COVID-19 IN THE TROPICS

STATE OF THE TROPICS

A STATE OF THE TROPICS REPORT **2022**

AUTHORS AND ACKNOWLEDGMENTS

James Cook University and the State of the Tropics leadership group acknowledge the contributions made by many individuals and institutions to the preparation and publication of this Report.

State of the Tropics leadership group institutions:

Project management and editorial team

Simon Biggs, Shelley Templeman (lead author) and Ann Penny.

Authors

Shelley Templeman, Tiani Dun, Madeline McKenzie, Matias Fabricio Vargas Masias, Clancy Walker-Fitzgerald, Chris Williams

Case studies, advice, assistance and reviews

Stuart Ballantyne, Hisham Ahmed Imad, Sarah McDonald, Victoria Mulama, Emma Porio, Jetsumon Prachumsri, Elviera Putri, Daniela Tello Toral, Vanessa Cannon, Ann Penny, Stewart Lockie.

Capstone Editing provided copyediting and proofreading services, according to the guidelines laid out in the university-endorsed national 'Guidelines for Editing Research Theses'.

Layout and Design: zephyrmedia.com.au

COVER PHOTO: Covid-19 face masks microplastic pollution at the beach. dronepicr https://creativecommons.org/licenses/by/2.0

Published by James Cook University on behalf of the State of the Tropics Leadership Group

 ISBN: 978-0-6454198-5-6

This report should be cited as: State of the Tropics (2022) COVID-19 in the Tropics. James Cook University, Townsville, Australia.

Disclaimer: The views and opinions expressed in this publication are those of the authors and do not necessarily reflect those of James Cook University or the leadership group for the State of the Tropics Project.

The designations employed and presentation of material in State of the Tropics does not imply the expression of any opinion of James Cook University or the State of the Tropics leadership group concerning the legal status of any country, territory, city of area of its authorities, or concerning the determination of their frontiers or boundaries.

CONTENTS

FOREWARD

The beginning of 2020 will doubtless prove to be a pivotal time in our shared history. The emergence of SARS-coronavirus-2, or COVID-19, continues to have far-reaching consequences across the world. Two years on, almost half a billion people have officially been diagnosed with COVID-19, and around 1.2% of these people have died with the disease. Officially, the Tropics have experienced a lower caseload compared to the rest of the world, but with borders now opening and the emergence of Omicron and other highly infectious variants of COVID-19, rapidly increasing caseloads are being observed in many tropical regions.

Efforts to combat COVID-19 and develop effective vaccines to protect the community have been a truly global effort. By April 2022, 65% of the global population had received at least one dose of a COVID-19 vaccination (WHO, 2022). However, supply-chain disruptions, competition for vaccines between countries and delays in regulatory approvals mