, J. 1988. Famine and Household Coping Strategies. *World Development* 16(9): 1099–1112.

Dawson, D. L. and N. Golijani-Moghaddam. 2020. COVID-19: Psychological Flexibility, Coping, Mental Health, and Wellbeing in the UK during the Pandemic. *Journal of Contextual Behavioral Science* 17: 126–134.

De Stefani, A., A. Laws, and A. Sollaci. 2022. Household Vulnerability to Income Shocks in Emerging and Developing Asia: The Case of Cambodia, Nepal and Vietnam. IMF Working Paper No. 2022/064. Washington, DC: International Monetary Fund.

Del Ninno, C., P. A. Dorosh, and L. C. Smith. 2003. Public Policy, Markets and Household Coping Strategies in Bangladesh: Avoiding a Food Security Crisis Following the 1998 Floods. *World Development* 31(7): 1221–1238.

DeLoach, S. B. and M. Smith-Lin. 2018. The Role of Savings and Credit in Coping with Idiosyncratic Household Shocks. *Journal of Development Studies* 54(9): 1513–1533.

Dercon, S. 2002. Income Risk, Coping Strategies, and Safety Nets. *World Bank Research Observer.*

Doss, C. et al. 2018. Assets and Shocks: A Gendered Analysis of Ecuador, Ghana and Karnataka, India. *Canadian Journal of Development Studies/Revue canadienne d'études du développement* 39(1).

Echevin, D. and L. Tejerina. 2013. Shocks and Coping Strategies in the Urban Squatter Settlements of San Salvador. *Poverty and Public Policy* 5(2): 180–202.

Ellis, F. 2000. *Rural Livelihoods and Diversity in Developing Countries.* Oxford: Oxford University Press.

Fafchamps, M., C. Udry, and K. Czukas. 1998. Drought and Saving in West Africa: Are Livestock a Buffer Stock? *Journal of Development Economics* 55(2): 273–305.

Fallon, P. R. and R. E. Lucas. 2002. The Impact of Financial Crises on Labor Markets, Household Incomes, and Poverty: A Review of Evidence. *World Bank Research Observer* 17(1): 21–45.

Flesia, L. et al. 2020. Predicting Perceived Stress Related to the Covid-19 Outbreak through Stable Psychological Traits and Machine Learning Models. *Journal of Clinical Medicine* 9(10).

Francisco, J. P. 2013. Determinants of Property Damage Recovery Time Among Households Affected by an Extreme Flood Event in Metro Manila, Philippines.

Galhena, D. H., R. Freed, and K. M. Maredia. 2013. Home Gardens: A Promising Approach to Enhance Household Food Security and Wellbeing. *Agriculture and Food Security* 2: 8.

Grupe, D. and J. Nitschke. 2013. Uncertainty and Anticipation in Anxiety: An Integrated Neurobiological and Psychological Perspective. *Nat Rev Neurosci* 14: 488–501.

GSO. 2019. *Công bố kết quả Tổng điều tra dân số 2019.* http://tongdieutradanso.vn/cong-bo-ket-qua-tong-dieu-tra-dan-so-2019.html

Hanspal, T., A. Weber, and J. Wohlfart. 2020. Exposure to the COVID-19 Stock Market Crash and Its Effect on Household Expectations. *Review of Economics and Statistics* 103(5): 1–45.

Islam, R. and G. Walkerden. 2014. How Bonding and Bridging Networks Contribute to Disaster Resilience and Recovery on the Bangladeshi Coast. *International Journal of Disaster Risk Reduction* 10: 281–291.

Kansiime, M. K. et al. 2021. COVID-19 Implications on Household Income and Food Security in Kenya and Uganda: Findings from a Rapid Assessment. *World Development* 137: 105199.

Kazianga, H. and C. Udry. 2006. Consumption Smoothing? Livestock, Insurance and Drought in Rural Burkina Faso. *Journal of Development Economics* 79(2): 413–446.

Kelvin, D. J. and S. Rubino. 2020. Fear of the Novel Coronavirus. *Journal of Infection in Developing Countries* 14(1): 1–2.

La, V.-P. et al. 2020. Policy Response, Social Media and Science Journalism for the Sustainability of the Public Health System Amid the COVID-19 Outbreak: The Vietnam Lessons. *Sustainability* 12(7): 2931.

Lal, R. 2020. Home Gardening and Urban Agriculture for Advancing Food and Nutritional Security in Response to the COVID-19 Pandemic. *Food Security* 12(4): 871–876.

Lippold, J. V. et al. 2020. The Role of Personality, Political Attitudes and Socio-Demographic Characteristics in Explaining Individual Differences in Fear of Coronavirus: A Comparison over Time and Across Countries. *Frontiers in Psychology* 11, 2356.

Mahmud, M. and E. Riley. 2021. Household Response to an Extreme Shock: Evidence on the Immediate Impact of the Covid-19 Lockdown on Economic Outcomes and Well-Being in Rural Uganda. *World Development* 140: 105318.

Ministry of Finance, Viet Nam. 2021. The Taxation Sector to Implement E-Invoices Nationwide. https://mof.gov.vn/webcenter/portal/btcen/pages_r/l/newsdetails?dDocName=MOFUCM215348

Morduch, J. 1995. Income Smoothing and Consumption Smoothing. *Journal of Economic Perspectives* 9(3): 103–114.

Nguyen, C. 2020. Urban Poverty in Vietnam: Recent Evidences from Household Surveys. MPRA Paper No. 108972. Munich: Munich Personal RePEc Archive.

OECD. 2009. *Managing Risk in Agriculture*. Paris: Organisation for Economic Co-operation and Development.

Phan, L. T. et al. 2020. Importation and Human-to-Human Transmission of a Novel Coronavirus in Vietnam. *New England Journal of Medicine* 382(9): 872–874.

Quach, H. L. and N. A. Hoang. 2020. COVID-19 in Vietnam: A Lesson of Pre-Preparation. *Journal of Clinical Virology* 127: 104379.

Rashid, D. A., M. Langworthy, and S. V. Aradhyula. 2006. Livelihood Shocks and Coping Strategies: An Empirical Study of Bangladesh Households (No. 379-2016-21620).

Rayamajhee, V. and A. K. Bohara. 2019. Natural Disaster Damages and Their Link to Coping Strategy Choices: Field Survey Findings from Post-Earthquake Nepal. *Journal of International Development* 31(4): 336–343.

Shoji, M. 2008. How Do the Poor Cope with Hardships When Mutual Assistance Is Unavailable. *Economics Bulletin* 15(13): 1–17.

Thunström, L. et al. 2020. The Benefits and Costs of Using Social Distancing to Flatten the Curve for COVID-19. *Journal of Benefit-Cost Analysis* 11(2): 179–195.

Tran, V. Q. 2014. Household's Coping Strategies and Recoveries from Shocks in Vietnam. *Quarterly Review of Economics and Finance*. 56(C): 15–29.

Tuoi Tre News. 2021. Vietnam's Da Dang Staggers Market-Going amidst Rapid COVID-19 Spread. *Tuoi Tre News*. 10 May. https://tuoitrenews.vn/news/society/20210510/vietnams-da-nang-staggers-marketgoing-amidst-rapid-covid19-spread/60835.html

UNDP. 2021. Rapid Assessment of the COVID-19 Socio-Economic Impact on Vulnerable Households in Viet Nam. New York: United Nations Development Programme.

Waibel, H. et al. 2020. COVID-19 in the Greater Mekong Subregion: How Resilient Are Rural Households? *Food Security* 12(4): 779–782.

WHO. 2020. *WHO Director-General's Opening Remarks at the Media Briefing on COVID-19—11 March 2020*. Geneva: World Health Organization. https://www.who.int/director-general/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing-on-covid-19---11-march-2020 (accessed 11 March 2022).

____. 2022. Viet Nam COVID-19 Situation Report #85. Geneva: World Health Organization. https://www.who.int/vietnam/internal-publications-detail/covid-19-in-viet-nam-situation-report-85 (accessed 31 March 2022).

World Bank. 2021. *A Year Deferred - Early Experiences and Lessons from Covid-19 in Vietnam (English)*. Washington, DC: World Bank Group.

Zimmerman, F. J., and M. R. Carter. 2003. Asset Smoothing, Consumption Smoothing and the Reproduction of Inequality under Risk and Subsistence Constraints. *Journal of Development Economics* 71(2): 233–260.

PART IV

Dynamics of Change in Society and People's Lifestyles

PART IV SUMMARY

Sakshi Pandey

The coronavirus disease (COVID-19) pandemic has unprecedently affected, both directly and indirectly, the economy, equity, and well-being of the people. Researchers around the world have been actively responding to the need to understand the social, economic, and ecological impacts and risks associated with the pandemic. The government-imposed lockdown measures to curb the COVID-19 infection led to a variety of adaptive efforts by people and institutions to cope with the challenge. Encouraging telework adoption, telemedicine, and social media became the most significant measures to relieve the pressure created by social distancing measures. Part IV of this book, Dynamics of Change in Society and People's Lifestyles, explores changes in the behaviors and attitudes of the people in response to COVID-19. Further, the chapters contemplate the ecological impact created by COVID-19 and future strategies for a post-pandemic world.

Chapter 10 by Sridhar examines the role played by urbanization and other factors on carbon emissions empirically by evaluating all of India and sub-state data at the district level. The chapter uses a unique data set of carbon footprint at the district level from Lee, Taherzadeh, and Kanemoto (2021). Sridhar estimates carbon emissions as dependent on urbanization, per capita income, literacy rate, workforce participation, poverty ratio, and population density. The regression is used to predict carbon emissions in the medium term, i.e., 2030, and the longer run, i.e., 2050, assuming current trends continue considering the pandemic. The author, using her illustrious statistical model, finds that urbanization has a positive and highly significant effect on carbon emissions per capita, and in each of the eight states studied, except in the most urbanized state, Tamil Nadu, poorest state, Bihar, and Karnataka. In each of the states, and all of India, the poverty ratio has a negative effect on the per capita carbon emissions, implying that poorer states have a low carbon footprint. While India's actual carbon footprint was at 0.52 metric tons per capita as of 2011, it is projected to steadily increase to 0.82 in 2030 and 1.17 by 2050, due to the effect of rising urbanization and per capita income and declining poverty rates. Given that reducing poverty is a factor in increasing the carbon footprint, the question to ask is if this is equitable. But the negative effect of workforce participation on the carbon footprint in India's most urbanized state suggests that it is possible to upskill employment in the post-pandemic world such that its effect on city level sustainability will be positive.

Chapter 11 by Okada, Takahashi, and Deguchi aims to clarify whether the introduction of telework during the COVID-19 pandemic has reduced the number of workers who work long hours in Japan, from the perspective of the relationship between telework, working long hours, and worker attributes. An online survey was conducted in August 2020 to determine the actual implementation of telework, changes in working hours, and other attributes such as working and family environments before the pandemic and as of July 2020. The survey results showed that the telework adoption rate in July had increased by about 13% from before the pandemic, with a particularly marked increase of about 20% in the Tokyo metropolitan area. New teleworkers worked on average about one hour less, and the percentage of workers who worked longer than 10 hours per day decreased by about 16% due to the introduction of telework. Moreover, telework tended to reduce the number of workers who worked long hours, especially male workers excluding company executives and full-time employees. On the other hand, there was a tendency, especially for medical and welfare workers and male workers living with their spouses, to continue working long hours even after teleworking was introduced during the pandemic.

The authors suggest that the gender gap that has existed since the high-growth period in lifestyles in Japan, in which "wives are left to take care of housework and childcare while husbands work long

hours to support the family budget," may still be evident today. The chapter concludes that in the post–COVID-19 era and in addition to promoting telework as a measure to improve work-life balance, it is necessary to improve the working environment in such a way that will reduce the long working hours of male workers, especially those in full-time employment.

Chapter 12 by Devkota and Miyazaki explores the reflection of COVID-19 in popular social media platforms, i.e., Twitter, Google, and Facebook in Japan to understand (i) the timeline of the crisis, (ii) public awareness level and response to the crisis, and (iii) the public reaction to the government's countermeasures for combating the crisis. This can be accomplished by mining the general public's feelings as expressed via Twitter and by examining their mobility as revealed via Facebook and Google platforms. People are more concerned when their movement is restricted, and hence, they express their thoughts on social media platforms like Twitter. Public tweets were significantly correlated with movement restrictions like lockdowns. Data depicted that when public attention is high, COVID-19 cases and deaths decrease. Similarly, when the public movement was restricted, COVID-19 cases and death rates went down.

Finally, the chapter provides useful recommendations based on public awareness and mobility, government countermeasures, and socioeconomic impact. Many people feel that we must devise ways to monitor and interpret these kinds of crises in real time to uncover various aspects that can assist in learning from such experiences to better plan for post-pandemic transformations. The explored knowledge can be a good guide to policy makers for planning better transformative measures for mitigating similar crises in the future.

In summary, COVID-19 and associated restriction measures triggered several ecological as well as social changes around the world. Due to complete lockdowns, on one hand, cities saw a decline in carbon emissions, while on the other hand, the internet became the primary medium of connectivity and information delivery. Moreover, during outbreaks like COVID-19, correct and trustworthy information spread via online digital media platforms can be critical for real-time situational awareness such as understanding public mobility, spreading awareness, and combating misinformation and rumors.

CHAPTER 10

Post-Pandemic Cities: India's Carbon Footprint Beyond 2020

Kala S. Sridhar

10.1 Introduction

The industrialized countries, being high-income, technologically advanced economies with aging societies, and developing countries, which were originally low-income and depended on the industrialized countries for trade and technology, were very different in terms of their trajectory of economic growth some years ago. Since the decade of the 2000s, developing countries such as India, Brazil, the People's Republic of China (PRC), and the Russian Federation have been increasingly converging with the industrialized ones in terms of economic growth and environmental sustainability.

In August 2021, the Intergovernmental Panel on Climate Change released a report on the dangers of climate change that warned of a "code red for humanity." The panel's report recognized that partly as a result of countries' pursuit of economic growth and their increasing urbanization, not only do cities aggravate climate change through carbon emissions, but they are also in turn sensitive to the effects of climate change.

It should be clear why cities aggravate climate change through their carbon emissions. First of all, the very definition of urbanization in many countries includes nonagricultural activities consisting of manufacturing and services, which consume energy. Depending on the type of energy used, urbanization can be quite polluting. Next, cities are characterized by vehicular mobility to access jobs. The density of vehicles and traffic congestion lead to carbon emissions. Finally, cities are home to some of the poorest people who are at the receiving end of public services. So, with waste management yet to reach many poor people in cities of developing countries, they resort to unhealthy practices such as burning of solid waste to dispose of it, which gives rise to carbon emissions and releases harmful chemicals into the atmosphere. The case of poor air quality in Delhi, due to excessive stubble burning by farmers in Punjab, is well known. Meanwhile, in the PRC, cities such as Beijing and Shanghai have been suffering poor air quality due to vehicular congestion.

Carbon emissions are determined not only by urbanization, but also by a city's income, workforce participation, and other socioeconomic characteristics. Here are our objectives in this chapter. We would like to answer the following research questions:

- Has urbanization led to carbon emissions in India?
- What are the effects of socioeconomic characteristics such as education, workforce participation, poverty, and income on carbon emissions?
- Given the effects of the above, what is the prediction for India's carbon footprint in 2030 and 2050?
- What are the policy implications of the answers to these questions?

10.2 Urbanization and Carbon Emissions: Existing Studies

A variety of studies examine the relationship between urbanization and carbon emissions. Using panel data of several countries over the period 1961–2011, Zhang et al. (2017) found an inverted U relationship between the two. They also estimated the turning point of the curve for Organisation for Economic Co-operation and Development (OECD) countries to be 73.8%. In other words, the researchers found that in these countries, carbon emissions started to decline after the threshold of 73.8% urbanization was crossed. Taking the case of the PRC, Wu et al. (2016) found that urbanization led to increases in carbon emissions and energy intensity.

Liddle (2014) offered a review of the existing literature on carbon emissions at the cross-country and macro levels. This study examined the effect of population, population density, age structure, urbanization, and household size on carbon emissions. Population was unanimously found to have a positive effect on carbon emissions with varying elasticities. While age structure was found to be unimportant in carbon emissions, household size was found to have a negative effect; population density had a negative effect on consumption of energy and carbon emissions, with urbanization contributing positively to carbon emissions.

Elliott and Clement (2014) conceptualized urbanization as an interactive force of increasing population density, built area, and the interaction of the two. Taking the continental United States as their empirical setting and controlling for spatial autocorrelation, they found strong effects of urbanization on carbon emissions. Musah et al. (2020), examining the relationship between urbanization and carbon emissions in West Africa, found a positive effect and a negative effect of the use of renewable energy on carbon emissions. They confirmed a positive effect of economic growth on carbon emissions. Hanif (2018) examined the determinants of carbon emissions in the developing countries of sub-Saharan Africa and found that the use of fossil fuels and urbanization both lead to increased carbon emissions. This study also confirmed the existence of the environmental Kuznets curve as found in an inverted U relationship between per capita income and emissions in the middle- and low-income economies of sub-Saharan Africa.

Contrary to these studies, interestingly, there is a stream of literature that finds negative effects of urbanization on carbon emissions. Ali, Abdul-Rahim, and Ribadu (2017) found that urbanization has a negative effect on carbon emissions, taking the case of Singapore, which is nearly 100% urban. Such an outcome is possible if urbanites are more conscious about the environmental costs they create and explicitly use best practices to avoid negative effects on the environment. This finding is also plausible because Singapore has good public transport. The researchers also found that economic growth had a positive impact on environmental quality. Similarly, a recent study by Wang et al. (2021) based on the high-income OECD countries found a negative effect of urbanization on carbon emissions, although the magnitude of the effects was weak. One reason for their result could be that urban areas also tend to be more energy efficient. Examining the effect of urban population and financial development in BRICS economies (comprising Brazil, the Russian Federation, India, and the PRC), Raghutla and Chittedi (2020) found negative effects of urban population, financial development, and technology on carbon emissions in these emerging economies. Taking the case of the PRC, Zheng et al. (2021) found a negative effect of urbanization on carbon emissions, even while industrialization had a positive effect.

Wang et al. (2018) examined the decoupling of economic growth and carbon emissions during 1980–2014 and found the decoupling to be weak in the case of the PRC during the period. In India, the largest drivers of the decoupling were found to be carbon emission intensity, urbanization, and per capita gross domestic product (GDP), leading the authors to conclude that increasing energy efficiency was the best route to increasing economic growth without increasing emissions in the two countries.

We find, based on this brief literature review, that studies of India that examine the relationship between urbanization and carbon emissions are limited, primarily due to the availability of sparse data at such a disaggregated level. Sridhar (2018), comparatively analyzing the carbon emissions in India and the PRC and correcting for stationarity, found that urbanization had no impact on carbon emissions per capita or per unit of geographical area. That study found that electricity consumption in the PRC and electricity produced from coal in India had a positive effect on carbon emissions. The study found that GDP per capita had a positive effect in India but not so in the PRC, but that per capita GDP squared had a negative impact on emissions in both the countries.

Given the lack of adequate research on the effects of urbanization on climate change and carbon emissions, in this chapter, we seek to understand this relationship by using disaggregated data at the level of districts in India.

10.3 Theory and Evidence from Other Countries

So far in this chapter, we have highlighted how and why cities and urbanization lead to carbon emissions: overuse of natural resources, vehicular mobility to access jobs, reduced green spaces, thermal sources of power, and management of solid waste. In addition to the effect of urbanization on carbon emissions, there are studies that show that socioeconomic characteristics such as education, workforce participation, poverty, and income impact carbon emissions.

Sarwar et al. (2021), based on data from 179 countries, found that education's effect on carbon emission was insignificant in the short run, but it became significant and positive in the long run, implying that education is a foundational factor influencing climate change mitigation. The assumption is that higher education leads to innovation, as Sarwar et al. (2021) argued, which results in improved carbon mitigation strategies.

In addition to the effect of education on emissions, it is also possible that a different type of education such as environmental education motivates the population to decrease their emissions. This possibility is confirmed by Cordero, Centeno, and Todd (2020), who used San Jose, California as their area of study. The authors found that those students who had taken a specific year-long intensive course were quite conscious environmentally regarding their car and food choices, which they attributed to their learning from the course. Cordero, Centeno, and Todd (2020) estimated that for the average course graduate, the carbon emissions declined by about 2.86 tons per year.

It is well known that rising per capita income leads to increased carbon emissions and higher poverty leads to lower emissions, as the poor cannot afford to drive cars or engage in luxurious lifestyles (use of air-conditioning is only one example), which lead to carbon emissions. On trade-offs between poverty and emissions, Malerba (2020) estimated the carbon intensity of poverty reduction (CIPR) and found a negative effect of economic growth on CIPR, similar to the environmental Kuznets curve.

While workforce participation need not always lead to carbon emissions, in emerging country cities, an increase in workforce participation can lead to carbon emissions, especially when there is inadequate public transport and overuse of personal transport, which is not environmentally friendly. Hence, the workforce participation is controlled for in the regressions of carbon emissions.

As Timmons, Zirogiannis, and Lutz (2016) found with respect to the United States, more densely populated areas are associated with decreased housing size, which in turn decreases carbon emissions. Taking the case of Bandung, Indonesia, Arifwidodo (2014) argued that a dispersed and less dense land use implied larger homes and more dispersed development, which lead to higher energy consumption

and higher carbon emissions. There is every reason to believe that with their density, Indian cities emit less carbon.

Therefore, we attempted to examine carbon emissions as being dependent on urbanization, education, density, per capita income, poverty rate, and workforce participation.

10.4 Methodology and Data

We formulated an econometric model to understand the effects of socioeconomic characteristics on the carbon footprint at the district level. While cities are blamed for harmful carbon emissions, there is unfortunately no systematic or secondary data published on emissions at the city level. We relied on a data set by Lee, Taherzadeh, and Kanemoto (2021), who constructed a data set estimating the carbon footprint at the district level for all districts in India. The same study by Lee et al. (2021) puts together data on poverty ratios for the districts. These data are for 2010–2011.

In addition, we obtained data on population density, literacy rate, workforce participation rate, and urbanization rate from the Census of India 2011 at the district level. The population density is computed as the number of persons per square kilometer of land area of the district. The literacy rate is calculated as the number of literates as a proportion of persons above 6 years of age. The workforce participation rate similarly is computed as the main and marginal workers above 6 years of age at the district level.

The per capita income of every district is from the state directorates of economics and statistics, in current prices. All the district level data are for 2010–2011 only, and data on all the variables are from the Census of India 2011. The only data that are not from the census are the carbon emissions and poverty rate, which are from Lee et al. (2021), and they are for 2010–2011 too.[1] The district per capita income is put together from information from indiastat.com, which in turn puts together data from the state directorates of economics and statistics. Table 10.1 summarizes the data, the sources, and their years.

Table 10.1: Summary of Variables, Sources, and Dates

Variable	Source	Date
Population density	Census of India	2011
Effective literacy rate	Census of India	2011
Workforce participation rate	Census of India	2011
Percentage urban	Census of India	2011
Poverty ratio	Lee et al. 2021	2011
Carbon emissions	Lee et al. 2021	2011
Per capita income	State Directorates of Economics and Statistics	Various years for which data are available

Sources: Lee et al. (2021), Census of India 2011, State Directorates of Economics and Statistics, and author's analyses.

Then the model shown in Equation (1) was econometrically estimated for all of India and was then estimated for several Indian states where the number of observations (districts) was large enough

[1] The data are available and can be shared upon request.

to permit regressions. We performed these regressions for Karnataka, Tamil Nadu, Uttar Pradesh, Rajasthan, Odisha[2], Bihar, Maharashtra, and Madhya Pradesh, where there are enough districts for regressions. This includes a reasonable mix of states in the north (Madhya Pradesh, Uttar Pradesh, Bihar, Odisha, and Rajasthan), which are also the relatively lagging states, fast-growing south Indian states such as Karnataka and Tamil Nadu, and urbanized states such as Maharashtra.

$$\text{Carbon footprint per capita}_i = \alpha_0 + \alpha_{1i}\text{Population density} + \alpha_{2i}\text{Per capita income} + \alpha_{3i}\text{Poverty ratio} + a_{4i}\text{Literacy rate} + a_{5i}\text{Workforce participation} + a_{6i}\,\text{Urbanization rate} + e_i \quad (1)$$

We then made some reasonable assumptions of projections for each of the independent variables in Equation (1). The regression is used to predict carbon emissions in the medium term, i.e., 2030, and longer term, i.e., 2050, assuming current trends continue. Given the coronavirus disease (COVID-19) pandemic, a question that naturally arises is: how realistic are these assumptions to say that current (post-2011) trends will continue? We evaluate the realistic nature of assumptions with respect to each of the variables in Equation (1).

While the pandemic has been influenced by population density, urbanization, and workforce participation, it has done little to change the pace of these phenomena in India. The literacy rate is entirely exogenous, and the pandemic has done nothing to change its trajectory. If anything, the only two variables likely affected by the pandemic are per capita income, whose growth could be a lot slower than the projections, and poverty rate, whose decline could be significantly slower than existing predictions, both due to the pandemic. While no scholarly literature has yet estimated the impact of the pandemic on poverty rate up to 2030 and 2050, the World Bank conjectures that there will be a setback to the extent of 6–7 years in accomplishing this goal. We've made some back-of-the-envelope calculations; even assuming that the pandemic sets us back in the poverty reduction goal, the poverty ratio can be reasonably assumed to be about 3% for India in 2030 and 1% in 2050.[3]

The goal of a $5 trillion economy for India, which was originally set to be accomplished by 2030, will be a reality only by 2032 due to the pandemic (*Economic Times* 2021). This prediction suggests that the assumptions used here of a $3,311 per capita income in 2030 and about a $15,000 per capita income in 2050, overtaking the United States economy, are not unrealistic.

10.5 Urbanization and Carbon Emissions in India

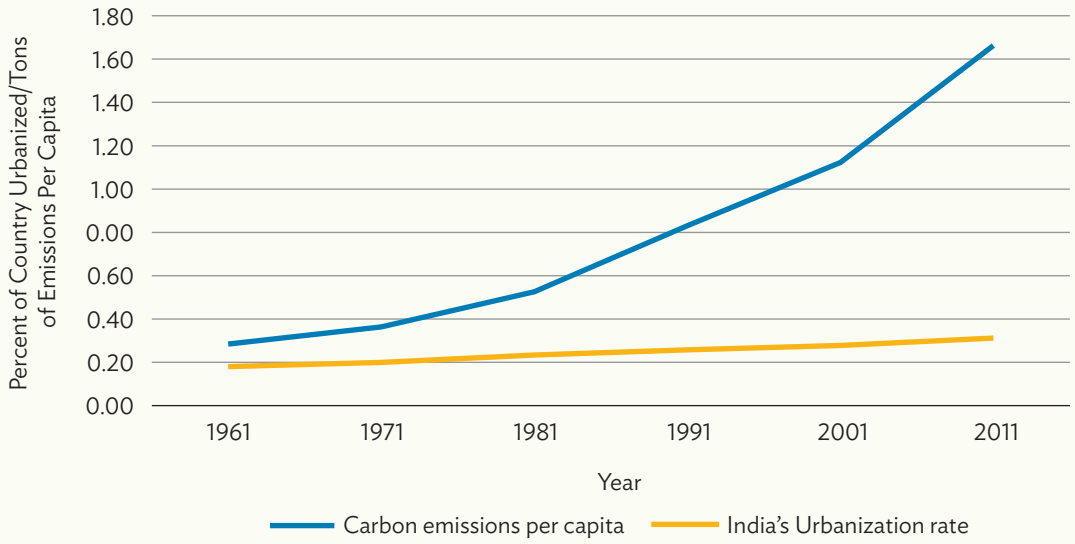
Figure 10.1 presents the trends in urbanization rate and carbon emissions per capita for India during 1961–2011. We find that urbanization was increasing very slowly, while carbon emissions were rising quite steeply, which implies urbanization was not the cause. It is instructive to note that McCarney (2009) found that Palo Alto, California in the United States was the most carbon emitting city in the world at 11 tons per capita, while the least was Sao Paolo in Brazil at 1.9 tons per capita. In India, Ramachandra, Aithal, and Sreejith (2015) found that the maximum carbon emitting city was Chennai at 4.79 tons per capita. Also see Table 10.2, which summarizes the carbon emissions of the world's top emitting cities. No Indian city appears in the list in Table 10.2, so Indian cities' carbon emissions are way below those of other cities globally.

---

[2] In 2011, the Government of India approved the name change of the State of Orissa to Odisha. This chapter reflects this change. However, when reference is made to policies that predate the name change, the formal name Orissa is retained.

[3] The World Bank projects that, in the post-pandemic world, in 2030, 14.75 million poor people will live in South Asia (https://blogs.worldbank.org/opendata/projecting-global-extreme-poverty-2030-how-close-are-we-world-banks-3-goal). Even assuming that all the 14.75 million live in India, which is projected to have a population of 1.51 billion in 2030, it accounts for a poverty rate of less than 1% even as of 2030.

Figure 10.1: Urbanization and Carbon Emissions, India, 1961–2011



Source: World Development Indicators Online, 2018.

Table 10.2: Carbon Emissions, Cities of the World

Urban Cluster	Country	Population	Per Capita Footprint	Global Ranking
Hong Kong, China	PRC	6,029,000	34.6 ± 6.3	1
Mohammed Bin Zayed City	UAE	188,000	32.9 ± 27.9	2
Abu Dhabi	UAE	911,000	32.9 ± 17.1	3
Singapore	Singapore	5,235,000	30.8 ± 6.5	4
Hulun Buir	PRC	198,000	30.0 ± 32.3	5
Al-Ahmadi	Kuwait	2,697,000	29.9 ± 7.2	6
Doha	Qatar	1,128,000	28.7 ± 10.2	7
Hinggan	PRC	242,000	28.6 ± 29.3	8
Chifeng	PRC	677,000	28.0 ± 16.2	9
Al-Jahrah	Kuwait	178,000	27.2 ± 18.4	10

PRC = People's Republic of China, UAE = United Arab Emirates.

Source: Moran et al. (2018).

10.5.1 What Do We Find?

Table 10.3 summarizes the ordinary least squares estimates of Equation (1) for all of India. The table shows that population density undoubtedly has a positive and statistically significant effect on the carbon footprint of the district, although it is not economically very significant in terms of its magnitude. The literacy rate has a positive and significant effect on the carbon footprint. This is contrary to our expectations, since literacy rate and education are expected to confer upon the population

understanding of the effects of their activity on the environment, due to which the educated (captured by a high literacy rate) are expected to wield a negative influence on carbon footprint per capita. The positive effect of the literacy rate on the carbon footprint shows that a more literate population increases carbon emissions. So, we find that the literacy rate's unfavorable effects on increasing the emissions are possibly offset by its beneficial effects, which one would've expected.

As we expect, undoubtedly, a higher level of workforce participation in the district leads to an increase in its carbon emissions. Presumably, higher workforce participation implies higher vehicular mobility to access jobs, which leads to higher carbon emissions. The extent of urbanization of the district leads to higher carbon emissions, primarily due to the density, use of energy, lack of enough green spaces, and use of vehicles. For every unit increase in the urbanization of a district, there is a carbon emissions increase to the extent of 0.48 tons per capita on average in such a district.

In contrast, higher poverty leads to a reduction in the carbon footprint. This implies that higher poverty rates lead to lower carbon emissions and vice versa. Specifically, for every unit increase in the poverty ratio, there is a carbon emissions reduction to the extent of 0.43 tons per capita on average. The per capita income of the district also has a positive effect on carbon emissions, reinforcing the environmental Kuznets curve, which demonstrates that rising incomes will lead to environmental degradation up to a certain point, and the degradation will start declining after that even as incomes continue to rise.

Table 10.3: Regression of Carbon Footprint, All Indian Districts Dependent Variable: Carbon Footprint per Capita

Variable	Unstandardized Coefficients	Std. Error	T-Statistic	P-Value	VIF	Variable Mean
Constant	0.04	0.06	0.74	0.46		
Population density in 100 persons per square kilometer of land area	0.00***	0.00	3.99	0.00	1.26	9.36
Effective literacy rate	0.37***	0.06	6.12	0.00	1.58	0.72
Workforce participation rate	0.27***	0.07	4.02	0.00	1.13	0.48
Proportion urban	0.48***	0.04	13.55	0.00	1.72	0.26
Poverty ratio	−0.43***	0.03	−12.68	0.00	1.45	0.19
District per capita income (in ₹10,000)	0.00***	0.00	4.84	0.00	1.18	76.05
R-squared	0.76					
Number of observations	425					

VIF = variance inflation factor.

***Statistically significant at the 1% level.

Sources: Lee et al. (2021), Census of India 2011, State Directorates of Economics and Statistics, and author's analyses.

The variance inflation factor (VIF) values displayed in Table 10.3 show that collinearity is not a problem. Table 10.4 presents the correlation matrix for all independent variables used in the model in Table 10.3.

Table 10.4: Correlation Matrix of Independent Variables

	Carbon Footprint per Capita	Population Density in 100 Persons per Square Kilometer of Land Area	District per Capita Income (in ₹10,000)	Poverty Ratio	Effective Literacy Rate	Workforce Participation Rate	Proportion Urban
Carbon footprint per capita	1.00	0.37	0.42	−0.67	0.56	−0.15	0.69
Population density in 100 persons per square kilometer of land area	0.37	1.00	0.27	−0.13	0.21	−0.22	0.52
District per capita income (in ₹10,000)	0.42	0.27	1.00	−0.27	0.33	0.04	0.34
Poverty ratio	−0.67	−0.13	−0.27	1.00	−0.51	0.03	−0.43
Effective literacy rate	0.56	0.21	0.33	−0.51	1.00	−0.18	0.55
Workforce participation rate	−0.15	−0.22	0.04	0.03	−0.18	1.00	−0.26
Proportion urban	0.69	0.52	0.34	−0.43	0.55	−0.26	1.00

Sources: Lee et al. (2021), Census of India 2011, State Directorates of Economics and Statistics, and author's analyses.

As discussed earlier, we ran several individual state regressions to understand whether the causes of the carbon footprint are the same, where the data on individual states permitted enough observations of districts. These states are in the south and are urbanized: Karnataka, Tamil Nadu, and Maharashtra. These states are in the north are frequently referred to as the lagging states: Bihar, Madhya Pradesh, Rajasthan, Uttar Pradesh, and Odisha.

10.5.2 Regressions for the Urbanized States

The urbanized states among those considered here are Karnataka, Tamil Nadu, and Maharashtra at 38%, 48%, and 45% urbanization as of 2011. These are also relatively high-income states. Tables 10.5–10.7 present the regressions of the carbon footprint for these three states.

Table 10.5 summarizes the regression for Karnataka. Surprisingly, given the urban state that Karnataka is, urbanization has no effect on the carbon footprint in the state. But as expected, the per capita income and poverty rates have opposite effects on the carbon footprint. While per capita income has a positive effect on the carbon footprint, poverty rate has a negative effect, with no other variables having significant effects, so the entire explanatory power of the model comes from these two variables.

Table 10.6 presents the regression of the carbon footprint for the most urbanized state, Tamil Nadu. The population density has a positive and significant effect on the carbon footprint, as we expect, as density also increases the intensity of power consumption. The effective literacy rate has a negative effect as we expect. This is because higher literacy assumes more responsible behavior on the part of residents to be conscious in reducing their emissions. The workforce participation rate was expected to have a positive effect on the carbon footprint because of vehicular mobility. However, it has a negative effect on emissions, likely because of the use of public transport or other environmentally sustainable modes of transport (such as bicycling or walking) by commuters in the state. Surprisingly enough, in

Table 10.5: Regression of Carbon Footprint, Karnataka
Dependent Variable: Carbon Footprint per Capita

Variable	Unstandardized Coefficients	Std. Error	T-Statistic	P-Value	VIF	Variable Mean
Constant	−0.03	0.59	−0.05	0.96		
Population density in 100 persons per square kilometer of land area	0.00	0.01	−0.53	0.60	3.95	4.21
Effective literacy rate	0.43	0.42	1.03	0.31	2.18	0.74
Workforce participation rate	−0.01	0.83	−0.01	0.99	1.49	0.52
Proportion urban	0.31	0.28	1.11	0.28	4.10	0.30
Poverty ratio	−0.77***	0.30	−2.53	0.02	1.46	0.11
District per capita income (in ₹10,000)	0.04***	0.01	3.29	0.00	2.69	7.49
R-squared	0.79					
Number of observations	29					

VIF = variance inflation factor.

*** Statistically significant at the 1% level.

Sources: Lee et al. (2021), Census of India 2011, State Directorates of Economics and Statistics, and author's analyses.

the most urbanized state, urbanization does not have the expected positive effect on carbon emissions. This could be due to the same reasons discussed in the case of workforce participation: urbanization is accompanied by the greater use of public transport and other best practices to reduce emissions. In addition, as in Karnataka, the per capita income and the poverty rate have opposite effects, confirming the positive association of income along with associated consumption and lifestyles with the carbon footprint. The model for Tamil Nadu is a very good fit, explaining 84% of carbon emissions.

Table 10.6: Regression of Carbon Footprint, Tamil Nadu
Dependent Variable: Carbon Footprint per Capita

Variable	Unstandardized Coefficients	Std. Error	T-Statistic	P-Value	VIF	Variable Mean
Constant	2.49***	0.70	3.58	0.00		
Population density in 100 persons per square kilometer of land area	0.00***	0.00	3.74	0.00	1.47	13.45
Effective literacy rate	−1.39***	0.56	−2.50	0.02	5.39	0.80
Workforce participation rate	−1.92***	0.63	−3.05	0.01	4.75	0.51
Proportion urban	0.12	0.14	0.91	0.37	4.40	0.43
Poverty ratio	−0.81***	0.16	−4.94	0.00	1.14	0.08
District per capita income (in ₹10,000)	0.07***	0.03	2.41	0.02	2.86	2.84
R-squared	0.84					
Number of observations	30					

VIF = variance inflation factor.

*** Statistically significant at the 1% level.

Sources: Lee et al. (2021), Census of India 2011, State Directorates of Economics and Statistics, and author's analyses.

Table 10.7 summarizes and presents the regression of carbon emissions for another urbanized state, Maharashtra. Quite contrary to what we find in Tamil Nadu, the literacy rate increases carbon emissions, as does the urbanization rate, in this state. This implies that urbanization comes with deforestation, increased use of power, and vehicular mobility, all of which increase the carbon footprint. The poverty ratio has a negative effect, confirming that the poor residents decrease the burden of carbon on the state.

Table 10.7: Regression of Carbon Footprint, Maharashtra
Dependent Variable: Carbon Footprint per Capita

Variable	Unstandardized Coefficients	Std. Error	T-Statistic	P-Value	VIF	Variable Mean
Constant	−0.48	0.39	−1.23	0.23		
Population density in 100 persons per square kilometer of land area	0.00	0.01	0.36	0.72	3.14	14.62
Effective literacy rate	0.97***	0.29	3.41	0.00	1.55	0.81
Workforce participation rate	0.33	0.47	0.70	0.49	2.15	0.51
Proportion urban	0.69***	0.16	4.26	0.00	4.14	0.33
Poverty ratio	−0.48*	0.27	−1.80	0.09	1.29	0.08
District per capita income (in ₹10,000)	0.00	0.00	−1.39	0.18	1.14	16.52
R-squared	0.84					
Number of observations	31					

VIF = variance inflation factor.

*** Statistically significant at the 1% level.
* Statistically significant at the 10% level.

Sources: Lee et al. (2021), Census of India 2011, State Directorates of Economics and Statistics, and author's analyses.

10.5.3 Regressions for the BIMARUO States

The BIMARUO states are the relatively slow-growing and less urbanized states consisting of Bihar, Madhya Pradesh, Rajasthan, Uttar Pradesh, and Odisha. While Chhattisgarh, Jharkhand, and Uttarakhand were also carved out of Madhya Pradesh, Bihar, and Uttar Pradesh, respectively, we do not have enough observations for the regressions for these new states, so we do not consider them. In this section, we present the regressions for Bihar, Madhya Pradesh, Rajasthan, Uttar Pradesh, and Odisha.

Table 10.8 presents the regression of the carbon footprint of one of India's poorest states, Bihar. This is also understandably one of the states with the lowest urbanization rates. Hence, urbanization fails to have a significant effect on carbon emissions here. As in Karnataka, the only two variables that have a significant effect on the carbon footprint are the per capita income (which has a positive effect) and poverty rate (which has a negative effect). This continues to show the unfair finding that increases in poverty will decrease carbon emissions! Increases in per capita income lead to increases in emissions, due to the consumption and living patterns higher income implies. However, the model for Bihar is a much poorer explanation when compared with that for Karnataka, where the findings are similar.

Table 10.8: Regression of Carbon Footprint, Bihar
Dependent Variable: Carbon Footprint per Capita

Variable	Unstandardized Coefficients	Std. Error	T-Statistic	P-Value	VIF	Variable Mean
Constant	0.33	0.15	2.18	0.04		
Population density (number of persons per square kilometer of land area)	0.00	0.00	0.76	0.45	1.88	11.44
Effective literacy rate	−0.04	0.12	−0.31	0.76	2.34	0.62
Workforce participation rate	0.00	0.18	0.00	1.00	2.79	0.41
Proportion urban	−0.01	0.14	−0.06	0.95	2.29	0.10
Poverty ratio	−0.27***	0.05	−4.92	0.00	1.18	0.32
District per capita income (in ₹10,000)	0.03**	0.01	2.03	0.05	2.19	1.77
R-squared	0.60					
Number of observations	36					

VIF = variance inflation factor.

*** Statistically significant at the 1% level.
** Statistically significant at the 5% level.

Sources: Lee et al. (2021), Census of India 2011, State Directorates of Economics and Statistics, and author's analyses.

Table 10.9 presents the findings for Madhya Pradesh, another BIMARUO state. As expected, higher workforce participation (entailing higher vehicular mobility) and higher urbanization lead to greater carbon emissions. Poverty rate has the expected negative effect on carbon emissions, as in the other states. The R-squared of this model is quite high at 0.84.

Table 10.9: Regression of Carbon Footprint, Madhya Pradesh
Dependent Variable: Carbon Footprint per Capita

Variable	Unstandardized Coefficients	Std. Error	T-Statistic	P-Value	VIF	Variable Mean
Constant	0.08	0.17	0.49	0.62		
Population density (number of persons per square kilometer of land area)	0.01	0.01	0.72	0.48	4.27	2.58
Effective literacy rate	0.20	0.15	1.28	0.21	2.00	0.68
Workforce participation rate	0.36*	0.20	1.84	0.07	1.76	0.52
Proportion urban	0.54***	0.17	3.23	0.00	7.76	0.24
Poverty ratio	−0.37***	0.06	−5.86	0.00	1.54	0.35
District per capita income (in ₹10,000)	0.00	0.01	0.38	0.70	3.45	7.24
R-squared	0.84					
Number of observations	50					

VIF = variance inflation factor.

*** Statistically significant at the 1% level.
* Statistically significant at the 10% level.

Sources: Lee et al. (2021), Census of India 2011, State Directorates of Economics and Statistics, and author's analyses.

Table 10.10 presents the regression for Rajasthan, the desert Indian state. For the state's relatively low level of urbanization (at 22%), urbanization has a positive effect on the carbon footprint, which implies that urbanization is polluting in terms of vehicular mobility, solid waste management, and deforestation. The only other significant variable is the poverty rate, which continues to exert a negative effect on the carbon footprint, which is unfair. The negative effect of the poverty rate on the carbon footprint is unfair because it implies that higher poverty rates are associated with lower carbon footprints and low poverty rates are associated with high carbon footprints. In a way, this makes sense because the poor do not own carbon emitting vehicles or have luxurious lifestyles that lead to a high carbon footprint. However, this should not lead to the erroneous implication that we need to keep poverty high in order to have a low carbon footprint, which would be unfair. So, the question to ask must be how to reduce the carbon footprint while keeping poverty also low. The model as a whole explains nearly three fourths of the carbon footprint in the state.

Table 10.10: Regression of Carbon Footprint, Rajasthan
Dependent Variable: Carbon Footprint per Capita

Variable	Unstandardized Coefficients	Std. Error	T-Statistic	P-Value	VIF	Variable Mean
Constant	0.12	0.37	0.32	0.76		
Population density (number of persons per square kilometer of land area)	0.01	0.01	0.62	0.54	1.94	2.6148
Effective literacy rate	−0.02	0.40	−0.05	0.96	4.14	0.6460
Workforce participation rate	0.49	0.39	1.25	0.22	2.48	0.5289
Proportion urban	0.72***	0.17	4.35	0.00	3.01	0.2166
Poverty ratio	−0.33***	0.14	−2.41	0.02	1.49	0.1226
District per capita income (in ₹10,000)	0.01	0.00	1.14	0.27	1.30	10.4822
R-squared	0.74					
Number of observations	32					

VIF = variance inflation factor.

*** Statistically significant at the 1% level.

Sources: Lee et al. (2021), Census of India 2011, State Directorates of Economics and Statistics, and author's analyses.

Table 10.11 presents the results for Uttar Pradesh, the largest and most populous Indian state, with 71 districts. A large number of variables significantly impact the carbon footprint in the state. Population density, as expected, has a positive effect on carbon emissions. The adult literacy rate too has a positive effect on carbon emissions per capita in the state, demonstrating that literacy rate is associated with more demands on the environment. The workforce participation has a positive effect on the carbon emissions per capita due to vehicular mobility and emissions thereof. Uttar Pradesh is a low urbanized state at 21% urbanization, but this has a positive effect on its carbon footprint. As in the case of Bihar and other states, the poverty rate and per capita income have negative and positive effects on the carbon footprint, indicating the tradeoffs between rising income and damage to the environment.

Table 10.12 presents the findings for another slow-growing state, Odisha. The results are quite similar to those for Uttar Pradesh. At a low level of urbanization (15%), it has a positive effect on carbon emissions. The adult literacy rate has a positive effect on carbon emissions, indicating the demand of the educated on the environment likely due to their consumption patterns and living styles. The poverty ratio has a negative effect on carbon emissions, indicating unfairly that as poverty rate increases the carbon emissions decrease.

Table 10.11: Regression of Carbon Footprint, Uttar Pradesh
Dependent Variable: Carbon Footprint per Capita

Variable	Unstandardized Coefficients	Std. Error	T-Statistic	P-Value	VIF	Variable Mean
Constant	−0.26	0.16	0.74	0.46		
Population density (number of persons per square kilometer of land area)	0.02***	0.00	3.99	0.00	2.04	9.5667
Effective literacy rate	0.23***	0.15	6.12	0.00	1.38	0.6769
Workforce participation rate	0.90***	0.28	4.02	0.00	1.25	0.3951
Proportion urban	0.30***	0.11	13.55	0.00	3.37	0.2142
Poverty ratio	−0.48***	0.10	−12.68	0.00	1.83	0.3257
District per capita income (in ₹10,000)	0.01***	0.00	4.84	0.00	1.40	6.3318
R-squared	0.87					
Number of observations	71					

VIF = variance inflation factor.

*** Statistically significant at the 1% level.

Sources: Lee et al. (2021), Census of India 2011, State Directorates of Economics and Statistics, and author's analyses.

Table 10.12: Regression of Carbon Footprint, Odisha
Dependent Variable: Carbon Footprint per Capita

Variable	Unstandardized Coefficients	Std. Error	T-Statistic	P-Value	VIF	Variable Mean
Constant	0.23*	0.13	1.81	0.08		
Population density (number of persons per square kilometer of land area)	0.00	0.01	0.20	0.84	3.68	3.1673
Effective literacy rate	0.15*	0.09	1.79	0.09	3.57	0.7084
Workforce participation rate	0.13	0.16	0.82	0.42	6.42	0.4983
Proportion urban	0.50***	0.07	7.31	0.00	1.74	0.1484
Poverty ratio	−0.30***	0.06	−4.66	0.00	3.69	0.4413
District per capita income (in ₹10,000)	0.00	0.00	0.07	0.95	1.62	5.0182
R-squared	0.93					
Number of observations	30					

VIF = variance inflation factor.

Note: In 2011, the Government of India approved the name change of the State of Orissa to Odisha. This publication reflects this change. However, when reference is made to policies that predate the name change, the formal name Orissa is retained.

*** Statistically significant at the 1% level.
* Statistically significant at the 10% level.

Sources: Lee et al. (2021), Census of India 2011, State Directorates of Economics and Statistics, and author's analyses.

10.6 Projections of Carbon Footprint

Table 10.13 summarizes the variable projections that were made for 2030 and 2050 from various sources and assumptions stated in the table.

Table 10.13: Variable Projections and Assumptions

Independent Variable	Variable Mean	Projected Variables, 2030	Assumptions	Projected Variables, 2050	Assumptions
District per capita income (₹)	76,000	3,750,000	Carnegie endowment: $5,000 PCI in 2030 converted to ₹ assuming $1 = ₹75	11,538,000	$15,384 PCI in 2050, converted to ₹ assuming $1 = ₹75
Poverty ratio	0.19	0.03	World Bank, 2030	0.01	Various estimates
Proportion urban	0.26	0.40	Government of India	0.50	Government of India
Effective literacy rate	0.72	0.95	Venkatanarayana (2013)	0.98	Venkatanarayana (2013)
Workforce participation rate	0.48	0.45	Kim (2010)	0.604	Marois, Zhelenkova, and Ali (2022)
Population density (number of persons per square kilometer of land area)	936.18	445.73	National Commission on Population, India (2019)	498.94	National Commission on Population, India (2019)

PCI = per capita income, Rs = Indian rupee.

Sources: Websites listed in the table and author's own calculations.

Based on the assumptions and projections in Table 10.13 for the independent variables, we projected carbon emissions per capita for the districts for 2030 and 2050. Table 10.14 summarizes the projections in 2030 and 2050 of the carbon footprint for all India. It also shows the predictions from the regression shown in Table 10.3 for all India and compares those with the actual carbon footprint. The most important observations to note from Table 10.14 are that the predicted carbon footprint for the country is 0.80 tons per capita in 2030 and 1.16 tons per capita in 2050. The increasing carbon footprint is to be expected with rising incomes and declining poverty rates (refer to Table 10.14). Further, population density is expected to decline with reduction in total fertility rates with increasing literacy (projected to be 95% by 2030 and 98% by 2050). The proportion urban is predicted to be only 50% by 2050 as per Table 10.13, but Sridhar (2020) observes that even as of 2011, India could've been up to 69% urban if only population density had been considered as the criterion for defining urbanization. Finally, the workforce participation rate is projected to increase to 60% by 2050, accompanied by a corresponding increase in vehicular mobility along with associated risks.

Table 10.14: Projections of Contribution to Carbon Footprint for Independent Variables, All India, 2030 and 2050

Variable	Predicted 2011	Predicted 2030	Predicted 2050
District per capita income (₹)	0.04	0.04	0.04
Poverty ratio	0.02	0.11	0.35
Proportion urban	–0.08	–0.01	0.00
Effective literacy rate	0.13	0.19	0.24
Workforce participation rate	0.27	0.35	0.36
Population density (number of persons per square kilometer of land area)	0.13	0.12	0.16
District per capita income (₹)	0.01	0.00	0.01
Total carbon footprint per capita (tons per capita)	0.52 (0.54, actual)	0.80	1.16

Sources: Lee et al. (2021), Census of India 2011, State Directorates of Economics and Statistics, and author's analyses.

10.7 Summary and Policy Implications

We find that for all of India, rising literacy rate, urbanization, labor force participation, population density, and income are the major causes of a growing carbon footprint. So, we find cities to be culprits. However, urbanization does not have any effect on carbon emissions in the most urbanized state, Tamil Nadu, the poorest state, Bihar, or in Karnataka, where cities and their residents are victims of an increasing carbon footprint. In all of India, and only in the relatively poorer states, Madhya Pradesh and Uttar Pradesh, the workforce participation rate has a positive effect on carbon footprint per capita, but in Tamil Nadu, it has a negative effect on the carbon footprint, which is desirable. The effective literacy rate has a positive effect on the carbon footprint for all of India and in Uttar Pradesh, Odisha, and Maharashtra, but has a negative effect in Tamil Nadu, again something to be emulated by the other states. Tamil Nadu's higher urbanization, literacy rate, and workforce participation do not lead to a higher carbon footprint, which is an example for other states to follow, given that it is the most urbanized in the country as of 2011.

To understand what Tamil Nadu is doing right, we reviewed Tamil Nadu's State of Environment Report (2017). We found that better conservation and protection of forests through efficient urban management must've contributed to Tamil Nadu's carbon footprint not being affected by increased urbanization. In Tamil Nadu, total forest cover increased by 14% during 2005–2015 due to better conservation and protection of forests (ENVIS Centre 2017). Carbon sequestration is a method by which carbon dioxide can be stored and captured from the atmosphere. In Karnataka, the carbon sequestration potential is higher in Uttara Kannada, Kodagu, Udupi, and Chikmagalur, which should all be tapped. Tamil Nadu is also a state where public transport is extensive when compared with other states. Availability of public transport may also be a factor contributing to lower emissions despite the higher workforce participation.

Another way states can reduce carbon emissions is through better recycling of waste from cities. Unfortunately, we do not have information on the urban planning strategies of the cities, which have to be studied in depth, taking into account their zoning regulations and other restrictions to understand their effect on carbon emissions.

To summarize, these policy implications are relevant for other states and cities: conserving forests, building end-to-end public transport, and providing pedestrian infrastructure to encourage walking. Another possibility, to learn from other countries, is introducing environmental education in schools to demonstrate the importance of a clean environment to students and inculcate the habit early on in their lives.

10.8 Conclusion

Some findings in this chapter are well known: the rich contribute to carbon emissions while the poor contribute very little. Developing countries and cities in India need a way to grow and also emit less carbon, as Ravallion et al. (2000) emphasized on growth with equity.

The inequitable part of our findings relates to the evidence that reducing the poverty ratio is a factor in increasing the carbon footprint. This situation is not equitable given we all have an obligation to end poverty, even if it implies increasing the carbon footprint. The most important policy message arising from this chapter is that we must devise ways in which increasing income and reducing poverty can have favorable effects on carbon emissions rather than increasing them. Some examples can be best practices followed by Tamil Nadu, which include the extensive use of public transport, pedestrianization, and practices like forest protection and conservation that entail carbon sequestration. Another example is the introduction of environmental education in schools, which increasing income and reduced poverty can endow to the high-income states. Further urbanization also should inculcate and enable the sharing of best and innovative practices to reduce carbon emissions.

References

Arifwidodo, S. 2014. Urban Form and Residential Energy Use in Bandung Indonesia. In K. S. Sridhar and G. Wan, eds. *Urbanization in Asia: Governance, Infrastructure and the Environment*. New Delhi: Springer.

Ali, H. S., A. S. Abdul-Rahim, and M. B. Ribadu. 2017. Urbanization and Carbon Dioxide Emissions in Singapore: Evidence from the ARDL Approach. *Environmental Science and Pollution Research* 24(2): 1967–1974.

Cordero, E. C., D. Centeno, and A. M. Todd. 2020. The Role of Climate Change Education on Individual Lifetime Carbon Emissions. *PloS One* 15(2): e0206266.

Economic Times. 2021. Pandemic Pushes Back India's $5-trillion GDP Goal by 3 Years to FY32: Report. *Economic Times*. 22 March. https://economictimes.indiatimes.com/news/economy/indicators/pandemic-pushes-back-indias-5-trillion-gdp-goal-by-3-years-to-fy32-report/articleshow/81635370.cms?from=mdr

Elliott, J. R. and M. T. Clement. 2014. Urbanization and Carbon Emissions: A Nationwide Study of Local Countervailing Effects in the United States. *Social Science Quarterly* 95(3): 795–816.

ENVIS Centre. 2017. State of Environment Report for Tamil Nadu. Environment and Forests Department, Government of Tamil Nadu, Chennai.

Hanif, I. 2018. Impact of Economic Growth, Nonrenewable and Renewable Energy Consumption, and Urbanization on Carbon Emissions in Sub-Saharan Africa. *Environmental Science and Pollution Research* 25(15): 15057–15067.

Kim, J. 2010. Past and Future of the Labor Force in Emerging Asian Economies. ADB Economics Working Paper Series No. 218. Manila: Asian Development Bank.

Lee, J., O. Taherzadeh, and K. Kanemoto. 2021. The Scale and Drivers of Carbon Footprints in Households, Cities and Regions across India. *Global Environmental Change* 66: 102205.

Liddle, B. 2014. Impact of Population, Age Structure, and Urbanization on Carbon Emissions/Energy Consumption: Evidence from Macro-Level, Cross-Country Analyses. *Population and Environment* 35(3): 286–304.

Malerba, D. 2020. The Trade-Off between Poverty Reduction and Carbon Emissions, and the Role of Economic Growth and Inequality: An Empirical Cross-Country Analysis Using a Novel Indicator. *Social Indicators Research* 150(2): 587–615.

Marois, G., E. Zhelenkova, and B. Ali. 2022. Labour Force Projections in India Until 2060 and Implications for the Demographic Dividend. *Social Indicators Research* 164(1): 477–497.

McCarney, P. 2009. City Indicators on Climate Change: Implications for Policy Leverage and Governance. Paper prepared for the World Bank's 5th Urban Research Symposium on Cities and Climate Change: Responding to an Urgent Agenda, Marseille, France, 28–30 June.

Moran, D. et al. 2018. Carbon Footprints of 13,000 Cities. *Environmental Research Letters*. https://doi.org/10.1088/1748-9326/aac72a

Musah, M., Y. Kong, I. A. Mensah, S. K. Antwi, and M. Donkor. 2020. The Link between Carbon Emissions, Renewable Energy Consumption, and Economic Growth: A Heterogeneous Panel Evidence from West Africa. *Environmental Science and Pollution Research* 27: 28867–28889.

National Commission on Population, India. 2019. Population Projections for India and States 2011–2036. New Delhi: Ministry of Health and Family Welfare. https://nhm.gov.in/New_Updates_2018/Report_Population_Projection_2019.pdf

Raghutla, C. and K. R. Chittedi. 2020. Financial Development, Energy Consumption, Technology, Urbanization, Economic Output and Carbon Emissions Nexus in BRICS Countries: An Empirical Analysis. *Management of Environmental Quality: An International Journal* 32(2): 290–307. https://doi.org/10.1108/MEQ-02-2020-0035

Ramachandra, T. V., B. H. Aithal, and K. Sreejith. 2015. GHG Footprint of Major Cities in India. *Renewable and Sustainable Energy Reviews* 44: 473–495.

Ravallion, M., M. Heil, and J. Jalan. 2000. Carbon Emissions and Income Inequality. *Oxford Economic Papers* 52(4), 651–669.

Sarwar, S. et al. 2021. Revisiting the Empirical Relationship among the Main Targets of Sustainable Development: Growth, Education, Health and Carbon Emissions. *Sustainable Development* 29(2): 419–440.

Sridhar, K. S. 2018. Urbanization and Carbon Emissions in India and China. *Environment and Urbanization Asia* 9(2): 113–126.

Timmons, D., N. Zirogiannis, and M. Lutz. 2016. Location Matters: Population Density and Carbon Emissions from Residential Building Energy Use in the United States. *Energy Research and Social Science* 22: 137–146.

Venkatanarayana, M. 2013. When Will India Achieve Universal Adult Literacy: Status and Prospects. MPRA Paper No. 56705. Munich Personal RePec Archive.

Wang, W. Z. et al. 2021. Impacts of Urbanization on Carbon Emissions: An Empirical Analysis from OECD Countries. *Energy Policy* 151: 112171.

Wu, Y. et al. 2016. The Impact of Urbanization on Carbon Emissions in Developing Countries: A Chinese Study based on the U-Kaya Method. *Journal of Cleaner Production* 135*:* 589–603.

Zhang, N., K. Yu, and Z. Chen. 2017. How Does Urbanization Affect Carbon Dioxide Emissions? A Cross-Country Panel Data Analysis. *Energy Policy* 107: 678–687.

Zheng, S. et al. 2021. How Energy Service Companies Moderate the Impact of Industrialization and Urbanization on Carbon Emissions in China? *Science of the Total Environment* 751: 141610.

CHAPTER 11

Telework and Working Time during the COVID-19 Pandemic in Japan

Jun Okada, Kyoko Takahashi, and Atsushi Deguchi[1]

11.1 Introduction

The coronavirus disease (COVID-19) pandemic that began in 2020 had a major impact on people's attitudes toward work. In Japan, a state of emergency was declared for the entire country in April 2020, and the prime minister requested the introduction of telework for up to 70% of the workforce (Prime Minister's Office 2020).

Before the pandemic, telework was considered to be one of the measures for improving work-life balance, especially for married female workers to balance paid work with housework and childcare (Sato 2019). However, there were also concerns that the implementation of telework would encourage longer working hours. Workers would be forced to respond to work-related e-mails regardless of their working hours, and overtime hours would increase unrecognized by supervisors (Sato 2013). These discussions were before the pandemic, when few companies had introduced telework programs and few workers had implemented them (Ministry of Internal Affairs and Communications 2019). The impact of telework on long working hours during the COVID-19 pandemic, when telework was introduced regardless of gender or presence of children, remains unclear.

Therefore, this study aims to clarify whether the introduction of telework during the COVID-19 pandemic has reduced the number of workers who work long hours, from the perspective of the relationship between telework, working long hours, and worker attributes. Especially in Japan, where working overtime and long working hours have long been a social problem to the extent that the Japanese term *karoshi* [death from overwork] is known in the English-speaking world (Takami 2019), it is highly significant to find out whether the introduction of telework contributes to an improved work-life balance.

Since the analysis in this study targets the actual situation during an emergency situation due to the COVID-19 pandemic, a limitation of the study exists in that the results may not endure after this pandemic. In other words, the introduction of telework as an emergency measure in response to the unprecedented situation of the COVID-19 outbreak was not intended to allow employees to continue their everyday work, but rather to enable them to perform only the minimum amount of essential and urgent work. Thus, special conditions are assumed in terms of the content of their work. However, one of the challenges of working long hours is that there are workers who do not have the authority to decide their own working hours and are forced to work long hours without following their own wishes. This study is useful in clarifying the vulnerability of particular types of workers during these emergencies.

[1] This study is based on a joint research project between the City Planning Survey and Information Office, City Planning Division, City Bureau, Ministry of Land, Infrastructure, Transport and Tourism (MLIT); the Institute of Behavioral Sciences (IBS); and H-UTokyo Lab. We thank Yusuke Sakai, Hidetaka Mori, and Asuka Yamazaki of MLIT and Takahiro Ishigami, Jun Morio, Ryoji Ishii, and Masataka Miyaki of IBS for their cooperation in planning and conducting the survey.

11.2 Literature Review

Long working hours are a recognized problem of the Japanese work environment. An employment system that forced workers to work long hours in exchange for stable long-term employment and a salary structure that considered the cost of living played a significant role in Japan's rapid economic growth after World War II (Takami 2019). Studies have pointed out that long working hours are detrimental to physical health as a significant factor in cardiovascular diseases (Takahashi 2019) and affect mental health problems (Ogawa et al. 2018). In Japan, despite these known dangers, long working hours have continued from the 1990s to the 2010s, a trend attributed to social norms and work practices (Ono 2018).

Against the backdrop of such a work environment, the Japanese government has been promoting the introduction of telework as a measure to improve work-life balance since before the COVID-19 pandemic (Adriani 2019). According to the Ministry of Internal Affairs and Communications, telework is defined as "a flexible work style that uses ICT (information and communications technology) and enables effective use of time and place" (Ministry of Internal Affairs and Communications n.d.) and includes working at home and satellite offices. A similar term for telework is remote work, but this chapter uses the term telework, which has been commonly used since the 1990s in previous studies. According to a Ministry of Internal Affairs and Communications survey, the number of companies introducing telework gradually increased by about 20% between 2004 and 2019 (Ministry of Internal Affairs and Communications 2019). However, the adoption rate for telework in Japan is lower than in other countries (Criscuolo et al. 2021), mainly because in Japan, people often work in groups, which makes the scope of individual work vague and unsuitable for telework, and also because telework makes it difficult to evaluate each employee's work (Sato 2013).

As for the relationship between telework adoption and worker attributes in Japan, scholars have observed that highly educated, full-time employees, workers with discretionary authority over their work, and companies that rely on information technology and large corporations tend to adopt telework (Kazekami 2018). Regarding the relationship between the introduction of telework and work hours, some studies show that telecommuting workers have shorter work hours (Sakamoto and Spinks 2008), while others point out that work hours are prolonged because the transition between work and other time is blurred or because people have to telework late at night or on holidays according to work rules (Sato 2019).

Studies can be found worldwide on the reality and impact of telework's introduction during the COVID-19 pandemic. For example, in India, researchers noted teleworking challenges including increased working hours, significant changes in work roles, decreased productivity, and increased stress (Jaiswal and Arun 2020). In addition, field studies in the United States, Germany, and other countries showed gender differences in the transition to telework, as well as unemployment and reduced working hours, which were more likely to occur among women than men (Reichelt, Makovi, and Sargsyan 2021).

Regarding Japanese telework during the COVID-19 pandemic, the rate of telework use was still low compared to many other countries in the world. One reason for this is the less strict lockdowns in Japan compared to those in other countries, in addition to the conservative corporate culture of Japanese companies (Nomura Research Institute 2020). In this country, workers who tended to use telework were especially highly educated, highly skilled in ICT, young women, and workers with less teamwork and more routine work (Okubo 2021). Studies have also found that urban areas had exceptionally high rates of telework adoption (Nomura et al. 2020) and that whether or not a person had telework experience affected life satisfaction (Ono and Mori 2021). However, few studies discuss

the impact of the introduction of telework on long working hours in the COVID-19 pandemic, the topic that we address in this chapter.

11.3 Method

The Ministry of Land, Infrastructure, Transport and Tourism conducted an online questionnaire survey, "Survey on Daily Activities Under the Influence of the COVID-19 Pandemic" (hereafter referred to as "the survey"), in August 2020 in collaboration with a research group of which two of the authors are members. The survey's purpose was to identify changes in the daily behavior and awareness of citizens during the COVID-19 pandemic. The survey collected valid responses from 12,872 respondents, but since the survey tabulation results are only published as a preliminary report (Ministry of Land, Infrastructure, Transport and Tourism 2020), this study focused on the portion of the survey related to telework.

The survey consists of four parts: (i) activity time survey, (ii) activity frequency survey, (iii) awareness survey, and (iv) personal attributes. In this study, we focused on the work hours in (i) and the actual implementation of telework included in (ii), and we conducted cross-tabulations and multivariate analysis with the survey results in (iv). In particular, in (i), we employed a method in which respondents were asked about their daily activities in 15-minute increments from midnight to midnight of the following day, in terms of "where they were" and "activities they performed." Respondents indicated which of the 19 action items shown in Table 11.1 they performed the longest during the 15-minute period. In (ii), respondents were also asked about the number of days per week they teleworked.

The survey was conducted at three points in time: before the new coronavirus epidemic (hereinafter referred to as "before COVID-19"), during the declaration of a state of emergency (16 April to 13 May 2020) (hereinafter referred to as "during the emergency"), and as of 30 July 2020 (hereinafter referred to as "as of July"). In particular, respondents were asked to indicate their most common daily activity pattern on weekdays before COVID-19 and during the emergency. In this survey, 12,872 respondents responded for all three time points, so the sample of responses at the three time points is identical. The survey was administered to residents of a part of a city with a population of 300,000 or more in the national Person Trip survey area or the Tokyo metropolitan area Person Trip survey area. Although this survey was not based on nationwide random sampling, it was designed to avoid excessive gender and age bias among the surveyed cities and regions.

Table 11.1: Location and Activity Items in the Activity Time Survey

Location	Home
	Around home (within 15 minutes' walking distance)
	Workplace
	Around the workplace (within 15 minutes' walking distance)
	Others
Activity	Sleep
	Eating alone or with family
	Meals with friends and acquaintances (including the presence of family members)
	Work
	Schoolwork
	Shopping for groceries and daily necessities
	Shopping for others
	Personal care such as bathing
	Housework such as laundry and cooking
	Childcare (including playing with children and transporting children)
	Elderly care
	Chaperoning
	Sports, walking, jogging, and exercise
	Socializing and dating
	Other free time (hobbies such as movies and reading)
	Studying (excluding schoolwork)
	Volunteer work
	Medical examination, treatment, and rehabilitation
	Traveling (including commuting)

Source: Authors.

11.4 Definition of Terms

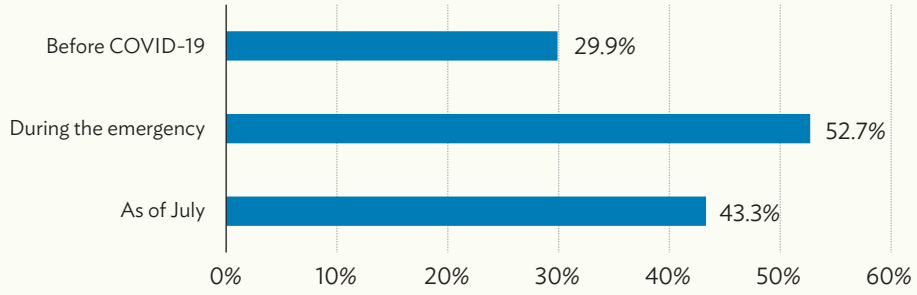
For this study, telework is defined as "doing work outside the workplace." The telework adoption rate is "the percentage of workers who teleworked at least one day per week among all workers." And new teleworkers are defined as "workers who did not use telework before COVID-19 and had adopted telework as of July."

11.5 Results

11.5.1 Changes in Telework Adoption Rates

Figure 11.1 shows the telework adoption rate at the three points in time. The rate was 29.9% before COVID-19, but it rose to 52.7% during the emergency, and as of July, it slightly decreased to 43.3%, but the rate was still higher than before COVID-19.

Figure 11.1: Telework Adoption Rates



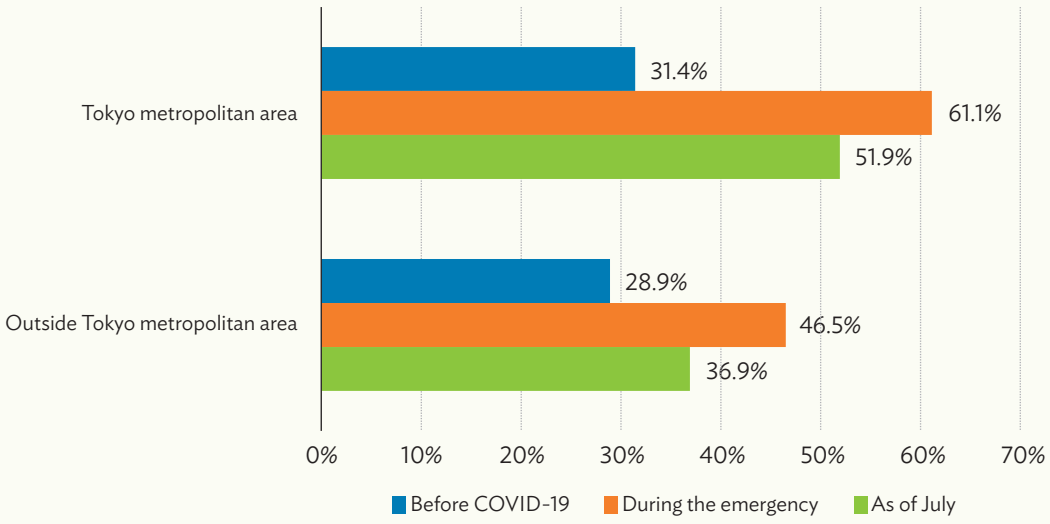
Note: n = 5,112.

Source: Authors.

11.5.2 Regional Differences in Telework Adoption Rates

Figure 11.2 shows the telework adoption rates in the Tokyo metropolitan area and outside of it at the three time points. While the Tokyo metropolitan area had a higher adoption rate at all three points in time, the regional difference before COVID-19 was only 2.5%, but the difference during the emergency and as of July was about 15% at both time points.

Figure 11.2: Telework Adoption Rates by Region and at Three Time Points



Note: Tokyo metropolitan area: n = 3,610; outside Tokyo metropolitan area: n = 1,502.

Source: Authors.

11.5.3 Changes in Work Hours Due to the Introduction of Telework

Table 11.2 shows the average working hours before COVID-19 and as of July for new teleworkers and commuters who commuted at both time points, and the percentage of workers who worked fewer hours in July. The average working hours decreased for both groups, but the new teleworkers worked 59.8 minutes less on average than they had before the pandemic, meaning that their working time decreased by 46.4 minutes more than the commuters group did. The percentage of workers with shorter working hours in July was also larger for new teleworkers, representing a majority of them (58.1%).

Table 11.2: Change in Working Hours before COVID-19 and as of July

		New Teleworkers (n = 814)	Commuters (n = 4,252)
Average work time (minutes)	As of July	525.7	570.5
	Before COVID-19	585.5	583.9
	Gap	–59.8	–13.4
Workers whose work hours have decreased (%)		58.1	38.0

Source: Authors.

11.5.4 Grouping of New Teleworkers by Working Hours

Figure 11.3 shows a scatterplot of the number of workers by working hours for new teleworkers before COVID-19 and as of July. To analyze the change in the number of workers with long working hours in this figure, we divided them into four groups according to whether they worked more than 10 hours per day at those two time points. Since the standard working hours in Japan are 8 hours per day and the maximum overtime hours per month is 45 hours, in this study, we say a worker is working long hours if their working hours exceed 10 hours per day.

Group 1 represents workers who worked long hours at both time points, Group 2 represents workers who worked long hours only in July, Group 3 represents workers who did not work long hours at either time point, and Group 4 represents workers who worked long hours only before COVID-19. Comparing Groups 2 and 4 shows that the number of new teleworkers working long hours decreased by 131 (about 16%).

Figure 11.3: Number of Workers by Working Hours before COVID-19 and as of July

Note: n = 814.

Source: Authors.

11.5.5 Relationship between Groups and New Teleworkers' Attributes

This section clarifies the relationship between changes in the number of workers who work long hours and the personal attributes of new teleworkers as seen in Section 11.5.4. Based on Section 11.5.2, we limited our analysis to a sample of new teleworkers residing in the Tokyo metropolitan area (n = 487) because we observed differences in the status of telework adoption between the Tokyo metropolitan and other areas. First, Table 11.3 shows the percentage of each group for each attribute item for new teleworkers. We also conducted a chi-squared test on the worker attributes and the percentage of the number in each group to identify trends. The results showed that "gender" and "age" were significant ($p < 0.01$). At the same time, "occupation," "presence of infants (under 3 years old) living together," " presence of lower elementary school students (1st–3rd grade) living together," and "presence of other than the above living together" were significant ($p < 0.05$).

Table 11.3: Number and Percentage of New Teleworkers by Attribute and Group

		Total	Group 1		Group 2		Group 3		Group 4		
		n	n	%	n	%	n	%	n	%	P-value
Gender	Male	331	66	19.9	19	5.7	163	49.2	83	25.1	***
	Female	156	10	6.4	8	5.1	109	69.9	29	18.6	
Age generation	20s or younger	43	0	0.0	1	2.3	34	79.1	8	18.6	***
	30s	125	25	20.0	8	6.4	60	48.0	32	25.6	
	40s	90	23	25.6	4	4.4	44	48.9	19	21.1	
	50s	123	19	15.4	10	8.1	60	48.8	34	27.6	
	60s or older	106	9	8.5	4	3.8	74	69.8	19	17.9	
Employment pattern	Self-employed and family workers	16	3	18.8	2	12.5	8	50.0	3	18.8	
	Regular employees and staff	358	64	17.9	21	5.9	184	51.4	89	24.9	
	Dispatched employees	14	0	0.0	0	0.0	11	78.6	3	21.4	
	Contract workers	43	5	11.6	0	0.0	29	67.4	9	20.9	
	Part-time employees	38	2	5.3	2	5.3	29	76.3	5	13.2	
	Directors of a company	11	1	9.1	2	18.2	7	63.6	1	9.1	
	Others	7	1	14.3	0	0.0	4	57.1	2	28.6	
Occupation	Administrative and managerial workers	84	9	10.7	7	8.3	49	58.3	19	22.6	*
	Professional and engineering workers	139	32	23.0	7	5.0	58	41.7	42	30.2	
	Clerical workers	151	18	11.9	8	5.3	96	63.6	29	19.2	
	Sales workers	15	1	6.7	1	6.7	10	66.7	3	20.0	
	Service workers	30	6	20.0	1	3.3	13	43.3	10	33.3	
	Security workers	0	0	-	0	-	0	-	0	-	
	Agriculture, forestry, and fishery workers	1	0	0.0	0	0.0	1	100.0	0	0.0	
	Manufacturing process workers	11	1	9.1	0	0.0	9	81.8	1	9.1	
	Transport and machine operation workers	2	2	100.0	0	0.0	0	0.0	0	0.0	
	Construction and mining workers	4	2	50.0	0	0.0	1	25.0	1	25.0	
	Carrying, cleaning, and related workers	4	0	0.0	0	0.0	4	100.0	0	0.0	
	Other occupation	46	5	10.9	3	6.5	31	67.4	7	15.2	
Industry	Agriculture and forestry	1	0	0.0	0	0.0	1	100.0	0	0.0	
	Fishery	0	0	-	0	-	0	-	0	-	
	Mining, stone-quarrying, or gravel-gathering enterprises	0	0	-	0	-	0	-	0	-	
	Construction industry	16	3	18.8	0	0.0	7	43.8	6	37.5	
	Manufacturing industry	139	24	17.3	9	6.5	73	52.5	33	23.7	
	Electricity, gas, heat supply, and water	1	0	0.0	0	0.0	1	100.0	0	0.0	
	Information and communication industry	99	6	6.1	5	5.1	54	54.5	34	34.3	
	Transportation and postal services	11	4	36.4	0	0.0	5	45.5	2	18.2	
	Wholesale/retail trade	24	3	12.5	2	8.3	19	79.2	0	0.0	
	Finance and insurance	32	8	25.0	1	3.1	15	46.9	8	25.0	
	Real estate, leasing of goods	7	1	14.3	0	0.0	4	57.1	2	28.6	

continued on next page

Table 11.3 *continued*

		Total	Group 1		Group 2		Group 3		Group 4		P-value
		n	n	%	n	%	n	%	n	%	
	Scientific research, professional and technical services	25	7	28.0	2	8.0	15	60.0	1	4.0	
	Eating and drinking services and accommodations	3	1	33.3	0	0.0	1	33.3	1	33.3	
	Living related and personal services, and services for amusement and hobbies	7	0	0.0	0	0.0	4	57.1	3	42.9	
	Education and learning support	20	6	30.0	1	5.0	9	45.0	4	20.0	
	Medical, health care, and welfare	13	4	30.8	1	7.7	6	46.2	2	15.4	
	Compound services	5	1	20.0	0	0.0	2	40.0	2	40.0	
	Other services	53	5	9.4	5	9.4	33	62.3	10	18.9	
	Public services	7	1	14.3	0	0.0	5	71.4	1	14.3	
	Other industries	24	2	8.3	1	4.2	18	75.0	3	12.5	
Number of employees	> 1,000	242	40	16.5	13	5.4	126	52.1	63	26.0	
	501–1,000	42	8	19.0	3	7.1	21	50.0	10	23.8	
	301–500	25	2	8.0	2	8.0	14	56.0	7	28.0	
	101–300	58	15	25.9	3	5.2	32	55.2	8	13.8	
	50–100	42	5	11.9	2	4.8	24	57.1	11	26.2	
	< 50	78	6	7.7	4	5.1	55	70.5	13	16.7	
Location of workplace	Tokyo wards area	276	40	14.5	15	5.4	155	56.2	66	23.9	
	Tokyo metropolitan area suburbs	208	36	17.3	12	5.8	115	55.3	45	21.6	
	Outside Tokyo metropolitan area	3	0	0.0	0	0.0	2	66.7	1	33.3	
Residential area	Tokyo wards area	96	14	14.6	6	6.3	55	57.3	21	21.9	
	Tokyo metropolitan area suburbs	391	62	15.9	21	5.4	217	55.5	91	23.3	
Type of housing	Privately owned house	319	52	16.3	18	5.6	180	56.4	69	21.6	
	Rental house	168	24	14.3	9	5.4	92	54.8	43	25.6	
Building type of house	Detached house	204	33	16.2	8	3.9	113	55.4	50	24.5	
	Multiple dwelling house	283	43	15.2	19	6.7	159	56.2	62	21.9	
Household income	< 2 million yen	6	2	33.3	0	0.0	4	66.7	0	0.0	
	2–3.99 million yen	50	5	10.0	5	10.0	34	68.0	6	12.0	
	4–5.99 million yen	96	12	12.5	4	4.2	60	62.5	20	20.8	
	6–9.99 million yen	164	23	14.0	9	5.5	83	50.6	49	29.9	
	10–14.99 million yen	90	21	23.3	4	4.4	44	48.9	21	23.3	
	> 15 million yen	32	4	12.5	4	12.5	16	50.0	8	25.0	
	Do not want to tell	49	9	18.4	1	2.0	31	63.3	8	16.3	
Commuting time	0–30 minutes	83	12	14.5	4	4.8	55	66.3	12	14.5	
	31–60 minutes	206	37	18.0	10	4.9	112	54.4	47	22.8	
	61–90 minutes	159	19	11.9	12	7.5	83	52.2	45	28.3	
	91–120 minutes	33	8	24.2	1	3.0	17	51.5	7	21.2	
	> 120 minutes	6	0	0.0	0	0.0	5	83.3	1	16.7	
Presence of infants (under 3 years old) living together	Existence	30	10	33.3	0	0.0	13	43.3	7	23.3	
	Nonexistence	457	66	14.4	27	5.9	259	56.7	105	23.0	

continued on next page

Table 11.3 *continued*

		Total	Group 1		Group 2		Group 3		Group 4		P-value
		n	n	%	n	%	n	%	n	%	
Presence of infants (3 years and older and preschoolers) living together	Existence	22	4	18.2	2	9.1	9	40.9	7	31.8	
	Nonexistence	465	72	15.5	25	5.4	263	56.6	105	22.6	
Presence of lower elementary school students (1st–3rd grade) living together	Existence	24	9	37.5	1	4.2	9	37.5	5	20.8	*
	Nonexistence	463	67	14.5	26	5.6	263	56.8	107	23.1	
Presence of higher elementary school students (4th–6th grade) living together	Existence	21	6	28.6	1	4.8	10	47.6	4	19.0	
	Nonexistence	466	70	15.0	26	5.6	262	56.2	108	23.2	
Presence of junior high school, high school, and college students living together	Existence	58	14	24.1	4	6.9	27	46.6	13	22.4	
	Nonexistence	429	62	14.5	23	5.4	245	57.1	99	23.1	
Presence of a spouse living together	Existence	276	40	14.5	15	5.4	156	56.5	65	23.6	
	Nonexistence	211	36	17.1	12	5.7	116	55.0	47	22.3	
Presence of father and mother (including spouse's parents) living together	Existence	93	10	10.8	7	7.5	51	54.8	25	26.9	
	Nonexistence	394	66	16.8	20	5.1	221	56.1	87	22.1	
Presence of other than the above living together	Existence	73	6	8.2	0	0.0	50	68.5	17	23.3	*
	Nonexistence	414	70	16.9	27	6.5	222	53.6	95	22.9	

P-value: χ^2 test results for each attribute.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Source: Authors.

Next, in order to examine in more detail the relationship between long working hours at the two time points and the attributes of new teleworkers, we conducted a multinomial logistic regression analysis using Stata/SE 17.0, with each attribute item as the explanatory variable and the group number as the objective variable, with Group 3 as the base. In the analysis, the sample and explanatory variables were set so that the pseudo-deterministic coefficient of determination would be high, resulting in a sample of new telework users (n = 487) residing in the Tokyo metropolitan area. Explanatory variables are shown in Table 11.4. The pseudo-determination coefficient is 0.2779 and the log likelihood is −391.59513. For each variable used in the analysis, the variance inflation factor was less than 10, and no multicollinearity problems were observed. In the analysis for each group, especially for attribute items with P-values of 0.05 or less, the regression coefficients are listed in order of magnitude as follows.

- Group 1: Medical, health care, and welfare; male; nonexistence of junior high school, high school, and college students living together; presence of a spouse living together
- Group 2: Presence of infants (3 years and older and preschoolers) living together
- Group 4: Directors of a company (negative); regular employees and staff (negative); male; number of employees 50–100

Table 11.4: Relationship between Attributes of New Teleworkers and Groups

		Group 1				Group 2				Group 4			
		Coefficient	SE	Z	P	Coefficient	SE	Z	P	Coefficient	SE	Z	P
Gender	Male	1.544	0.508	3.040	0.002**	0.186	0.689	0.270	0.787	0.888	0.359	2.480	0.013*
Age generation	20s or younger	−16.077	1,561.848	−0.010	0.992	−0.898	1.495	−0.600	0.548	−0.639	0.681	−0.940	0.347
	30s	0.783	0.674	1.160	0.245	1.279	1.028	1.240	0.213	0.420	0.518	0.810	0.417
	40s	1.124	0.697	1.610	0.107	0.677	1.114	0.610	0.543	0.247	0.539	0.460	0.647
	50s	0.384	0.642	0.600	0.550	1.306	0.938	1.390	0.164	0.484	0.448	1.080	0.280
Employment pattern	Self-employed and family workers	17.554	3,350.975	0.010	0.996	16.561	6,267.088	0.000	0.998	−1.417	1.341	−1.060	0.291
	Regular employees and staff	17.429	3,350.975	0.010	0.996	14.463	6,267.088	0.000	0.998	−2.222	1.132	−1.960	0.05*
	Dispatched employees	1.229	4,394.022	0.000	1.000	−2.283	7,619.211	0.000	1.000	−2.081	1.370	−1.520	0.129
	Contract workers	17.222	3,350.975	0.010	0.996	−1.553	6,559.689	0.000	1.000	−2.191	1.204	−1.820	0.069
	Part-time employees	15.359	3,350.975	0.000	0.996	15.506	6,267.088	0.000	0.998	−2.523	1.294	−1.950	0.051
	Directors of a company	16.922	3,350.975	0.010	0.996	17.733	6,267.088	0.000	0.998	−3.435	1.721	−2.000	0.046*
Occupation	Administrative and managerial workers	−0.880	0.810	−1.090	0.278	0.271	1.223	0.220	0.825	−0.245	0.624	−0.390	0.695
	Professional and engineering workers	1.085	0.692	1.570	0.117	0.638	1.131	0.560	0.573	0.594	0.546	1.090	0.277
	Clerical workers	0.092	0.706	0.130	0.896	0.553	1.187	0.470	0.641	0.012	0.558	0.020	0.982
	Sales workers	−0.663	1.391	−0.480	0.634	1.154	1.756	0.660	0.511	−0.293	0.988	−0.300	0.767
	Service workers	0.806	0.952	0.850	0.397	−0.342	1.593	−0.220	0.830	1.273	0.743	1.710	0.086
	Agriculture, forestry, and fishery workers	−15.318	13,697.810	0.000	0.999	−1.633	23,034.380	0.000	1.000	−18.015	11,283.630	0.000	0.999
	Manufacturing process workers	−1.576	1.521	−1.040	0.300	−17.809	4,073.157	0.000	0.997	−1.616	1.272	−1.270	0.204
	Transport and machine operation workers	53.853	17,996.160	0.000	0.998	33.969	60,215.240	0.000	1.000	−1.481	32,833.840	0.000	1.000
	Construction and mining workers	1.324	1.992	0.660	0.506	−1.647	8,390.403	0.000	1.000	0.169	1.811	0.090	0.926
	Carrying, cleaning, and related workers	−15.665	4,897.303	0.000	0.997	−16.787	8,972.454	0.000	0.999	−17.603	4,969.768	0.000	0.997
Industry	Construction industry	1.248	1.328	0.940	0.347	−15.592	4,332.432	0.000	0.997	1.057	1.015	1.040	0.298
	Manufacturing industry	0.733	0.950	0.770	0.440	1.031	1.429	0.720	0.471	0.480	0.795	0.600	0.546
	Electricity, gas, heat supply, and water	−15.676	13,697.810	0.000	0.999	−20.093	2,2981.370	0.000	0.999	−16.382	11,283.630	0.000	0.999
	Information and communication industry	−1.260	1.022	−1.230	0.218	0.420	1.455	0.290	0.773	0.510	0.776	0.660	0.511
	Transportation and postal services	2.393	1.460	1.640	0.101	−15.385	4,519.391	0.000	0.997	2.101	1.252	1.680	0.093
	Wholesale/retail trade	0.395	1.211	0.330	0.744	0.831	1.639	0.510	0.612	−16.986	2,025.366	−0.010	0.993
	Finance and insurance	1.248	1.040	1.200	0.230	−0.249	1.755	−0.140	0.887	0.383	0.875	0.440	0.661
	Real estate, leasing of goods	−15.447	3,862.758	0.000	0.997	−15.609	7,116.422	0.000	0.998	1.056	1.248	0.850	0.397

continued on next page

Table 11.4 *continued*

		Group 1				Group 2				Group 4			
		Coefficient	SE	Z	P	Coefficient	SE	Z	P	Coefficient	SE	Z	P
	Scientific research, professional and technical services	0.509	1.101	0.460	0.644	1.035	1.636	0.630	0.527	−2.184	1.318	−1.660	0.097
	Eating and drinking services and accommodations	4.348	3.727	1.170	0.243	−17.925	7,474.508	0.000	0.998	1.653	1.938	0.850	0.394
	Living related and personal services, and services for amusement and hobbies	−16.032	4,027.935	0.000	0.997	−15.717	5,651.558	0.000	0.998	1.578	1.230	1.280	0.199
	Education and learning support	1.421	1.203	1.180	0.238	−0.291	1.829	−0.160	0.874	0.428	1.033	0.410	0.679
	Medical, health care, and welfare	2.783	1.297	2.150	0.032*	2.447	1.997	1.230	0.221	0.476	1.195	0.400	0.690
	Compound services	3.483	1.887	1.850	0.065	−15.859	7,306.643	0.000	0.998	1.697	1.415	1.200	0.231
	Other services	0.156	1.077	0.140	0.885	1.588	1.521	1.040	0.296	0.141	0.862	0.160	0.870
	Public services	0.673	1.581	0.430	0.670	−16.153	5,868.630	0.000	0.998	−0.874	1.559	−0.560	0.575
Number of employees	> 1,000	0.917	0.646	1.420	0.156	1.155	1.062	1.090	0.276	0.903	0.462	1.950	0.051
	501–1,000	1.077	0.784	1.370	0.169	1.419	1.322	1.070	0.283	0.814	0.611	1.330	0.183
	301–500	0.199	1.061	0.190	0.851	1.355	1.372	0.990	0.323	1.235	0.704	1.750	0.080
	101–300	0.836	0.754	1.110	0.268	0.428	1.276	0.340	0.737	0.299	0.614	0.490	0.626
	50–100	0.897	0.875	1.020	0.305	1.235	1.394	0.890	0.376	1.280	0.594	2.150	0.031*
Location of workplace	Tokyo wards area	14.086	6,071.990	0.000	0.998	13.082	8,280.239	0.000	0.999	−1.279	1.626	−0.790	0.432
	Tokyo metropolitan area suburbs	13.987	6,071.990	0.000	0.998	13.772	8,280.239	0.000	0.999	−1.213	1.618	−0.750	0.453
Residential area	Tokyo wards area	0.407	0.531	0.770	0.444	−0.186	0.776	−0.240	0.810	−0.144	0.388	−0.370	0.710
Type of housing	Privately owned house	0.324	0.484	0.670	0.503	0.049	0.693	0.070	0.943	−0.605	0.384	−1.580	0.115
Building type of house	Detached house	0.174	0.445	0.390	0.696	−0.838	0.663	−1.260	0.207	0.396	0.343	1.160	0.248
Household income	< 2 million yen	2.783	1.916	1.450	0.146	−16.974	7,134.177	0.000	0.998	−17.450	4,682.524	0.000	0.997
	2–3.99 million yen	−0.511	0.892	−0.570	0.566	1.653	1.330	1.240	0.214	−0.566	0.734	−0.770	0.441
	4–5.99 million yen	−1.307	0.732	−1.790	0.074	0.387	1.339	0.290	0.772	0.004	0.589	0.010	0.994
	6–9.99 million yen	−1.139	0.640	−1.780	0.075	1.098	1.246	0.880	0.378	0.577	0.530	1.090	0.276
	10–14.99 million yen	−0.177	0.692	−0.260	0.798	0.745	1.367	0.550	0.586	0.515	0.586	0.880	0.379
	> 15 million yen	−1.104	0.989	−1.120	0.264	2.265	1.470	1.540	0.123	0.930	0.738	1.260	0.207
Commuting time	0–30 minutes	15.916	4,205.225	0.000	0.997	16.683	4,876.439	0.000	0.997	−0.174	1.281	−0.140	0.892
	31–60 minutes	16.805	4,205.225	0.000	0.997	16.249	4,876.439	0.000	0.997	0.153	1.234	0.120	0.901
	61–90 minutes	16.399	4,205.225	0.000	0.997	17.448	4,876.439	0.000	0.997	0.596	1.229	0.480	0.628
	91–120 minutes	16.934	4,205.225	0.000	0.997	16.441	4,876.439	0.000	0.997	−0.165	1.317	−0.130	0.900
Presence of infants (under 3 years old) living together		−0.283	0.731	−0.390	0.698	18.006	2,791.814	0.010	0.995	0.190	0.117	0.630	0.852

continued on next page

Table 11.4 *continued*

	Group 1				Group 2				Group 4			
	Coefficient	SE	Z	P	Coefficient	SE	Z	P	Coefficient	SE	Z	P
Presence of infants (3 years and older and preschoolers) living together	0.879	0.874	1.010	0.314	−2.783	1.275	−2.180	0.029*	−0.365	0.679	−0.540	0.590
Presence of lower elementary school students (1st–3rd grade) living together	−0.717	0.725	−0.990	0.323	1.641	1.397	1.180	0.240	−0.312	0.759	−0.410	0.681
Presence of higher elementary school students (4th–6th grade) living together	−0.168	0.804	−0.210	0.835	0.325	1.314	0.250	0.805	1.086	0.793	1.370	0.171
Presence of junior high school, high school, and college students living together	−1.230	0.566	−2.170	0.03*	0.132	0.787	0.170	0.867	0.033	0.475	0.070	0.945
Presence of a spouse living together	1.096	0.466	2.350	0.019*	−0.245	0.690	−0.360	0.722	0.237	0.369	0.640	0.521
Presence of father and mother (including spouse's parents) living together	0.864	0.636	1.360	0.174	−1.364	0.764	−1.790	0.074	−0.537	0.431	−1.250	0.213
Presence of other than the above living together	0.618	0.659	0.940	0.348	17.620	1,561.848	0.010	0.991	0.296	0.409	0.720	0.469

SE = standard error.

* p < 0.05, ** p < 0.01, *** p < 0.001.

Notes:
Group 3 is the base.

For each attribute item, the following categories were referenced:
- Gender: Female
- Age generation: 60s or older
- Employment pattern: Others
- Occupation: Other occupation
- Industry: Other industries
- Number of employees: < 50
- Location of the workplace: Outside Tokyo metropolitan area
- Type of housing: Rental house
- Building type of house: Multiple dwelling house
- Household income: Do not want to tell
- Residential location: Tokyo metropolitan area suburbs
- Others: Nonexistence

Source: Authors.

11.6 Discussion

This chapter has analyzed the relationship between the introduction of telework and changes in work hours during the COVID-19 pandemic. The telework adoption rate as of July was about 9% lower than during the emergency, but about 13% higher than before COVID-19. It is possible that some workers and companies continued to telework after the declaration was lifted as a measure to prevent infection, or that their experience with telework during the declaration helped them understand its benefits. The teleworking way of working took root. In addition, while there was little regional difference before COVID-19, during the emergency, and as of July, the adoption rate was approximately 15% greater in the Tokyo metropolitan area than outside of it. This may be due to the location bias of companies in the Tokyo metropolitan area, such as a larger percentage of workers in the information and telecommunications industry and other industries that are more likely to shift to teleworking.

In addition, daily working hours for new teleworkers decreased by approximately 1 hour. The change in working hours for workers who commuted to work both before COVID-19 and as of July showed a decrease of only about 13 minutes, so the decrease was about 47 minutes longer for the new teleworkers. Furthermore, the introduction of telework reduced the percentage of workers who worked longer than 10 hours per day by about 16%. One possible reason for these results is that the introduction of telework led to a review of working hours and improved work-life balance. On the other hand, it is undeniable that technological issues such as inferior performance of home computers to those in the office and challenges in the home environment such as having young children make it difficult to work at home, so there is a possibility that teleworkers are not able to secure sufficient working hours.

Therefore, in order to clarify the relationship between the introduction of telework and long working hours, we analyzed the relationship between long working hours and worker attributes for new teleworkers before COVID-19 and as of July. We found significant differences for attributes such as "gender" and "age" ($p < 0.01$), and for attributes such as "occupation," "presence of infants (under 3 years old) living together," "presence of younger elementary school students (1st to 3rd grade) living together," and "presence of other than the above living together" compared to the other attributes ($p < 0.05$). We conducted a more detailed analysis for new teleworkers residing in the Tokyo metropolitan area using multinomial logistic regression. Next, we discuss comparisons with Group 3 (workers who did not work long hours at either time point) for each group of workers.

Group 1 (workers who worked long hours at both time points). The attribute "male" showed a significant difference ($p < 0.01$) compared to the other attribute items. The chronically long work hours of male workers in Japan have long been considered a problem (Ono 2018), and this trend has remained even after the introduction of telework. In order to correct long working hours, it seems necessary not only to introduce telework but also to consider how to manage working hours online. In addition, we found a significant difference ($p < 0.05$) in the "medical and welfare" industry category compared to the other attribute items. It is possible that the increased workload during the pandemic necessitated working longer hours even with the introduction of telework. We also found significant differences ($p < 0.05$) for Group 1 in terms of family environment, such as "nonexistence of junior high school, high school, and college students living together" and "existence of a spouse living together." In particular, given the fact that significant differences in the latter were also found for "men," as mentioned above, we think that the composition of domestic labor is based on gender, in which wives are responsible for housework and childcare. At the same time, husbands work long hours, which remained during the pandemic. This is another issue in Japanese society that has been pointed out for about half a century (Takami 2019). The introduction of telework alone is not expected to be effective enough to change this composition.

Group 2 (workers who worked long hours only in July). For Group 2, there were significant differences ($p < 0.05$) compared to the other attribute items, especially for workers living with children between the ages of 3 and 6. The reason may be that families with preschool children spent more time on childcare than families with children of elementary school age and older, and that the introduction of telework made the boundary between work and childcare more ambiguous, resulting in lower work efficiency during the day and work at night, after the children had gone to bed.

Group 4 (workers who worked long hours only before COVID-19). In Group 4, in which the respondents no longer work long hours after the introduction of teleworking, there was a significant difference ($p < 0.05$) in the employment status of company executives and regular employees compared to the other attribute items, and the pseudo-determinant coefficients were negative. In other words, the results indicate that the introduction of telework is unlikely to correct long working hours in the case of executives and regular employees. This may indicate the vulnerability of non-regular employees in an emergency such as the COVID-19 pandemic, in which the work of company executives and regular employees can be performed as usual. As Takami points out, differences in labor market status may contribute to disparities in work hours and income during a crisis situation such as a pandemic (Takami 2021). In contrast, the work opportunities and work hours of other non-regular employees are likely to decrease. Group 4 also shows a significant difference ($p < 0.05$) for males, indicating that, in contrast to Group 1, the introduction of telework tends to correct the long working hours of some male workers.

Although each group showed a relatively small relationship with place of residence, as the introduction of telework and improved work-life balance progresses, workers may move from the city center to the suburbs in search of a better living environment. According to another demographic survey (Sumitomo Mitsui Trust Bank 2021), Tokyo wards experienced an unusually high rate of out-migration in 2021, with 56% of those who moved out of Tokyo moving to neighboring suburban areas.

Although the impact of telework on the mental health of workers and their families is beyond the scope of the survey, some literature discusses the increase in stress caused by changes in work content and methods due to telework (Jaiswal and Arun 2020). In discussing whether or not telework will take root in the future, it will be necessary to consider such psychological effects.

In conjunction with this, the number of companies that establish telework may increase. In Japanese society, telework is useful as a measure to increase work comfort and worker diversity. In promoting the introduction of telework after the pandemic, it might be important for companies to expand their telework systems in combination with measures such as flexible working hours and cooperation with coworking spaces, so that companies that can offer more flexible work styles will be attractive to workers.

11.7 Conclusion

The purpose of this chapter was to determine whether the introduction of telework during the COVID-19 pandemic would correct Japan's long working hours. The analysis results showed that the introduction of telework tended to reduce the number of workers who worked long hours, especially among male workers, excluding company executives and full-time employees. However, it is unclear whether this reduction is because the decrease in work hours indicates an improvement in work-life balance or because the amount of work to be done in an emergency such as the pandemic had decreased. The latter case requires additional examination because it may indicate the vulnerability of informal workers during emergencies. On the other hand, there was a tendency, especially for medical and welfare workers and male workers living with their spouses, to continue working long hours even after teleworking was introduced in the pandemic. This suggests that the gender gap that has existed

since the high-growth period in lifestyles in Japan, in which wives are left to take care of housework and childcare while husbands work long hours to support the family budget, may still be evident today. In the first place, the Japanese work environment has been viewed by some as a result of men working long hours, which hinders women's entry into society and leads to low fertility rates (Takami 2019; Nomura et al. 2019). Therefore, the Japanese government has positioned telework as one of the measures to improve work-life balance in its workstyle reform; the government has been expecting telework to be an effective measure (Ministry of Health, Labor and Welfare 2014). However, even if telework is introduced widely, if the practice of men working long hours is not changed, as this study has shown, women's advancement in society will be hindered. Therefore, in looking toward the post–COVID-19 era and in addition to promoting telework as a measure to improve work-life balance, it is necessary to encourage improvements in the working environment that will correct the long working hours of male workers, especially those in regular employment.

References

Adriani, S. 2019. Teleworking System: A New Working System in Japan as a Solution to Encourage Women's Participation in Economic Sectors. *Journal of Physics: Conference Series* 1175, 1st International Conference on Advance and Scientific Innovation 23–24 April 2018, Medan, Indonesia. https://doi.org/10.1088/1742-6596/1175/1/012249

Criscuolo, C. et al. 2021. The Role of Telework for Productivity during and Post-COVID-19: Results from an OECD Survey among Managers and Workers. OECD Productivity Working Papers, No. 31. Paris: OECD Publishing. https://doi.org/10.1787/7fe47de2-en

Jaiswal, A. and C. Arun. 2020. Unlocking the COVID-19 Lockdown: Work from Home and Its Impact on Employees. Research Square. https://doi.org/10.21203/rs.3.rs-34556/v1

Kazekami, S. 2018. Does Teleworking Improve Labor Productivity? https://ies.keio.ac.jp/upload/20180928appliedpaper.pdf

Ministry of Health, Labor and Welfare, Japan. 2014. Workstyle Reform. https://www.mhlw.go.jp/english/wp/wp-hw13/dl/07e.pdf

Ministry of Internal Affairs and Communications, Japan. n.d. Telework no igi/kouka (The Significance and Effects of Telework). https://www.soumu.go.jp/main_sosiki/joho_tsusin/telework/18028_01.html (in Japanese).

____. 2019. Report on the 2019 Survey on Telecommunications Usage Trends. https://www.soumu.go.jp/johotsusintokei/statistics/pdf/HR201900_002.pdf

Ministry of Land, Infrastructure, Transport and Tourism, Japan. 2020. Impacts and Changes in Lifestyles and Attitudes due to COVID-19: Preliminary Results of the Lifestyle Behavior Survey. https://www.mlit.go.jp/report/press/content/001366703.pdf

Nomura, K. et al. 2019. For Making a Declaration of Countermeasures against the Falling Birth Rate from the Japanese Society for Hygiene: Summary of Discussion in the Working Group on Academic Research Strategy against an Aging Society with Low Birth Rate. *Environmental Health and Preventive Medicine* 24, 14. https://doi.org/10.1186/s12199-019-0768-x

Nomura, S. et al. 2020. Time to Reconsider Diverse Ways of Working in Japan to Promote Social Distancing Measures against the COVID-19. *Journal of Urban Health* 97(4): 457–460. https://doi.org/10.1007/s11524-020-00464-4

Nomura Research Institute. 2020. Shingata corona virus to sekai 8 kakoku ni okeru telework riyo (COVID-19 and Telework Use in 8 Countries in the World). 2020-12. https://www.nri.com/-/media/Corporate/jp/Files/PDF/knowledge/report/cc/digital_economy/20201218.pdf (in Japanese).

Ogawa, R. et al. 2018. The Relationship between Long Working Hours and Depression among First-Year Residents in Japan. *BMC Medical Education* 18(1). https://doi.org/10.1186/s12909-018-1171-9

Okubo, T. 2021. Telework in the Spread of COVID-19. Keio-IES Discussion Paper Series. https://ies.keio.ac.jp/en/publications/14419/

Ono, H. 2018. Why Do the Japanese Work Long Hours? Sociological Perspectives on Long Working Hours in Japan. *Japan Labor Issues* 2(5). https://www.jil.go.jp/english/jli/documents/2018/005-03.pdf

Ono, H. and T. Mori. 2021. COVID-19 and Telework: An International Comparison. *Journal of Quantitative Description: Digital Media* 1: 1–35. https://doi.org/10.51685/jqd.2021.004

Prime Minister's Office, Japan. 2020. COVID-19 Control Headquarters (36th meeting). https://www.kantei.go.jp/jp/98_abe/actions/202005/25corona.html (in Japanese).

Reichelt, M., K. Makovi, and A. Sargsyan. 2021. The Impact of COVID-19 on Gender Inequality in the Labor Market and Gender-Role Attitudes. *European Societies* 23(S1): S228–S245. https://doi.org/10.1080/14616696.2020.1823010

Sakamoto, Y. and W. Spinks. 2008. The Impact of Home-Based Telework on Work-Family Conflict in the Childcare Stage. *Journal of eWorking* 2(2): 144–158. https://www.scinapse.io/papers/2397040853

Sato, A. 2013. Teleworking and Changing Workplaces. *Japan Labor Review* 10(3): 56–69. https://www.jil.go.jp/english/JLR/documents/2013/JLR39_all.pdf#page=58

___. 2019. Telework and Its Effects in Japan. In J. Messenger, ed. *Telework in the 21st Century: An Evolutionary Perspective*. https://www.elgaronline.com/view/edcoll/9781789903744/9781789903744.00008.xml

Sumitomo Mitsui Trust Bank. 2021. Koronaka deno Jinkoido no Henka (Change of Population Move during the COVID-19 Pandemic). Sumitomo Mitsui Trust Bank Chosa Geppo 2021-5. https://www.smtb.jp/-/media/tb/personal/useful/report-economy/pdf/109_1.pdf (in Japanese).

Takahashi, M. 2019. Sociomedical Problems of Overwork-Related Deaths and Disorders in Japan. *Journal of Occupational Health* 61(4): 269–277. https://doi.org/10.1002/1348-9585.12016

Takami, T. 2019. Current State of Working Hours and Overwork in Japan Part II: Why Do the Japanese Work Long Hours? *Japan Labor Issues* 3(18). https://www.jil.go.jp/english/jli/documents/2019/016-04.pdf

___. 2021. Working Hours under the COVID-19 Pandemic in Japan: Reviewing Changes by Situation Phase during and after the 2020 State of Emergency Declaration. *Japan Labor Issues* 5(30): 2–10. https://www.jil.go.jp/english/jli/documents/2021/030-01.pdf

CHAPTER 12

Social Media Reactions to COVID-19 and Its Countermeasures

Bidur Devkota and Hiroyuki Miyazaki

12.1 Introduction

In December 2019, people linked to a wet market of Wuhan city of the People's Republic of China (PRC) experienced a peculiar pneumonia-like disease (Lu, Stratton, and Tang 2020). The World Health Organization (WHO) received information about the novel disease. It was highly contagious, and a large number of people were infected not only within the PRC but also worldwide. Therefore, in January 2020, the WHO declared a global public health emergency and general well-being crisis. In February 2020, the disease was named COVID-19, and the virus causing this disease was called SARS-CoV-2 (severe acute respiratory syndrome coronavirus 2) because of its genetic similarity with the coronavirus that caused the 2003 SARS outbreak (World Health Organization 2020).

The outbreak has become a global threat and created shocking distress in social and economic aspects worldwide (Cinelli et al. 2000; Yeyati and Filippini 2021; Almarayeh and Almarayeh 2021; De Jong and Ho 2020; Bashir, Ma, and Shahzad 2020). Its unprecedented spread is inextricably linked to human mobility. Various countries implemented social distancing, lockdowns, and movement restrictions as non-pharmaceutical measures to control the outbreak (Muley et al. 2020). It has become a health and development catastrophe and requires comprehensive examination so that we can understand the potential for post-pandemic changes. This pandemic has illustrated that the future is full of unpredictable events, so the world must focus on mitigating their effects as far as possible.

Social media platforms such as Twitter, Facebook, WhatsApp, and WeChat allow people to disseminate and share information about various events at an unprecedented level. These platforms have come to immensely influence human life on a broad scale such that people spend a lot of time using these platforms to share their feelings and communicate with friends and family.

Apart from personal use, government, businesses, researchers, and others have also started to utilize the advantages of such social media platforms and their contents (Preoțiuc-Pietro et al. 2015; Khan 2017; Devkota, Kim, et al. 2019; Devkota, Miyazaki, et al. 2019). These platforms have aided in the timely dissemination of information to a larger audience, which has aided in the prevention and control of communicable illnesses, not only for health professionals but also for the general population (Chan et al. 2020; Gough et al. 2017). However, the major concern with social media services is the questionable reliability of the content. The danger is that while this content is widely accessible and immediately available, much of it is unreviewed; it is vulnerable to fake news and misinformation (Shimizu 2020; Apuke and Omar 2021). People must be cautious and avoid misleading information to safely use social media services.

The public digital footprint made possible by digital data sources and social media platforms such as Twitter (Chen, Lerman, and Ferrara 2020), Facebook (Facebook 2021), and Google (Google 2021) has served successfully as a proxy for public behaviors. Various studies have demonstrated the usefulness of such data to study changing dynamics and understand the effects of efforts to mitigate disease. Recently, such data proved helpful in research related to COVID-19 dynamics and various other aspects such as public sentiments (Boon-Itt and Skunkan 2020; Feng and Kirkley 2021), social connectivity, and human mobility (Kuchler, Russel, and Stroebel 2021; Fritz and Kauermann 2020;

Layer et al. 2020; Shepherd et al. 2021; Feng and Kirkley 2021; Gonzalez, Hidalgo, and Barabasi 2008; Benjamin et al. 2020).

Numerous studies have utilized Facebook data on public movement to track public mobility patterns during the COVID-19 period in different places such as the United Kingdom and the United States (Layer et al. 2020; Kissler et al. 2020; Shepherd et al. 2021; Fritz and Kauermann 2020). Researchers observed significant variations in the mobility patterns between pre- and post-pandemic mobility. Reduced commuting mobility was shown to be linked to regional differences in COVID-19 infections in the study areas.

Xu et al. used publicly available geolocated Twitter data in the United States to investigate public mobility and devised the Twitter Social Mobility Index, which analyzes public behavior such as social distancing and traveling (Xu, Dredze, and Broniatowski 2020). At the city and state level, the researchers studied the mobility variation of over 3 million users. In the United States, when social distancing regulations were implemented, there was a significant decline in travel. The findings revealed that geotagged social media data can be used to track social distancing practices, a tool that could be useful for ongoing pandemic response planning.

The government and policy makers must be aware of popular opinion during various public events in order to acquire a more balanced appraisal of current perspectives. This enables authorities to make better decisions. Boon-ltt and Skunkan (2020). analyzed social media posts to understand the level of public awareness regarding the COVID-19 pandemic. The researchers analyzed 107,990 COVID-19–related tweets in order to learn more about public perceptions of the virus, its propagation and symptoms, and the various subjects people discuss. The findings suggest that Twitter may be used to better assess public interests and awareness related to COVID-19.

The main objective of this chapter is to explore and examine the feasibility of social media for understanding various aspects of the COVID-19 pandemic. We explore the reflection of COVID-19 in popular social media platforms, i.e., Twitter, Google, and Facebook, in Japan during the year 2020. The findings provide an understanding regarding (i) the timeline of the crisis, (ii) the public awareness level and response to the crisis, and (iii) the socioeconomic aspects of the government's measures for combating the crisis and the public adherence to those measures. The findings can provide a guide to policy makers for planning better transformative measures for mitigating similar crises in the future. In summary, this investigation demonstrates that wise use of social media services can provide an easy and effective means of communication during pandemic scenarios such as COVID-19 for rapid information dissemination, monitoring, and control.

12.2 Methodology

12.2.1 Data Used

Social media platforms have a user base of 3.8 billion active users (Kemp 2020). These are a part of big data where members of the public share their ideas and opinions beyond geographical and political boundaries in real time. Hence, such media have emerged as a rich source of big data and provide useful insights from a variety of geographical regions throughout the world. This study utilizes the data provided by some of the most used websites in the world: Google (rank 1), Facebook (rank 3), and Twitter (rank 4) (Similarweb 2022).

Mobility data. Various mobile apps record users' GPS locations via positioning features. Such data, provided by Google and Facebook, allow us to understand public mobility. Navigation apps such as Google Maps provide real-time GPS coordinates. This data can be used to calculate the frequency of access to various points of interest (POI) like parks, health facilities, residential areas, and recreational spaces. Mobility data from social media apps like Facebook is also useful. Though Google and Facebook are used for location-based mobility data, these platforms bear significant differences. People use Google mainly for search and mapping, whereas they use Facebook for connection with friends and family. Also, Google and Facebook provide data in different formats. Google's data is focused on POI-based data, and Facebook data is grid-based data (in this case, 600 meter × 600 meter tiles). POI-based data labels a place on a map that people find useful or interesting. Grid-based data is more informative for geospatial analysis. Google's community mobility data shows mobility patterns over time by region and for many types of locations, including parks, transit hubs, workplaces, and grocery stores and pharmacies, while Facebook's mobility data provides only two parameters: inter-grid movements and within-grid movements. Hence, Google's mobility data provides more parameters than Facebook's mobility data (though our study did not use all parameters provided, which can be utilized during future exploration).

Facebook data. Facebook provides data sets from March 2020 for researchers, which is useful to investigate public response to restrictions regarding mobility and physical distancing. Facebook data is based on the user location history, and it can reveal the location of active Facebook users, their mobility patterns, and their engagements (Facebook 2021). The user location is based on the geolocation (GPS) services and internet connection data from mobile devices that have the Facebook app installed. The user locations are based on the Bing Tile architecture (Microsoft 2021), with users being assigned to individual tiles of approximately 600 meters × 600 meters. However, due to various constraints such as user privacy, the available mobility data is normally at lower resolutions. Also, for anonymity reasons, Facebook ensures a minimum of 300 active users to provide data for any region. Furthermore, only the data of the users who have enabled location services is made available. Two main metrics—the remain-in-tile index and the movement-between-tiles index—are in the data set. February 2020 was taken as the baseline period as this period predates most mobility and social distancing restrictions. The movement-between-tiles index shows how much people are moving around and compares it with a baseline period. The remain-in-tile index reflects the percentage of the public that stayed within a small area (a Bing Tile) during an entire day.

Google data. Google Maps tracks public movement during users' daily activities via a Google-enabled device, such as an Android phone. This is the information gathered and released for the COVID-19 Mobility Report (Google 2021). Google Community Mobility Reports show the changes in public social habits as a result of legislation targeted at fighting COVID-19. The data set provides insights on how movement trends have changed over time in several categories such as grocery and pharmacy, parks, retail and recreation, transit stations, workplaces, and residential. The COVID-19 Mobility Report is created by comparing changes in daily visitor numbers to the benchmark. The benchmark is made up of seven values, one for every day of the week, and the value is the median of 5 weeks (3 January to 6 February 2020). The report shows change percentages as a comparison to the baseline. This report is published at the county level or even state level based on the availability of the data. There might be data gaps that are intentional and happen while maintaining the quality and privacy level.

Twitter data. Twitter is one of the largest sources of research data as its free access policy provides unrestricted access to about 1% of its social media content (Martín et al. 2020). It is a social networking and a micro-blogging site. Twitter serves as a platform to publish and share tweets, i.e., text messages

up to 280 characters.[1] About 500 million tweets are published every day on Twitter (InternetLiveStats 2021). Normally, tweets are public, unlike Facebook posts. Twitter provides a free streaming application programming interface (API) that can be used to gather sample tweets. Though the sample data is small in proportion (i.e., around 1%), different studies have suggested the representative usability of such data in research studies (Morstatter et al. 2013; Morstatter, Pfeffer, and Liu 2014). As explained by Twitter, location tags can be embedded within tweets via different ways (Twitter 2021). The first way is to post tweets using GPS-enabled devices that are enabled to embed location (i.e., latitude and longitude). Another way is to indicate the tweet locations manually via the Twitter user interface. The Twitter API pushes streaming messages encoded in JavaScript Object Notation (JSON) format, which includes various information such as a user identifier, tweet identifier, tweet time stamp, tweet text content, tweet language, and location information. This study utilizes the COVID-19-TweetIDs data set, which provides an ongoing collection of tweet IDs of multiple language tweets related to COVID-19 (Chen, Lerman, and Ferrara 2020).

The social media data used in this study has a few limits. Google, Facebook, and Twitter are restricted in various nations like the PRC. Also, these sites may not provide unlimited access to all the data. The positional accuracy of the information acquired from these online platforms relies upon the precision of users' cell phones. Past studies have highlighted the fact that social media users vary substantially from the general population in terms of age, education, geography, gender, etc. (Mellon and Prosser 2017; Kariryaa et al. 2018). Yet, social media is a useful tool for understanding public concerns because sometimes it is important to know what people said rather than how many people said it. In other words, unrepresentative data may also be useful (An and Weber 2015)). Policy makers must be aware of all public concerns, and social media provides such information. Lately, due to the usefulness and richness of information embedded within it, social media data has established itself as a promising complement, and sometimes even as a complete substitute, for traditional survey data (Reveilhac, Steinmetz, and Morselli 2022). Further, recent explorations have asserted that rich information is embedded in the social media, which can be mined to discover useful knowledge (Gundecha and Liu 2012 ; Heikinheimo et al. 2017). Also, studies have shown that social media data can better capture social phenomena more quickly and economically than on-the-ground surveys (Buntain et al. 2016). Table 12.6 provides a comparative overview of social media and traditional surveys as a source of data for research (Reveilhac, Steinmetz, and Morselli 2022).

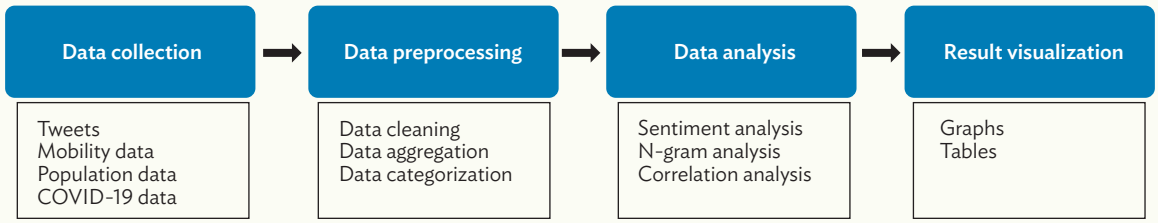
12.2.2 Overall Approach

As depicted in Figure 12.1, the overall workflow of collecting and analyzing data happens in four different phases: data collection, data preprocessing, data analysis, and result visualization. We collected tweet data (frequency count and sentiment), mobility data (Facebook and Google), population, and COVID-19 cases and deaths across the countries from the respective data sources. Next, we cleaned the data and then merged and aggregated the available data at country level. We did further investigation on a daily and weekly basis. We analyzed tweet frequency and sentiments to understand the public awareness regarding the COVID-19 pandemic. We conducted correlation analysis of the aggregated data to extract valuable insights regarding the relationships among COVID-19 data (cases and deaths), Twitter statistics, Facebook mobility data, and Google mobility data. Finally, we obtained and visualized the results to gain insights, which are discussed in the following sections.

Data collection and preprocessing. We used the COVID-19-TweetIDs GitHub repository (Chen, Lerman, and Ferrara 2020) to obtain the IDs of COVID-19–related tweets from 21 January 2020 through 31 August 2020. We used Python programming to hydrate the tweet IDs and obtain the full

[1] More recently, Twitter has increased its character limits (Reimann 2023).

Figure 12.1: Overall Methodology



Source: Authors.

tweets. Since the data set collects tweets containing COVID-19–related keywords, several keywords related to COVID-19 were used to filter the data set (Chen 2021). Such keywords include words and phrases like "Coronavirus," "corona virus," "lock down," and "social distancing." We then categorized tweets by country using the location information encoded in the "latitude" and "longitude" fields as well as the "place" field obtained in the tweet payload. Though the tweet text obtained contains user posts in various languages, the data shows a bias toward English tweets because all of the keywords used to filter the tweets were in English.

We obtained human mobility data from Google and Facebook from the respective data sources for the year 2020. These data are based on anonymized and aggregated data sets of users who have enabled the "location history" feature. We filtered the data set to obtain the data for selected countries only. The data from Google depict the daily variations in public movement patterns across various categories such as retail and recreation, workplaces, transit hubs, and grocery and pharmacy. The community movement trends were prepared from 15 February 2020 through 31 December 2020 in Japan. Similarly, movement pattern indices, i.e., remain-in-tile index and movement-between-tiles index, were obtained from Facebook from 1 March 2020 through 31 December 2020 in Japan.

We obtained population data for Japan from the World Data portal (World Bank 2021). Various organizations like the Johns Hopkins Center for Systems Science and Engineering have been collecting and publishing the cumulative confirmed cases of COVID-19 for each country. This study utilizes clinical data regarding COVID-19 cases and deaths from the portal of Our World in Data (Our World in Data 2021).

Text mining and sentiment analysis. Twitter text analysis aids in understanding the public awareness level regarding the COVID-19 pandemic trends. Tweet frequency and the sentiment expressed are important indicators for observing the public awareness level. The Python Natural Language Toolkit (NLTK) performs various natural language processing tasks such as N-gram analysis (NLTK 2021). N-gram analysis identifies frequently occurring phrases in a data set. Sentiment analysis categorizes the sentiments appearing in Twitter messages as positive, neutral, or negative. For English language tweets, we used the TextBlob library in Python, which analyzes the keywords appearing in the tweets and rates the sentiments expressed in a polarity score within the range [−1.0, 1.0] (TextBlob 2021). Similarly, we used the Japanese language sentiment analyzer Asari to quantify the sentiment level of Japanese tweets (Nakayama 2021).

Correlation analysis. The aim of this step is to explore the possibility of a link between the new COVID-19 data (cases and deaths), Twitter statistics, and mobility data. We used Pearson Correlation, a correlation analysis method commonly used to evaluate whether two variables are related (Freedman

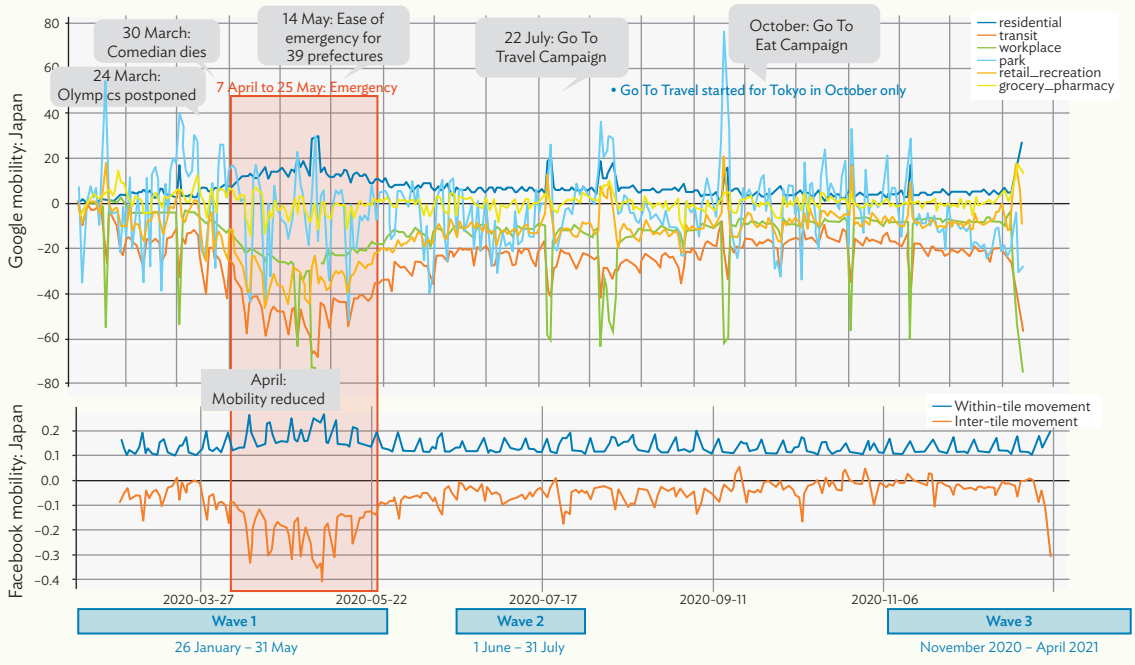
et al. 2007). The variables are related if a change in one causes a change in the other. As we have time series data, we used cross-correlation analysis to look for an indicator of the time lag between the variables. Because its peak occurs at the lag at which the two time series are best correlated, that is, the lag at which they best line up, cross-correlation analysis is useful in aligning two time series, one of which is delayed with regard to the other. We calculated the cross-correlation function between the selected time series data at different lags. The typical "time delay" is established by examining the lag that has the maximum cross-correlation value.

12.3 Results and Discussion

Figure 12.2 shows the trends of daily mobility patterns as indicated via Google and Facebook data. The red box indicates the first state of emergency period in Japan, which started on 7 April and lasted until 25 May. In 2020, Japan experienced three major COVID waves, the first during January–May, the second during June–July, and the last starting in November.

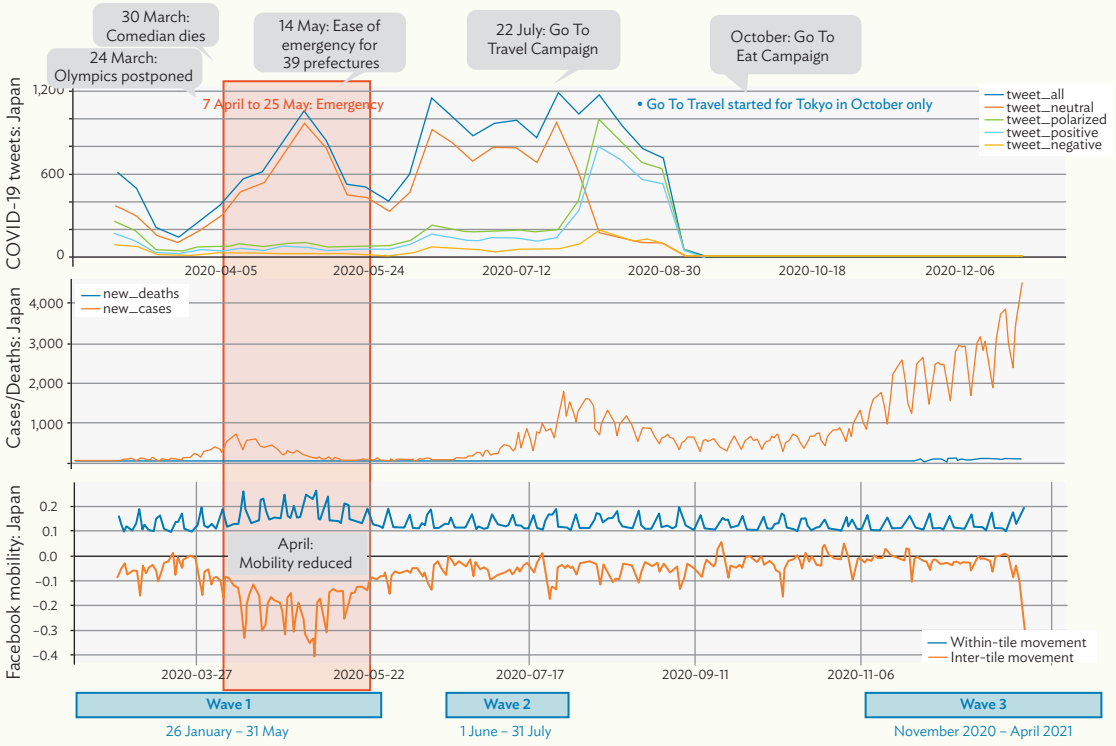
Similarly, Figure 12.3 illustrates the time series of tweet statistics, COVID-19 cases and deaths, and Facebook mobility during 2020 in Japan. The tweet statistics are available till August 2020. The tweet statistics include tweet_all (count of all tweets collected), tweet_neutral (count of all tweets that contain neutral opinions), tweet_polarized (count of all tweets that contain polarized views), tweet_positive (count of all tweets that contain positive sentiments), and tweet_negative (count of all tweets that contain negative sentiments). The frequency of COVID-19–related tweets increased during the first and second waves. This reflects the high level of community awareness representing the intensity of COVID-19–related discourse on Twitter.

Figure 12.2: Google and Facebook Mobility Time Series during 2020 in Japan



Source: Based on data collected from multiple sources.

Figure 12.3: Tweet Statistics, COVID-19 Cases and Deaths, and Facebook Mobility Time Series during 2020 in Japan



Note: The tweet statistics are available until August 2020.

Source: Based on data collected from multiple sources.

12.3.1 Public Awareness and COVID-19 Cases

A meaningful relationship exists between COVID-19–related information flow and the occurrence of new cases. Here, we examine public awareness regarding COVID-19 via the frequency of tweets containing COVID-19 keywords. Figure 12.3 shows that the number of tweets increased with the rise in the number of COVID-19 infections. During the first wave, tweets increased rapidly and continued to increase until the start of May even after the decline of the infection rate in mid-April. Before and after the second wave in June, an even larger volume of tweets appeared. The second wave had started to decline by mid-August, but the Go To Travel Campaign increased travel-related COVID-19 cases in September (Anzai and Nishiura 2021).

Table 12.1 lists selected tweets that provide some insight into the state of public psychology and awareness toward COVID-19 in Japan. People expressed anxiety, fear, and consciousness about the disease and its cure, as well as their response to government policies and actions. Apart from informative tweets (as shown in Table 12.1), rumors and misinformation also spread on Twitter. Policy makers should consider controlling disinformation on social media because it might lead to panic impeding overall pandemic response efforts (Kamada 2021; Cato et al. 2021).

Table 12.2 displays some of the most frequently discussed topics on Twitter in relation to COVID-19. Though all the tweets were related to COVID-19, the topics of public concern in January 2020, March 2020, and January 2021 have evolved from basic information about COVID-19 like “COVID test” to the “new normal” lifestyle.

Table 12.1: Sample Tweets Illustrating Public Sentiments during COVID-19

Tweets with Positive Sentiments	Tweets with Negative Sentiments
First... Mask, thorough hand wash. We want you to get the correct information right. (まずは…マスク、手洗いの徹底。正確な情報を正しく入手していただきたいと思います)	I don't really understand. Where will we go home in a city on lockdown? Our own homes? Are we safe at home? (よく分からない。 封鎖された都市のどこに帰る？ 自宅？ 自宅なら安全なのだろうか？)
The Philippine Department of Health says Moringa can fight coronavirus. I really hope so. (フィリピン保健省いわく、マルンガイはコロナウィルスと戦えるそうです。ほんとうにそうならいいですが。)	It's scary, no matter how much cases increase, the fatality rate is still around 2.2%.z (こわいよぉ、どんだけ増えても致死率2 2 程度キープしてるし。)
With successful isolation of coronavirus, vaccine development is likely to proceed. (コロナウィルス 分離成功にて、ワクチン開発進みそう)	Eh! Were they sending out masks? Employees have to wear masks, and they can only be white. "Buy your own mask," they say. First of all, they're sold out and we can't buy them. Why send them when the country is short of masks? Honor is more important to them than Japan. They're too stupid. (え！マスク送ってたの？従業員はマスクつけなければいけなくなり、しかも真っ白しかダメと。マスクは自費で買ってください。って、まず売り切れていて買えないから。自国がマスク不足してるのになぜ送る？日本より名誉の方が大事なんや。アホすぎるやろ。)

Note: The text is translated from Japanese tweets.

Source: Based on data from Twitter.

Table 12.2: Some Frequent Topics of Discussion during January 2020, March 2020, and January 2021

Period	Awareness Level	Frequent Tweet Content
Early stage: starting in January 2020	– Start of awareness about severity – Rapid spread of the disease – Confused and afraid	In Japan, the Ministry of Health, Labor and Welfare has already issued a notification to check body temperature upon arrival at airports. (日本でもすでに厚生労働省通達で空港入国体温チェック空港港湾で熱咳自己申告体行なっている)
		Test positive coronavirus.
Epidemic stage: starting in March 2020	– Disease spread worldwide – Still confused but more aware about the disease and prevention	Even if you follow the World Health Organization... you need a mask, especially in a closed space. (のだからwhoに従っても マスク必要 特に閉鎖空間屋内で)
		Based on this article, you don't know who is infected with the coronavirus, so even if you follow the World Health Organization... (記事根拠なら誰が新型コロナウイルス患者かわからないのだからwhoに従っても)
Mature stage: starting in January 2021	– Awareness at a scientific level – Awareness of medical knowledge – Effective government policies	stayhome: The power to withstand the new coronavirus. (stayhome: 新型コロナに負けないチカラ)
		newnormal: wearamask

Note: The text is translated from Japanese tweets.

Source: Based on data from Twitter.

Table 12.3 displays the results of cross-correlation of different tweet and COVID-19 statistics. The variables are taken from Twitter statistics (i.e., number of tweets) and COVID-19 cases and deaths statistics. The time lag is used to measure the similarity between the Twitter statistics and the COVID-19 cases (and deaths). It is shifted in time relative to one another by one week; for example, a week lag of 5 means the time difference between the two time series is 5 weeks. This means it takes 5 weeks' time for the effect of one variable (say tweet statistics) to propagate to another variable (say new cases statistics).

Table 12.3: Tweet Statistics vs. COVID-19 Cases and Deaths

	Highest Correlation		Number of Lag Weeks					
Variables	Week Lag	Value	0	1	2	3	4	5
new_cases vs. tweets	5	−0.448	−0.376	−0.381	−0.398	−0.422	−0.437	−0.448
new_deaths vs. tweets	5	−0.463	−0.316	−0.300	−0.306	−0.349	−0.413	−0.463

Note: The correlation values for all lags are close to the highest value.

Source: Calculations based on data collected from multiple sources.

We found a negative correlation between overall tweet frequency and new cases. Though the correlation is moderate and not very strong, it indicates that when public attention was high, COVID-19 cases decreased. The maximum correlation of −0.448 is at a lag of 5 weeks' time, and the correlation values for other week lags are also close to the highest. This means that when people were aware about the occurrence of COVID-19, they started to take precautions that could help in controlling the cases and deaths.

In the case of Japan, we can say that the public awareness and effective information sharing is high because the number of COVID-19–related tweets increased as COVID-19 cases increased. For example, as evident in Figure 12.3, the number of COVID-19–related tweets have increased during the COVID-19 waves. During this ongoing COVID-19 pandemic, people are using social media to generate, distribute, and consume a variety of information on an unprecedented scale. Along with real-time situational data, fake news and misinformation are also shared on social media. It is important for the concerned authority (e.g., government) to identify, filter, and disseminate only true situational information for proper response planning. Based on the content and time period of tweets, we made a series of observations in relation to the topic of discourse and its dynamics. People talk about a variety of topics. This study was performed on a less granular scale. More fine-grained investigation may capture insights about specific themes and their dynamics.

12.3.2 Public Mobility and COVID-19 Cases

One of the main strategies promoted by the Japanese government to counteract COVID-19 was limiting community movement. Border control measures, home isolation, school closures, suspension or postponement of concerts and theater performances, and other social distancing measures were all advised under Japan's epidemic response policy (Wang et al. 2021).

Recalling Figures 12.2 and 12.3—which illustrate the relationship of COVID-19 cases, COVID-19 deaths, tweet statistics, and mobility patterns from Google and Facebook data—the graphs clearly show a

strong relationship between the COVID-19 cases and mobility. During April 2020, as the number of COVID cases rose, restrictions on travel were imposed, which resulted in a significant decline of overall mobility. Facebook's inter_tile_movement indicator showed a decrease of about 25% in long distance movements. Similarly, Google's long distance movement indicators such as transit, workplaces, and retail_recreation also declined by 30% or more. Moreover, the residential movements increased during the period. From the month of June, the mobility indicators moved nearer to their baseline values as the restrictions were relaxed. It is also noticeable that public movement started to rise even before the lifting of travel restrictions because people did not tolerate long emergency periods. Finally, after May, once the public mobility resumed to normal, the COVID-19 cases went up.

Table 12.4 shows the results of cross-correlation of different mobility indicators and COVID-19 cases and deaths. Google's residential (also Facebook's within_tile movement) and COVID-19 cases and deaths exhibited negative correlations with a week lag of 5. This indicates that when population movement was restricted, the number of cases and deaths went down. But other long distance movement indicators showed positive correlations with the number of cases and deaths. For instance, we observed a positive correlation between Facebook's inter_tile movement and new_cases within a lag of 5 weeks. Hence, free movements without regulatory obligations induced the rise in COVID-19 cases and deaths.

Table 12.4: Mobility Indicators vs. COVID-19 Cases and Deaths

Variables	Highest Correlation		Number of Lag Weeks						Mobility Data Source
	Week Lag	Value	0	1	2	3	4	5	
inter_tile vs. new_cases	5	0.314	0.297	0.256	0.207	0.224	0.261	0.314	Facebook
inter_tile vs. new_deaths	5	0.264	−0.163	−0.182	−0.174	−0.024	0.104	0.264	Facebook
transit vs. new_cases	5	0.361	0.300	0.265	0.225	0.247	0.299	0.361	Google
transit vs. new_deaths	5	0.212	−0.162	−0.179	−0.173	−0.045	0.082	0.212	Google
workplaces vs. new_cases	5	0.488	0.288	0.281	0.280	0.333	0.410	0.488	Google
workplaces vs. new_deaths	5	0.235	−0.121	−0.119	−0.098	0.008	0.124	0.235	Google
residential vs. new_cases	5	−0.396	−0.279	−0.254	−0.225	−0.261	−0.320	−0.396	Google
residential vs. new_deaths	5	−0.243	0.167	0.184	0.159	0.023	−0.114	−0.243	Google
within_tile vs. new_cases	5	−0.315	−0.240	−0.216	−0.180	−0.204	−0.245	−0.315	Facebook
within_tile vs. new_deaths	5	−0.319	0.196	0.200	0.161	−0.004	−0.153	−0.319	Facebook

Source: Calculations based on data collected from multiple sources.

In summary, the observations seem to support the government policy of applying non-pharmaceutical measures like travel restrictions due to the positive outcome they had on containing the COVID-19 cases.

Public opinion during government restrictions. People's perceptions about COVID-19 and social distancing are important factors in limiting the spread of the virus. As a result, it is critical to comprehend what people are talking about and their reactions. Table 12.5 displays the results of cross-correlation of different tweet statistics and mobility indicators.

Table 12.5: Tweet Statistics vs. Mobility Indicators

Variables	Highest Correlation		Number of Lag Weeks						Mobility Data Source
	Week Lag	Value	0	1	2	3	4	5	
tweets vs. transit	2	−0.515	−0.501	−0.513	−0.515	−0.507	−0.511	−0.501	Google
tweets vs. workplaces	0	−0.510	−0.510	−0.503	−0.473	−0.383	−0.318	−0.290	Google
tweets vs. residential	2	0.508	0.499	0.502	0.508	0.495	0.486	0.483	Google
tweets vs. within_tile	0	0.406	0.406	0.389	0.387	0.350	0.314	0.322	Facebook
tweets vs. inter_tile	2	−0.436	−0.436	−0.435	−0.436	−0.415	−0.420	−0.430	Facebook

Note: The correlation values for most lags are close to the highest value.

Source: Calculations based on data collected from multiple sources.

Google's residential (also Facebook's within_tile movement) and tweet statistics have shown a strong positive correlation. This indicates that when population movement was restricted, COVID-19–related tweets increased. This means people are more concerned when their movement is restricted and hence they frequently express their thoughts via social media. But other long distance movement indicators showed a strong negative correlation with the tweet statistics. For instance, we observed a significant negative correlation between Google's transit movement and tweets. Hence, fewer tweets are posted when movement is not restricted.

Figure 12.3 shows that during the first COVID-19 wave, number of tweets started to decline starting from the beginning of May 2020 because that was when people started to commute outside their residential areas. Government policies like travel restrictions induce harsh negative consequences on economy (Jay et al. 2020; Bonaccorsi et al. 2020; Spelta and Pagnottoni 2021). That may be one of the prominent reasons why people do not tolerate long periods of travel restrictions. A large proportion of the population faced the risk of income reduction and loss of employment, and temporary workers, students, and self-employed people suffered the most severe economic hardship (Miura 2020). The Japanese government responded by providing multiple COVID-19 stimulus packages amounting to 117.1 trillion yen (Smith and McClean 2020). The packages included incentives for small and medium-sized enterprises, medical assistance, cash transfers to the public, etc.

Sentiment analysis of social media content further clarifies the public concern during the pandemic period. Figure 12.3 showed earlier in this chapter that the number of tweets increased with the development of the pandemic and rose as infections increased. During such peak periods, Twitter users posted a higher number of polarized tweets that characterized their emotional state and the feelings of fear and anxiety toward the new disease and related countermeasures (as shown previously in Table 12.1). However, Japanese people have posted comparatively fewer polarized tweets when compared to the number of neutral tweets (as indicated by Figure 12.3). Also, during the entire period

of 2020, tweets with positive sentiments always outnumbered tweets with negative sentiments. This might be because people were optimistic about the cure for this new disease. Also, since more information regarding COVID-19 detection, prevention, and mitigation became available, the positive feelings increased in the community.

These observations suggest that social media provides an easy channel to gauge real-time situational information during crises. Being aware of public opinion in real time is also important for the detection of rising public concerns as well as controlling the spread of misinformation and terror. The data and the patterns observed must be evaluated as these potentially provide useful guidelines for crisis management and socioeconomic planning.

Recently, the usefulness of social media data in research has shown up in many studies. The traditional approaches for collecting research data use typical strategies such as interviews and questionnaire surveys. Such techniques are often slow, expensive, and sometimes restricted spatiotemporally. Table 12.6 summarizes the differences between social media data and traditional survey data (Reveilhac et al. 2022). As discussed in Section 12.2.1, social media data have limitations regarding representativeness (like age bias and being banned in some countries), censored content, and limited sample data available. Despite the limitations, such data have become popular and have been extensively used, with various levels of success, in research in various domains like health and infectious disease (Generous et al. 2014; Chan et al. 2020; Gough et al. 2017), tourism (Maeda et al. 2018; Lee and Tsou 2018), socioeconomy (Preoțiuc-Pietro et al. 2015), and box office predictions (Mestyán, Yasseri, and Kertész 2013). Past research has pointed out that the rich information embedded in social media can be mined to discover useful knowledge (Gundecha and Liu 2012). Recent investigations have highlighted the usefulness of such emerging data sources, which can provide added insights (Heikinheimo et al. 2017). Also, studies have shown that social media data can better capture social phenomena more quickly and economically than on-the-ground surveys (Buntain et al. 2016).

Table 12.6: Differences between Social Media Data and Traditional Survey Data

	Traditional Survey Data	Social Media Data
Population type	Representative	Selective
Data frequency	Infrequent	Frequent
Data signals	Opinion poll of people with a predetermined sampling period	Platform users and signals such as posts or tweets
Data unit	Individuals reflecting a target population in a sample frame	Can be any such as hashtags, users, search queries, location, keywords
Metadata	Precise and nearly complete individual sociodemographic data (e.g., number of members in a household) as well as supporting information	Collection of contextual information (e.g., time and location) and user behavior data (e.g., interactions, network, use frequency)
Cost	Expensive and resource intensive	Economical
Data type	Structured data	Unstructured data
Speed of data collection	Slow	Fast

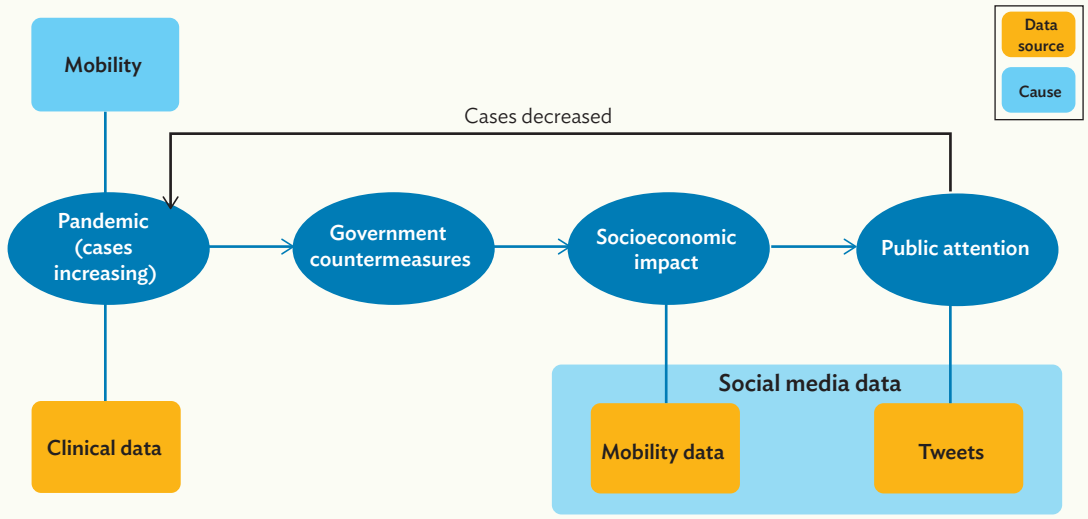
Source: Based mainly on Reveilhac et al. (2022).

12.4 Conclusion and Further Suggestions

This chapter has investigated the reflection of the COVID-19 situation in Japan via the social media platforms Twitter, Google, and Facebook. We explored the timeline of the crisis, public awareness level, and response to the crisis, as well as the public reaction to the government's measures for combating the crisis.

Figure 12.4 summarizes the research observations and the conclusion of this study. Unrestricted mobility played an important role in spreading the virus, an observation supported by clinical data. Government countermeasures like mobility restrictions helped in controlling the pandemic, but such measures incur negative socioeconomic impacts. Also, public attention toward the crisis situation is indispensable for its control. The level of public awareness and mobility patterns can be effectively understood through data from social media platforms like Twitter, Facebook, and Google.

Figure 12.4: Summary of the Research Observations



Source: Authors.

We used the frequency and dynamics of tweets, as well as their content, to assess public awareness regarding the COVID-19 outbreak. Public awareness is essential for containing the pandemic. Unfortunately, social media disseminates not only useful situational information, but also fake news and misinformation. Hence, it is important for the concerned authority (such as government) to identify, filter, and disseminate only true situational information for proper response planning.

We used Google and Facebook mobility data to examine public movements during the pandemic. Our analysis showed that unrestricted public movement contributes to the spread of COVID-19 infections. The findings supported the government's approach of using non-pharmaceutical measures like travel restrictions to contain COVID-19 infections.

We examined public opinion while government restrictions were in place during the pandemic using mobility data as well as tweet statistics. People are more anxious when their mobility is constrained,

and they regularly voice their concerns through social media. People do not want to be restricted from traveling for long periods of time because mobility reductions induce harsh negative consequences on economic systems. These findings show that social media can be used to quickly assess real-time situational information during crises.

12.4.1 Implications and Suggestions

In the future, government and policy makers can optimize pandemic response by utilizing social media data for easily gathering real-time situational awareness information. During outbreaks like COVID-19, correct and trustworthy information spread via online media platforms can be critical for real-time situational awareness such as understanding public mobility, spreading awareness, and combating misinformation and rumors. Hence, real-time social media monitoring can be a valuable tool for better response planning. Policy makers should take note of these observations and suggestions for practical implications:

(i) Strict government policy and movement restrictions seem to be effective in order to control the spread of a pandemic. Such restrictions can include curfews and lockdowns, border control, social distancing, home isolation, mass gathering prohibition, and school closure. If such restrictions continue for long periods, then they may degrade the economic conditions of the people, who will stop adhering to such policies. Hence, continuous monitoring of the effect of applying such policies as well as public reaction to such policies is essential. Policies should be updated based on their effectiveness as well as public reaction. If the new policy does not improve the quality of people's lives, then it should be updated. Social media is useful for monitoring the effectiveness of new policies.

(ii) As mobility reductions (e.g., lockdown) induce harsh negative consequences on economic systems, economic support policies seem to be effective in reducing the spread of the disease. Social media can provide an easy and quicker means of monitoring the effectiveness of such policies.

(iii) Disasters like earthquakes and hurricanes are not long-lasting like the COVID-19 pandemic. Hence, during long-lasting events, continuous monitoring of the event and related public reaction over the time is necessary. Social media provides easy access to gauge such situations. Pandemics like COVID-19 come in waves that need continuous monitoring, which is possible via social media data. For example, in Figure 12.3, accompanying the COVID-19 waves during April and June, there is an increase in COVID-19–related tweets during April and June. This illustrates the need for continuous monitoring of the pandemic and also the usefulness of social media data for monitoring such scenarios in an easy, economical, and timely manner.

(iv) Location information is a key feature for specifying policy. This study focused only on Japan. Similar studies using location-based social media data can be applied for other regions at various scales. Though social media data has limitations, it can be used as a promising data source because it is rich, easy, economical, and frequently available. However, privacy preservation mechanisms such as data anonymization must be employed before using such data.

Policy makers can be better informed only when the social media data is continuously collected and analyzed. However, it is important to limit the state power to track individuals. Instead, independent bodies can monitor the social media for this purpose. For example, startup platforms like JX Press, a Japan-based virtual news agency,[2] and its FASTALERT service[3] utilize artificial intelligence to provide urgent information on natural disasters, accidents, etc.

[2] The website for JX Press is https://jxpress.net/.

[3] The website for FASTALERT is https://fastalert.jp/.

The national government as well as the local government can utilize social media as an easy and quicker means to monitor the effectiveness of such policies. Whenever data from other sources such as traditional survey data, Google Trends, etc. are available, it is advisable to add these to the social media data to enhance the overall results.

12.4.2 Limitations and Future Work

Due to the constraints of the data source, only a subset of social media data is used for this analysis. Our future work would focus on the following points:

(i) Since we focused on aggregated country-level data, a future possibility would be to perform insight analysis on a more local level.
(ii) For better insights, sentiment analysis can be done on selected themes like the economy, fear, excitement, symptoms, cure, and vaccine.
(iii) Tweet topic modeling can be done on a more fine-grained level to capture further insights about specific themes and their dynamics.

References

Almarayeh, T. and A. Almarayeh. 2021. Health, Economic and Social Lifestyle: A Rapid Assessment of COVID-19: Evidence from MENA Countries. *PSU Research Review*.

An, J. and I. Weber. 2015. Whom Should We Sense in "Social Sensing"-Analyzing Which Users Work Best for Social Media Now-Casting. *EPJ Data Science* 4: 1–22.

Anzai, A. and H. Nishiura. 2021. "Go To Travel" Campaign and Travel-Associated Coronavirus Disease 2019 Cases: A Descriptive Analysis, July–August 2020. *Journal of Clinical Medicine* 10(3): 398.

Apuke, O. D. and B. Omar. 2021. Fake News and COVID-19: Modelling the Predictors of Fake News Sharing among Social Media Users. *Telematics and Informatics* 56: 101475.

Bashir, M. F., B. Ma, and L. Shahzad. 2020. A Brief Review of Socio-Economic and Environmental Impact of Covid-19. *Air Quality, Atmosphere and Health* 13(12): 1403–1409.

Benjamin, J. et al. 2020. Anonymised and Aggregated Crowd Level Mobility Data from Mobile Phones Suggests That Initial Compliance with COVID-19 Social Distancing Interventions was High and Geographically Consistent across the UK [version 1; peer review: awaiting peer review]. *Wellcome Open Research*.

Bonaccorsi, G. et al. 2020. Economic and Social Consequences of Human Mobility Restrictions under COVID-19. *Proceedings of the National Academy of Sciences* 117(27): 15530–15535.

Boon-Itt, S. and Y. Skunkan. 2020. Public Perception of the COVID-19 Pandemic on Twitter: Sentiment Analysis and Topic Modeling Study. *JMIR Public Health and Surveillance* 6(4): e21978.

Buntain, C. et al. 2016. Comparing Social Media and Traditional Surveys around the Boston Marathon Bombing. #Microposts2016 1691: 34–41.

Cato, S. et al. 2021. The Bright and Dark Sides of Social Media Usage during the COVID-19 Pandemic: Survey Evidence from Japan. *International Journal of Disaster Risk Reduction* 54: p.102034.

Chan, A. K. et al. 2020. Social Media for Rapid Knowledge Dissemination: Early Experience from the COVID-19 Pandemic. *Anaesthesia* 75(12): 1579–1582.

Chen, E. 2021. COVID-19-TweetIDs/keywords.txt. https://github.com/echen102/COVID-19-TweetIDs/blob/master/keywords.txt (accessed 1 December 2021).

Chen, E., K. Lerman, and E. Ferrara. 2020. Tracking Social Media Discourse about the Covid-19 Pandemic: Development of a Public Coronavirus Twitter Data Set. *JMIR Public Health and Surveillance* 6(2): e19273.

Cinelli, M. et al. 2020. The COVID-19 Social Media Infodemic. *Scientific Reports* 10(1): 1–10.

Devkota, B., K. S. Kim, et al. 2019. February. Disaggregate Hotel Evaluation by Using Diverse Aspects from User Reviews. In *2019 IEEE International Conference on Big Data and Smart Computing (BigComp)*. New York: IEEE.

Devkota, B., H. Miyazaki, et al. 2019. Using Volunteered Geographic Information and Nighttime Light Remote Sensing Data to Identify Tourism Areas of Interest. *Sustainability* 11(17): 4718.

Facebook. 2021. Data For Good. https://dataforgood.facebook.com (accessed 16 May 2021).

Feng, S. and A. Kirkley. 2021. Integrating Online and Offline Data for Crisis Management: Online Geolocalized Emotion, Policy Response, and Local Mobility during the COVID Crisis. *Scientific Reports* 11(1): 1–14.

Freedman, D. et al. 2007. *Statistics*. New York: W. W. Norton and Company.

Fritz, C. and G. Kauermann. 2020. On the Interplay of Regional Mobility, Social Connectedness, and the Spread of COVID-19 in Germany. arXiv preprint arXiv:2008.03013.

Generous, N. et al. 2014. Global Disease Monitoring and Forecasting with Wikipedia. *PLOS Computational Biology* 10(11): p.e1003892.

Gonzalez, M. C., C. A. Hidalgo, and A. L. Barabasi. 2008. Understanding Individual Human Mobility Patterns. *Nature* 453(7196): 779–782.

Google. 2021. COVID-19 Community Mobility Reports. https://www.google. com/covid19/mobility/ (accessed 16 May 2021).

Gough, A. et al. 2017. Tweet for Behavior Change: Using Social Media for the Dissemination of Public Health Messages. *JMIR Public Health and Surveillance* 3(1): e6313.

Gundecha, P. and H. Liu. 2012. Mining Social Media: A Brief Introduction. In P. Mirchandani, ed. *New Directions in Informatics, Optimization, Logistics, and Production*. Catonsville, MD: Institute for Operations Research and the Management Sciences.

Heikinheimo, V. et al. 2017. User-Generated Geographic Information for Visitor Monitoring in a National Park: A Comparison of Social Media Data and Visitor Survey. *ISPRS International Journal of Geo-Information* 6(3): 85.

InternetLiveStats. 2021. Twitter Usage Statistics. https://www.internetlivestats.com/twitter-statistics/ (accessed 13 February 2021).

Jay, J. et al. 2020. Neighbourhood Income and Physical Distancing during the COVID-19 Pandemic in the United States. *Nature Human Behaviour* 4(12): 1294–1302.

De Jong, M. and A. T. Ho. 2020. Emerging Fiscal Health and Governance Concerns Resulting from COVID-19 Challenges. *Journal of Public Budgeting, Accounting and Financial Management*.

Kamada, H. 2021. When Accurate Information Harms People: Information on Covid-19 Infection Clusters in Japan. *Cosmopolitan Civil Societies: An Interdisciplinary Journal* 13(2): 60–72.

Kariryaa, A. et al. 2018. Defining and Predicting the Localness of Volunteered Geographic Information Using Ground Truth Data. In Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems. Montreal: CHI.

Kemp, S. 2020. Digital 2020: Global Digital Overview. https://datareportal.com/reports/digital-2020 -global-digital-overview (accessed 10 July 2022).

Khan, G. F. 2017. *Social Media for Government: A Practical Guide to Understanding, Implementing, and Managing Social Media Tools in the Public Sphere*. Singapore: Springer Nature.

Kissler, S. M. et al. 2020. Reductions in Commuting Mobility Correlate with Geographic Differences in SARS-CoV-2 Prevalence in New York City. *Nature Communications* 11(1): 1–6.

Kuchler, T., D. Russel, and J. Stroebel. 2022. JUE Insight: The Geographic Spread of COVID-19 Correlates with the Structure of Social Networks as Measured by Facebook. *Journal of Urban Economics* 127: 103314.

Layer, R. et al. 2020. Case Study: Using Facebook Data to Monitor Adherence to Stay-at-Home Orders in Colorado and Utah. *MedRxiv*.

Lee, J. Y. and M. H. Tsou. 2018. January. Mapping Spatiotemporal Tourist Behaviors and Hotspots through Location-Based Photo-Sharing Service (Flickr) Data. *Progress in Location-Based Service*.

Lu, H., C. W. Stratton, and Y. W. Tang. 2020. Outbreak of Pneumonia of Unknown Etiology in Wuhan, China: The Mystery and the Miracle. *Journal of Medical Virology* 92(4): 401.

Maeda, T. N. et al. 2018. Extraction of Tourist Destinations and Comparative Analysis of Preferences between Foreign Tourists and Domestic Tourists on the Basis of Geotagged Social Media Data. *ISPRS International Journal of Geo-Information* 7(3): 99.

Martín, Y. et al. 2020. Using Geotagged Tweets to Track Population Movements to and from Puerto Rico after Hurricane Maria. *Population and Environment* 42(1): 4–27.

Mellon, J. and C. Prosser. 2017. Twitter and Facebook Are Not Representative of the General Population: Political Attitudes and Demographics of British Social Media Users. *Research and Politics* 4(3): p.2053168017720008.

Mestyán, M., T. Yasseri, and J. Kertész. 2013. Early Prediction of Movie Box Office Success based on Wikipedia Activity Big Data. PLOS One 8(8): p.e71226.

Microsoft. 2021. Bing Maps Tile System https://docs.microsoft.com/en-us/bingmaps/articles/bing-maps-tile-system (accessed 13 February 2021.)

Miura, L. 2020. It's Time to Face the Real Risks Posed by COVID-19. *Japan Times*. 24 May. https://www.japantimes.co.jp/opinion/2020/05/24/commentary/japan-commentary/time-face-real-risks-posed-covid-19/ (accessed 5 December 2020).

Morstatter, F. et al. 2013. Is the Sample Good Enough? Comparing Data from Twitter's Streaming API with Twitter's Firehose. *Proceedings of the International AAAI Conference on Web and Social Media* 7(1): 400–408.

Morstatter, F., J. Pfeffer, and H. Liu. 2014. When Is It Biased? Assessing the Representativeness of Twitter's Streaming API. In *Proceedings of the 23rd International Conference on World Wide Web*. Association for Computing Machinery.

Muley, D. et al. 2020. Role of Transport during Outbreak of Infectious Diseases: Evidence from the Past. *Sustainability* 12(18): 7367.

Nakayama, H. 2021. Asari: Japanese Sentiment Analyzer Implemented in Python. https://pypi.org/project/asari/ (accessed 1 December 2021).

NLTK. 2021. Natural Language Toolkit. https://www.nltk.org/ (accessed1December 2021).

Our World in Data. 2021. Coronavirus (COVID-19) Cases. https://ourworldindata.org/covid-cases (accessed 1 December 2021).

Preoțiuc-Pietro, D. et al. 2015. Studying User Income through Language, Behaviour and Affect in Social Media. *PLOS One* 10(9): p.e0138717.

Reimann, N. 2023. Twitter Boosts Character Limit to 4,000 for Twitter Blue Subscribers. *Forbes*. 8 February. https://www.forbes.com/sites/nicholasreimann/2023/02/08/twitter-boosts-character-limit-to-4000-for-twitter-blue-subscribers/?sh=31d0f1665ab8

Reveilhac, M., S. Steinmetz, and D. Morselli. 2022. A Systematic Literature Review of How and Whether Social Media Data Can Complement Traditional Survey Data to Study Public Opinion. *Multimedia Tools and Applications* 81: 10107–10142.

Shepherd, H. E. et al. 2021. Domestic and International Mobility Trends in the United Kingdom during the COVID-19 Pandemic: An Analysis of Facebook Data. *International Journal of Health Geographics* 20(1): 1–13.

Shimizu, K. 2020. 2019-nCoV, Fake News, and Racism. *The Lancet* 395(10225): 685–686.

Similarweb. 2022. Top Websites Ranking. https://similarweb.com/top-websites/ (accessed 10 July 2022).

Smith, S. and C. McClean. 2020. COVID-19 Overtakes Japan and the United States. *Comparative Connections: A Triannual E-Journal on East Asian Bilateral Relations* 22(1): 15–26.

Spelta, A. and P. Pagnottoni. 2021. Mobility-Based Real-Time Economic Monitoring amid the COVID-19 Pandemic. *Scientific Reports* 11(1): 1–15.

TextBlob. 2021. TextBlob: Simplified Text Processing. https://textblob.readthedocs.io/en/dev/index.html (accessed 1 December 2021).

Twitter. 2021. Tweet Location Metadata. https://developer.twitter.com/en/docs/twitter-api/v1/data-dictionary/object-model/geo/ (accessed 13 February 2021).

Wang, X. et al. 2021. Policy Disparities in Fighting COVID-19 among Japan, Italy, Singapore and China. *International Journal for Equity in Health* 20(1): 1–11.

World Bank. 2021. Population Total. https://data.worldbank.org/indicator/SP.POP.TOTL (accessed 1 December 2021).

World Health Organization. 2020. Technical Guidance: Naming the Coronavirus Disease (COVID-19) and the Virus That Causes It. Geneva: World Health Organization.

Xu, P., M. Dredze, and D. A. Broniatowski. 2020. The Twitter Social Mobility Index: Measuring Social Distancing Practices with Geolocated Tweets. *Journal of Medical Internet Research* 22(12): p.e21499.

Yeyati, E. L. and F. Filippini. 2021. Social and Economic Impact of COVID-19. Brookings Global Working Paper #158. Washington, DC: Brookings Institution.

PART V

The Way Forward

CHAPTER 13

Toward Cities for Resilience and Growth in the Post–COVID-19 World

Tsuyoshi Hashimoto

13.1 Introduction

Diverse views were presented in the previous chapters by experts on Asian urban development and management, both researchers and practitioners, to understand the changes induced by the coronavirus disease (COVID-19) pandemic and to pursue desirable responses. Many of the chapters are based on extensive surveys of people, firms, and governments conducted by various means in the middle of the pandemic to examine their responses. Some chapters suggest transformation of urban forms and infrastructure as effective coping strategies against pandemics, specific methods to strengthen urban functions to enhance resilience, and institutional measures to facilitate resilient urban management. These suggestions are not solutions or definite answers to present and future disasters but rather important issues to be further investigated to deal with disasters in a more resilient way.

A relevant concept of resilience in the context of urban development and management in view of properly dealing with pandemics in the post–COVID-19 world has emerged from these chapters. To form a common base for further research and discussions, a clear definition of this concept of resilience may be useful—although any definition represents a tentative proposition at this stage.

Resilience of cities in response to various disasters, then, is their capacity to allow alternatives and versatility of actions to cope with disasters, supported by a network of actors and an integrated system of related facilities and institutions and based on lessons learned from past experiences of such events.

Major factors affecting resilience of cities, therefore, may be summarized as follows:

(i) governance system with division of roles/responsibilities vis-à-vis allocation of various resources between national and local governments,
(ii) physical infrastructure and facilities including medical and caretaking facilities, open space and greenery, and a mobility system for both car-centric transport and walking and cycling mobility, and
(iii) institutions such as landownership and use regulation, incentives for complying with guidance/control of social behaviors, and support measures for socioeconomic activities.

In this concluding chapter, first, fundamental issues related to further urbanization and pandemics are discussed including urbanization needs, distinction between short- and long-term measures and effects, and social and psychological effects of response measures. Then, some complementary discussions are presented for the major factors listed above, referring to other chapters.

13.2 Fundamental Issues Related to Urbanization and Pandemics

In this section, the origin and changing views of urbanization are first discussed. Then, recent development of new economic activities under economic globalization supported by development of information and communication technology (ICT) is reviewed, which has been affecting urbanization patterns. The recent COVID-19 pandemic has revealed negative aspects of urbanization, and short- and long-term effects of measures to cope with pandemics are distinguished. Social and psychological effects of coping strategies against pandemics are also noted.

13.2.1 Need for and Desirability of Urbanization

Until the spread of COVID-19, urbanization had been taken for granted. Urbanization proceeded steadily throughout the world, and the ratio of the urban population worldwide exceeded 50% of the total population in 2007 and was projected to reach 68% by 2050 (UN Department of Economics and Social Affairs, Population Division 2019). COVID-19 has raised a fundamental question of whether continued urbanization is desirable. Fundamental changes may be necessary in our perception of urbanization and development as a whole induced by the pandemic, as recently discussed (Hashimoto 2020, 2021, 2022).

Urbanization has been considered generally desirable because it realizes economies of scale and scope, allowing low economic transaction costs. Diseconomies of urbanization have also arisen due to traffic congestion, air and water pollution, solid waste generation, and other undesirable socioeconomic effects. These problems were considered to be due mainly to the capacity of urban infrastructure being insufficient to catch up with rapid urbanization. Capacity expansion of urban infrastructure by responsive planning, however, encouraged further urbanization, aggravating diseconomies of urbanization.

Table 13.1 Changes in Location of Economic Activities from the Past to the Future

Sector	Traditional Location	New Phenomena
Agriculture	Rural area with land, water, and other natural resources	Factory-type agriculture Automated control of production conditions
Mining	Rural area with mineral deposits	AI-operated remote mining
Industry	Resource processing industries in rural areas Others close to urban markets	Value-added processing with design and labeling in urban areas
Tourism	Rural areas capitalizing on natural resources	Virtual tourism

AI = artificial intelligence.

Historically, a city developed as a venue to exchange products from geographically disparate areas, and thus the main urban function is trade, supported by financial, administrative, and other services. Other economic activities were traditionally conducted elsewhere (Table 13.1). Recent globalization and ICT development have been changing the situations rapidly. These changes are characterized by service-oriented economic development. A city is where services take place. Therefore, further urbanization seems indeed inevitable. The question is, therefore, what kind of urbanization should be pursued in view of pandemics in the future.

13.2.2 Short- and Long-Term Measures and Effects: Resilience vs. Robustness

Nowadays, the word resilience is a common term in daily conversation for many people. It is characterized by robustness, resourcefulness, redundancy, rapidity, and being readjustable. Robustness is a technical term referring to system performance over an extended period of time without causing changes in its structure, i.e., the persistence of a system. These terms have been used for decades in various fields including water resources development and management (Hashimoto et al. 1982a, b)

To cope with urbanization and pandemics, the resilience of an urban system may be enhanced with infrastructure and institutional measures ensuring robustness of the system. An example may clarify this point. One example is the impact of COVID-19 on micro, small, and medium-sized enterprises (MSMEs) in India, discussed by Sharma and Rai. Following a lockdown, demand for products of MSMEs decreases immediately, followed by unstable supply, increased prices of raw materials, and delays in payments, resulting in a decrease in production. As demand continues to decrease, some business may eventually collapse.

Most of MSMEs' immediate challenges are related to finance, but eventually reduced demand affects them most significantly. MSMEs try to survive by making internal adjustments, showing resilience in the short run, but the longer term tests their robustness. Governments should make any interventions to enhance the robustness of the MSME sector while allowing resilient responses. Proper support measures at the right time should be taken in line with the evolving stages of the disaster.

Another example of distinction between short- and long-term effects comes from the household coping strategies discussed by Trang. Having a wide range of effective ex-ante strategies such as diversified income sources and accumulated assets makes urban households robust against disasters but may not ensure resilient responses to them. Ex-post strategies such as availability of lenders, access to charity and savings, and holding assets of high liquidity make urban households resilient to disasters.

13.2.3 Social and Psychological Effects of Response Measures

Another important viewpoint in taking measures against disasters is presented by information asymmetry between various stakeholders, which may cause discrepancies in the effects of interventions between different people and firms. Some MSMEs make internal adjustments to deal with crises. For instance, lockdowns affected the employment of informal workers most, while employment of formal workers and family workers increased, as shown by Sharma and Rai. In this way, informal workers at MSMEs may be doubly penalized.

Coping strategies differ widely between poor and affluent urban households. When compared to poor urban households, non-poor urban households do not resort to seeking support from friends or family, taking loans, reducing consumption, relying on savings, or putting more efforts into their current jobs, according to Trang. Both may be relatively resilient for short-term responses, but long-term effects will vary widely. The urban ethnic majority group relies on borrowing as a coping strategy, and its members are less likely to reduce their food consumption compared to their peers from ethnic minority groups, as availability of food is more limited for people living in the city, where they cannot grow food conveniently during the pandemic.

The psychological effects of pandemics and support measures have not been much discussed. The top principle to guide COVID-19 response and recovery, on the list presented by Punongbayan-Dela Rosa, is to support the most vulnerable people first. Other listed principles are to support workers and local economies and partner with community-based organizations, showing concerns about the social

effects of pandemics and responses. Okada et al. mention the effects of teleworking on mental health. Also noted is that teleworking would not stimulate community activities or the local economy during a pandemic.

Trang states that further research should focus on psychological coping strategies by urban households. For instance, if the pandemic is seen as a short-term phenomenon, a coping strategy may be to reduce current consumption, but if it is considered to be a prolonged phenomenon, consumption behavior over time will change. Policy measures should be taken to induce desirable long-term structural changes.

13.3 Issues for Post–COVID-19 Urbanization

In this section, various models of urbanization are presented and examined. First, a classical discussion on optimal urban size and advantages and disadvantages of large and small cities are presented, and utility of open spaces and greenery in urban areas is discussed. After introducing a case of a resilient city with redundancy of urban infrastructure, city networking to reconcile large and small cities is explained and suggested as a possible way to enhance resilience. Finally, concepts of regional cities are presented with an example, and importance of relationships between urban areas and their respective rural hinterland is discussed together with the need for spatial planning encompassing both of the areas.

13.3.1 Urban Size and Morphology

COVID-19 has provided opportunities to renew our views on the effects of urbanization with respect to city size, concentration of population and economic activities, urban governance, and the old issue of economic efficiency versus environmental health. Many laypeople and experts have compared the ideas of a mega city and a compact city. How do our views on the optimal size and desirable morphology of cities change as a result of COVID-19?

A mega city can realize economies of scale for various socioeconomic activities and more easily accommodate diverse activities and high-grade social services, but it suffers from many social and environmental problems. The concentration of a population in larger cities becomes a disadvantage during pandemics, as we learned recently.

A compact city may enable governments to provide cost-effective infrastructure and make social services more accessible for residents. A compact city may also realize a scale economy if the population density is increased, but this will result in the same problems as a mega city has, although the densification may make infrastructure costs comparatively smaller. A fundamental problem with the compact city is that it cannot stay compact unless we control urban sprawl.

A multi-core city may enjoy the advantages of both mega and compact cities while overcoming their disadvantages. A multi-core city consists of several urban centers in a city, with the urban centers separated by greenery and mutually linked by an effective urban transport system. Each urban center is a compact city that is self-sufficient in daily urban functions and at the same time specialized in some higher-order urban function, such as high-grade medical services or advanced education and research. All the urban centers may develop in a mutually complementary manner by sharing the higher-order urban functions of other urban centers linked by effective transport and ICT infrastructure.

Punongbayan-Dela Rosa claims biophilic cities with open spaces, ensuring integration of nature into urban design for quality of urban life, are sustainable and resilient cities. Existing cities may be transformed into biophilic cities by actions such as making the transition from a car-centric model to

a pedestrian and cycling model, creating enough safe public spaces, and accounting for the location of public health facilities in land use planning. It is claimed urban form and function determine the type and efficacy of response measures (UN Habitat 2020).

Bessho and Yokohari introduce an ongoing initiative in Tsukuba City, Japan to create a lively rural-urban community incorporating welfare functions by involving persons with disabilities and caretakers in urban farm operation. Spaces connecting the private properties of individual houses with outdoor public spaces are called "Satoyama Common spaces," which facilitate daily interactions and oversight among neighborhood residents. A traditional "satoyama" in Japan, or home countryside, provides a recreation area for local residents, seasonal food such as bamboo shoots and mushrooms and also firewood, and protection against disasters or a shelter during disasters.

These models of urban development with greenery are not totally new. The idea of garden cities was presented by Ebenezer Howard in 1898. A garden city is planned with greenbelts surrounding urbanized areas, where residential and industrial zones and social and commercial facilities coexist to enable people to live closer to work. Biophilic urban design may be regarded as a direct descendant of **Design with Nature** by Ian McHarg, published in 1969. The applicability of these models depends on factors including population size and dynamics. Letchworth Garden City, planned by Howard, had a planned population of 30,000 in an urbanized area of 4.05 square kilometers. While the concept of a multi-core city may be applied to large urban areas, biophilic cities and the rural-urban communities in Tsukuba City should be examined in the context of much larger urban areas.

13.3.2 City Networking and Resilient Cities

In physical terms, the resilience of cities is enhanced by providing redundancy of infrastructure to widen alternatives or options. For instance, a small region in Papua New Guinea called the Kokopo-Rabaul region suffers from volcanic eruptions, floods, and landslides. The Tokua international airport, the main airport of the region, was totally buried by volcanic ash during the eruption of Tavurvur volcano in 1994, and the city of Rabaul, then the capital of the region, was destroyed.

To enhance resilience of the Kokopo-Rabaul region against disasters, an alternative artery road was conceived inland to complement the existing coastal road that is vulnerable to landslides, and an alternative airport was also conceived. To justify additional investments for these somewhat redundant infrastructure facilities, an approach of regional development is effective covering a larger area with several small cities. These small cities may have complemental functions shared through city networking to support various economic activities for regional development.

An original form of city networking is an alliance between small and medium-sized municipalities for more efficient joint provision of public services such as water supply from a common water source and solid waste management with a common final disposal site. City networking may be realized at a much larger scale to share higher-order urban functions.

Randstad in the Netherlands is considered a conurbation where four sizeable cities and many small towns exist in a region of 11,370 square kilometers with the combined population of 8.4 million (2020) or 48% of the national population. Each of the four cities has distinct characteristics with strong functions derived from the cities' respective histories and serves the entire region: Amsterdam as commercial center, Rotterdam as port city with major industries, The Hague as administrative capital, and Utrecht as transport hub. The conurbation has extensive greenery, including large farmlands between the cities. A city networking model fits well for these cities having complementary functions.

An international city networking consists of large cities specialized in high-grade urban services such as an international financial center or major energy base. All the high-grade urban functions are shared by member cities for mutually complementary development. Other possible urban functions to share are as follows:

- storage and supply of basic food products in preparation for food crises,
- rescue and restoration from disasters such as earthquakes and floods,
- international mechanism for various insurance schemes related to trade and logistics to compensate for economic losses from wars, internal conflicts, and disasters,
- common ownership and use of development funds and funding methods, and
- information sharing for various purposes.

Storage and supply of basic food products in preparation for food crises and rescue and restoration from disasters are particularly important in the present day. City networking may, in fact, enhance the resilience of the international society against disasters.

13.3.3 Regional Cities

The third issue for future urbanization that may be relevant to the post–COVID-19 world is presented by a regional city. Globalization makes self-reliant regional development a challenge. A self-contained region where residents produce and consume all they need is not realistic. This is because when better products are coming from outside and sold at lower prices in the region, no one can say "Don't buy them; buy local products."

Products and industries producing products that are not competitive in the global market cannot survive. This is a harsh reality of globalization. Exceptions are specialty products such as local cuisine and products having established niche markets as well as indigenous energy and water resources. Self-reliant regional development may be realized by establishing local industries that produce products and/or services that are competitive in the global market and/or specialty products.

For any region to survive in globalization, a city needs direct access to the global market. This may be called a regional city. It should have a certain size with multiple functions, proper urban infrastructure under proper urban management, and an international airport and port facilities. As a basic condition, a regional city must be connected to industries in the region's hinterland that produce exportable goods/services with respect to quality and prices. A regional city not only exports products from its hinterland, but also imports advanced technology from outside and creates innovative designs to support primary and secondary industries in its hinterland.

An example will clarify the idea of a regional city. Tsubame City in Niigata Prefecture, Japan is famous for its metalworks producing high-quality kitchen utensils and other products. As it has a population of only 80,000, Tsubame City cannot be a regional city. Niigata City, the capital of the prefecture located some 30 kilometers from Tsubame City, is qualified as a regional city with its population of 800,000, major port facilities, and an international airport.

Spatial planning guidelines for the post–COVID-19 world provided by UN Habitat (2020) note that mapping the flow of goods, labor, and markets and strengthening and enhancing links between cities, states, and regions are important steps in building socioeconomic resilience. This perspective is supported by the use of big data with geospatial tools presented by Bharule and Miyazawa, who have given a glimpse of the potential utility of such data applied to people's mobility for holiday travels in Japan during COVID-19.

Increasing adoption of teleworking as examined by Okada et al. may change relationships between urbanized areas and their hinterlands. The flow of goods and services will increase as economic interactions expand between a regional city and its rural hinterland. The flow of people may also increase, despite teleworking, as those working in the city may find greenery available in the hinterland closer and more attractive due to online access by 5G and 6G communication systems.

These possibilities and effects of mobility restrictions during pandemics may be analyzed using big data, and more insights may be obtained if responses expressed through social media are combined for more informed and less biased decision making. Devkota and Miyazaki note that mobility restrictions resulted in increased tweets on the social media platform Twitter, immediately followed by reduced movement with a time lag. This indicates that better decisions may be made by observing tweets and adjusting responses.

13.4 Urban Governance

In this section, implications of various urbanization models presented above for urban governance are first discussed. Then, a hierarchical structure of governance is examined with functional division of administrative responsibilities in response to pandemics. Also, new phenomena affecting urban governance are examined including changing relationships between urban and rural areas supported by ICT with possible change in spatial perception of people and availability of geospatial data. Finally, the importance of urban governance for various urbanization models is highlighted.

13.4.1 Implications of Post–COVID-19 Urbanization for Urban Governance

Implications of different urbanization models for urban governance are summarized in Table 13.2. A mega city represents tradeoffs between economies of scale and environmental problems, and metropolitan governance may reconcile the tradeoffs. A compact city should not be a self-contained stationary city, and urban governance may properly control city expansion and urban sprawl.

A resilient city is supported by options, redundancy, and city networking, and urban governance may properly manage the tradeoffs between increased investment in urban infrastructure and enhanced resilience. Also, city networking with functional division for complemental development calls for cities of autonomous governance as a prerequisite. A regional city is supported by economic interactions with its hinterland, and integrated governance covering both urban and rural areas is desirable for effective interactions.

Table 13.2: Urban Governance Issues Related to Urbanization and City Models

Urbanization Characteristics	Governance Issues
Urbanization is inevitable (no idealistic primeval society).	Diversity, amenities, and high-grade social services delivery depend on urban governance.
A mega city represents tradeoffs between economies of scale and environmental problems.	Metropolitan governance may be a solution.
A compact city should not be a self-contained stationary city.	City expansion and urban sprawl may be controlled by urban governance.
A resilient city is supported by options, redundancy, and city networking.	City networking calls for cities of autonomous governance.
A regional city is supported by economic interactions with its hinterland.	Integrated governance covering both urban and rural areas is desirable.

Source: Author.

Many people are talking about smart cities these days. Many concepts of smart cities have been presented and different types of smart cities have been experimented with in both developed and developing countries. In essence, a smart city uses ICT to improve operational efficiency of various urban functions for economic growth and quality of urban life.

A smart city may solve all the problems foreseen for different types of future cities and realize desirable urbanization, but urban governance holds a key. The issue is how to build the most appropriate city structure with respect to physical infrastructure and governance for various activities undertaken in cities, ensuring a free city atmosphere. Is centrally controlled management for efficiency desirable, or is it better to build self-reliant governance based on residents and private firms?

13.4.2 Hierarchical Structure of Governance and Response to Pandemics

Maquiling et al. discuss division of responsibilities between the national government and local government units at different levels in the Philippines to deal with hydrometeorological hazards and pandemics and dual disasters combining both. To enhance the resilience of governance in responding to various disasters, division of responsibilities between the national and local governments is the most important consideration with respect to use of various resources necessary to deal with disasters: money, people, information, and time.

Sharma et al. clarify that larger cities or state governments show a greater ability to utilize access and leverage for technology, and larger cities may also utilize nongovernmental actors more effectively. They conclude that in the Indian context, public health response systems need to be organized and implemented at the city level with higher-level integration that aligns with technological evolution. This conclusion is consistent with the division of responsibilities between the national government and the local government units in the Philippines.

Sridhar discusses advantages and disadvantages of cities from a macroscopic viewpoint and suggests cities may facilitate sharing and use of best practices to combat global issues such as climate change. This practice applies to pandemics as well, since cities or at least large cites would allow better availability and accessibility of information, various opportunities for technological innovation, and thus more effective measures if properly managed. This point is illustrated by the carbon sequestration accomplished by conserving and protecting forests through efficient urban management in Tamil Nadu. This accomplishment may be due to region-based urban governance supported by wide awareness of urban residents.

Advantages of cities in dealing with pandemics lie in better access to hospitals and health care services, but the issue is how such advantages can be shared by the wide range of people living in cities. One possible way may be to align the health referral system to a hierarchy of urban parks. Some large hospitals in the Philippines are located near large parks, which may be used to expand medical and test facilities during pandemics. Historically, Hyde Park in London was used as a place for refuge by city residents during the 1665 pandemic. Small neighborhood parks, on the other hand, support physical and mental health during pandemics while ensuring social distancing.

Hierarchical systems for health facilities and services and for urban parks may be aligned with hierarchical governance structures as well. This enables governments to reflect overall health concerns covering both physical and mental health in design, planning, and development of urban spaces in the future.

Pandemics affect people directly and also through limited access to lifeline infrastructure and safe open spaces. As noted by Payonga and Ihara for power supply in the Philippines, the residential sector

was most affected by blackouts during the pandemic, representing double vulnerability under poor health conditions aggravated by degraded livelihoods. Interestingly, an effective coping strategy by the Philippine people is socialization. Public spaces with greenery aid socialization and social distancing, representing double coping strategies. Payonga also notes that during blackouts, availability of water supply helps people to cope with the effects of the pandemic.

Public health and equity concerns should be built into land use, transport, and public spaces including parks. This was realized only ex-post during the COVID-19 pandemic. Notable measures taken by world cities in response to the pandemic include subsidized bike sharing programs, enhanced sanitation of public transport vehicles, slow street programs, conversion of some streets into bicycle and pedestrian paths, mobility restriction, and building of temporary health facilities.

13.4.3 New Phenomena Affecting Urban Governance

Use of real-time geospatial data will grow with technological evolution, systematic adoption, and integration in the decision-making frameworks as discussed by Bharule and Miyazawa. Researchers should take care, however, as big data generated naturally through social networking services, video streaming, and other online platforms and services contains biases. To deal with these biases, it is important to conduct data verification, possibly by AI and machine learning, and to use open source frameworks to ensure equitable data access and sharing as well as technical and interdisciplinary integration between users. Local governments should take the initiative to work with the national government to clarify division of responsibilities between the national and local governments supported by soft infrastructure, and they should make institutional arrangements for data verification and sharing to manage such a decision support system.

ICT development with 5G/6G communication systems will change the relationships between urban and rural areas, habitation patterns, and even spatial perception of people. Rural residents may enjoy rural life in pleasant nature, receiving remote education and health services, or work in the service industry in a nearby city. Urban residents working in a nearby office may have access to the rural environment virtually on a big screen installed in their offices. They may feel like walking immediately into the rural environment after a hard day of work, or they may decide to visit the rural place during the next weekend. They would feel closer to the rural environment next to the city where they live and work. This may result in new spatial perception. Urban residents may perceive surrounding rural areas as a new form of "satoyama" or home countryside. Of the functions of traditional "satoyama" in Japan mentioned previously, protection against disasters or a shelter during disasters may be the most important.

Many countries practiced city lockdowns as countermeasures against COVID-19. The strong national authority to enforce a city lockdown is against the universal trend of localization of development administration. In view of changes anticipated in the relationships between urban and rural areas, an open and dynamic urbanization model is necessary. Such a model would allow viable relationships between a regional city and its hinterland, compact but not stationary cities, resilient cities with useful redundancy, city networking and alliances, and local autonomy. The authoritarian model would not be desirable just for the ease of city lockdowns.

As regional cities are important for self-reliant regional development in the global society, "region-based urban governance" is conceived to comprehensively cover both the regional city and the hinterland strongly linked to it. This may be seen as a new form of localization of development administration. New urban governance covering enlarged urban areas encompassing the urbanized area and its surrounding rural areas may facilitate fundamental solutions to various urban problems

including control of pandemics. Master planning applied under such region-based urban governance may prove to be a strategic enabler to influence the direction a city will take to make it more vibrant, livable, and productive as suggested by Shinde et al. for riverine cities.

13.5 Institutional Aspects

In this section, institutional measures to improve urban development and management are discussed. First, the importance of land ownership and land use regulation is emphasized to improve the quality of urban life. Next, how to affect urban residents' behavior by incentives and enforcement to prevent and control pandemics is discussed. Also, support measures for socioeconomic activities during pandemics are suggested with case studies during the COVID-19 pandemic.

13.5.1 Land Ownership and Land Use Regulation

Urban planning, development, and management are based commonly on land use planning, regulation, and control. Institutions related to landownership and use vary in different countries. In Japan, landownership by individuals is absolute and strong, and landowners are free to use their land in their chosen way as long as it complies with zoning, while formal urban plans by local governments provide only conceptual frameworks. This tends to result in a rather haphazard urban landscape. In the United States and some European countries, land use is prescribed by formal urban plans prepared by local governments with participatory approaches. With rather weak landownership, local governments may use public spaces or even private properties to build temporary health facilities. This may not happen in Japan without legal and institutional reform related to landownership and use regulation.

There exist various instruments related to land for regulating urban land use including land adjustment, transferrable development rights, guided land development, and other development control measures with norms and standards as discussed by Shinde et al. To realize cities as envisioned in this book, some new institutional mechanism may have to be established.

In the case of Letchworth Garden City, planned by Howard, landownership was transferred to a management association for collective ownership. Residents had rented or leased their land and often houses as well. This allowed residents to live not only close to work but also in a beautiful and pleasant urban space with an identity. Once the garden city has reached the planned population, another garden city will be created some distance away, and the two cities will be linked by a railway. This may eventually lead to a large urban area with interlinked autonomous cities similar to a multi-core city.

The ongoing initiative in Tsukuba City presented by Bessho and Yokohari has utilized a new zoning category called a rural residential zone. It was introduced by a 2018 amendment to the City Planning Act of Japan. This zoning category allows regulation of large residential developments incorporating productive green spaces for creating livable residential spaces with urban-rural mixed landscapes. For effective enforcement of the regulation, residents are required to follow guidelines for houses according to the landscape and building agreements approved by the city. While such institutional arrangements would be effective in creating pleasant landscapes locally, overall effects on urbanization with greenery in a broader city context and beyond are not clear, unlike the case of garden cities.

13.5.2 Incentives and Enforcement

Social measures in response to pandemics include social distancing, wearing masks, and various hygiene measures as well as testing, vaccination, and contact tracing. Guidance by the government for these measures may be facilitated by a help line or help desk. The effectiveness of these measures

depends on the social and cultural characteristics of societies. In Japan, the effectiveness of measures was augmented because peer pressure may be as effective as guidance by the government and because Japanese people are generally hygiene conscious.

In addition to raising awareness on public health and hygiene, measures to modify the mobility of people and to ensure access to open spaces would be effective. Bike sharing, enhanced sanitation of public transport vehicles, conversion of some streets into bicycle and pedestrian paths, and introduction of slow streets may be supported by incentive measures. For mobility restriction, incentive measures would be preferable to strict control with bans and containment enforced by a zero-COVID policy. Ensuring equity for access to open spaces and provision of social and basic services is certainly the government's responsibility.

Promotion of teleworking is another area where incentives will be effective. In the case of Japan, it may not be so simple. Okada et al. show that teleworking adoption rates in Japan increased due to COVID-19 countermeasures, but reduction of working hours was rather limited. Reasons for persistent long working hours in Japan include the lack of a performance evaluation system for teleworking, the understanding of an office with social functions being more than a venue for work, a poor housing environment, and probably comradeship of salaried workers. The capability to evaluate teleworkers may be established, and the housing environment will be improved along with migration to suburbs or local cities for teleworking. Other conditions may take much longer to change as they relate to social habits.

13.5.3 Support Measures for Socioeconomic Activities

As clarified by Sharma and Rai, more immediate challenges faced by MSMEs during the pandemic are related to finance, but eventually reduced demand affects them most significantly. Financial supports including cash benefits may be effective in the short term, but in the long term, government supports should focus more on revival of the demand for products and services.

Sharma and Rai note that awareness of government support measures was relatively high among MSMEs, but that beneficiaries were limited. This implies that firms make their own decisions in view of eligibility conditions and procedures, among other factors, for support measures. They also note that registered firms have better awareness about government schemes and access to them. It is recommended that MSMEs strengthen planning under uncertainties, but stability of government measures, especially financial support, is a prerequisite.

In sum, encouraging registration, careful design of eligibility conditions for support measures, transparency and stability of support measures, and strengthening planning capacity will help firms, especially MSMEs, to survive during pandemics. Also, online registration of MSMEs in a digital database would allow them online access to government support measures.

Enhanced planning and financial capacity will allow firms to make resilient responses during pandemics, but for more proactive responses for the long term, the robustness of firms and industry as a whole should be strengthened by the development of industrial clusters. In these clusters, MSMEs are integrated with indigenous industries as suppliers of parts and components to produce products that may be exported. In Japan, many MSMEs and cottage and household firms in some districts of Tokyo produce specialty products and components for global enterprises and international organizations including NASA.

The point here is with the link to export industries, the entire industrial cluster becomes viable and competitive in the global economy, and the total value added is maximized by internalization of value added by component industries. Industrial clusters would create a more favorable business environment for component industries including MSMEs and would ensure more effective policy support during pandemics and other crises.

13.6 Conclusion

The resilience of cities depends on physical infrastructure, the governance system, and institutions related to urbanization. Urban size and morphology affect the resilience of cities, but any city may not be resilient enough by itself. Relationships between multiple cities, represented by the concept of a multi-core city involving city networking and relationships with rural hinterlands, are increasingly important to enhance the resilience of post–COVID-19 societies.

The resilience of firms against pandemics depends on their financial resources in the short term and their ability to invest in new technologies and business opportunities in the long term. The survival and revival of firms are facilitated by government supports at the right times. It is most essential for a city to be a center of innovation by lively firms with technological capabilities supported by governments.

Irrespective of specific urbanization models, urban governance holds a key to realize desirable urbanization for resilient cities. Particularly against pandemics, a health referral system with a hierarchy of hospitals and medical care facilities should be made in line with the hierarchical structure of governance and also a hierarchy of urban parks to ensure the availability of health care services and equitable access to open spaces by all the city residents.

In pursuing desirable urbanization models that are effective against pandemics, institutional aspects are critically important. These aspects include legal and institutional reform related to land, social measures in line with social and cultural characteristics of societies, and incentive measures to improve the mobility of people and promote teleworking as well as support measures for socioeconomic activities including promotion of industrial clusters.

ICT development is changing the relationships between urban and rural areas, habitation patterns, and even the spatial perception of people. COVID-19 has induced changes and also revealed strong interdependence between socioeconomic activities and between people in urban and rural areas. This implies the importance of people's sense of community in living under the threat of pandemics. Links between people living in urban and rural areas are strengthened by ICT with 5G/6G communication systems. Questions have been raised about whether the pandemic has encouraged community activities and improved local socioeconomic conditions and how teleworking may help stimulate them. Also, urban greenery and river management may provide a clue for improving overall urban management with environmental concerns.

COVID-19 has highlighted the importance of essential workers, particularly in contrast with teleworkers. This has led to discussions on social value vs. individual value. While teleworking contributes to generating individual value, it is not clear if it contributes to social value as much as essential workers generate directly. The effects of teleworking on the mental health of nonessential workers are also discussed as well as changing work ethics. There seems to be a general consensus that teleworking is a complement to, not a substitute for, face-to-face working.

The essential workers include not only medical staff and caretakers and those involved in the operation and maintenance of lifeline infrastructure, but also farmers producing essential food and those ensuring supply of daily commodities, basic clothing, and shelter. Their work cannot be undertaken online. They contribute collectively to the creation of social goods or commons in the form of a pleasant living environment that helps human beings to pursue creative lives without much worry about survival.

When the survival of human beings is at stake with threats like global warming, pandemics, and nuclear war, the exchange of ideas becomes more important. The city, developed as a venue for the exchange of products, should be a venue for the exchange of diverse and innovative ideas and values through wide-ranging communication between people of different sociocultural backgrounds, which is essential for the survival of human beings.

References

Hashimoto, T. 2020. Urban Development in Post Corona Era and ODA: An Open and Dynamic Urban Model is Necessary for Future Urbanization. *International Development Journal*. IDJ English Editorial Report. 28 September.

____. 2021. Paradigm Shift to Re-Think the Role of Cities and Urban Functions: Issues, Ideas, and Case Studies. Asian Development Bank Institute Webinar. 24 August.

____. 2022. Response by Development Consultants to Paradigm Shift: Away from 20th Century Development Model. *International Development Journal*. IDJ English. 24 March.

Hashimoto, T., J. R. Stedinger, and D. P. Loucks. 1982a. Reliability, Resiliency, and Vulnerability Criteria for Water Resource System Performance Evaluation. *Water Resources Research* 18(1): 14–20.

____. 1982b. Robustness of Water Resources Systems. *Water Resources Research* 18(1): 21–26.

Howard, E. 1898. To-morrow: A Peaceful Path to Real Reform. London: Swan Sonnenschein & Co.

McHarg, I. L. 1969. *Design with Nature*. Garden City, NY: Doubleday/Natural History Press.

UN Department of Economics and Social Affairs, Population Division. 2019. World Urbanization Prospects 2018 Highlights. New York: United Nations.

UN Habitat. 2020. Spatial Planning Guidelines during COVID-19. Nairobi: United Nations Human Settlements Programme.

EPILOGUE

Shreyas Bharule, Kyoko Takahashi, KE Seetha Ram, and Shogo Kudo

The coronavirus disease (COVID-19) pandemic has accelerated a trend that pioneers of city planning and urban living had already envisioned. These pioneers envisioned that people wanted to live close to the central business district. Living near the city center was important because people needed to be in a building, at a specific time, on a daily or routine basis. Additionally, since commuting all the time was terrible, if one were to be stuck in traffic, that would simply be a waste of time.

Before the COVID-19 pandemic, the planners of cities with sparsely connected but closely networked neighborhoods like Sydney had envisioned a 30-minute city. People could access their necessities within 30 minutes of walking from home. Urban planners and designers also envisioned a 15-minute city in Europe. The initial experiments for the 15-minute city were planned in Paris. In a nutshell, a city measured in minutes would be a walking- or bicycling-centric city. The concept also promotes the idea of shared office spaces as hubs in the cities, with the distance between them measured in minutes. The hub becomes a place for face-to-face meetings with clients and coworkers, while the main office remains in the central business district. The arrangement might enable a better work-life balance for individuals as they would not visit the main office daily.

Such visions and other externalities had made the cities expensive, particularly for choosing the location of office buildings and with residents wanting to live closer to their offices. Over time, such concepts have created "categorized zones" of land use with a range of premiums in terms of value, density, and mixture of land use. Higher-premium buildings were closer to offices in the central business district, and distant areas would accommodate lower-income groups, widening the urban inequality in the city regions. However, since late 2019, over 200 cities have undergone some form of lockdown, temporarily paralyzing the daily repeated activity of visiting workplaces. The critical impact has driven the daily officegoers into a conundrum of whether they need to live in high-premium areas when they are not required to commute to the office.

Japan did not implement a complete lockdown. However, companies voluntarily asked their employees to work from home, fearing a mass outbreak of COVID-19. Additionally, many office commuters moved out of the city center into suburban and, in certain instances, peri-urban areas. Such movement enabled people to enjoy rural landscapes' social and environmental fabric while staying connected to their city networks and offices. As for the economic benefits, relocating individuals earned city pay scales while enjoying the rural cost of living, resulting in significant savings. The ultimate impact one may foresee is cities that are more spread out and act like city regions. In Japan, people's outward movement was observed the most in its largest city, Tokyo.

During the pandemic, we realized that we do not need to commute long distances and for long hours from the outskirts to the central business district. Instead, people may become much more open to more humane scales, creating neighborhood-level hub-and-spoke models of urban land-use configurations. In such models, not everything has to happen physically at corporate headquarters in the central business district. This does not mean the central business district concept will totally disappear. For instance, countries with multiple million-plus cities like India and the People's Republic of China, considering their cities spanning many kilometers, have come up with several last-mile connectivity and logistics solutions. Enterprises have developed a new data-driven sphere of service industries that offer door-to-door last-mile logistics with claims of delivery time as fast as 10 minutes in some instances. Such establishments have skyrocketed in number and revenue as several began services in the later part of the COVID-19 pandemic.

In terms of smart interventions in the city framework, the first is our access to data and feedback from the weather, congestion, travel schedules, and several other sources. Tracking and monitoring have evolved in many ways. Moreover, fintech services, such as the Unified Payments Interface in India, where wallets have taken the form of an application generating dynamic QR codes to make payments, have changed the landscape and people's activity patterns around financial institutions. People can often avoid having to queue in front of bank cashiers, ATMs, and other payment booths.

In the near future, people and society may adopt data-driven lifestyles, inviting more trackers and sensors to enable enhanced personalized services. The emerging collective perspective that *remote work is not necessarily inferior* has also affected the services and deeper penetration of internet connectivity, logistics, and other services in regional locations. However, although it is a distant reality, having everything available within 15 minutes is a healthier and less stressful way of living.

When cities in the United States started locking down, Seattle was one of the first to start the rethinking process. To readapt the crumbling infrastructure, the city council developed a 30-page design playbook with modules to open the street infrastructure to people and bicyclists. The city chose these areas because they were underserved by existing infrastructure for pedestrians and bicycles and were in neighborhoods experiencing more profound impacts of the pandemic from health and economic perspectives. A few months into the plan, the city's mayor announced the closure of 20 miles of streets to all motorized transport. Later, a team of city engineers was deployed to work with the neighborhood groups to design alternative visions for streets.

About a century ago, when cities were grappling with issues of clean drinking water and safe housing, streets were handed over to a relatively narrow goal of maximizing vehicular traffic flow. Another United States city, Austin in Texas, has been on the list of fastest-growing cities. The pace of growth strained the city dwellers during the pandemic lockdowns. As a response, the city reserved streets for pedestrians and bicyclists. Additionally, the city reserved two more lanes on either side of the road to encourage nonmotorized transport and pedestrians. As the pedestrians moved to roads, the pavements were used for dining, enhancing comfort, security, and safety.

As described in multiple chapters of this book, stakeholders of cities in various cases have arrived at diverse thoughts and approaches to "rethink the city." In the wake of the pandemic, we hold the prospects for a much brighter future owing to technological, economic, and environmental change.

This world is in a once-in-a-century situation with the pandemic. We have the public attention and realization of the need to repurpose streets, to redevelop vacant lands, from developing data-driven urban services to informed health care and developing other people-centric services and utilities. The evidence shows that in the long run, rethinking cities as resilient engines will make our communities more just and adaptable. Although the recent episode of COVID-19 was a blip in the evolutionary timeline of our planet, it still shows: *Though pandemics will come and go, cities will learn and grow in number and size.*

***

Rethinking Cities for Resilience and Growth in the Post-COVID-19 World

In the aftermath of the coronavirus disease (COVID-19) pandemic, cities have witnessed profound behavioral shifts and innovative governance strategies. The lessons have been strikingly clear: resilience hinges on striking a balance between growth and environmental sustainability. This equilibrium can be best attained through inclusive planning that addresses the vulnerabilities and social inequalities ingrained within urban societies.

Rethinking Cities for Resilience and Growth in the Post-COVID-19 World draws on experiences from the global pandemic to provide a roadmap for health, social, and economic responses to crises. It redefines the significance of cities, sounding a call to action and advocating for a harmonious relationship between urban expansion and ecological preservation. It also sheds light on the colossal challenge of the climate crisis, which is being driven by unsustainable urban development and human activities.

The volume offers insights into the complexities of building cities that can flourish even in the face of adversity. It aims to guide and empower individuals, policy makers, and organizations in shaping urban landscapes that are more adaptable, equitable, and prosperous.

Kyoko Takahashi is a postdoctoral researcher at the Graduate School of Frontier Sciences, The University of Tokyo, Japan.

Shreyas Bharule is an assistant professor at the Department of Architecture and Regional Planning, Indian Institute of Technology Kharagpur, India.

Shogo Kudo is an associate professor in the Global Studies Program at Akita International University, Japan.

KE Seetha Ram is a senior capacity building and training specialist at the Asian Development Bank Institute and a visiting professor at The University of Tokyo, Japan.

About the Asian Development Bank Institute

The Asian Development Bank Institute (ADBI) is the Tokyo-based think tank of the Asian Development Bank. ADBI provides demand-driven policy research, capacity building and training, and outreach to help developing countries in Asia and the Pacific practically address sustainability challenges, accelerate socioeconomic change, and realize more robust, inclusive, and sustainable growth.

ADBIPress
ASIAN DEVELOPMENT BANK INSTITUTE
3-2-5 Kasumigaseki, Chiyoda-ku
Tokyo, 100-6008 Japan
Tel +81 3 3593 5500
www.adbi.org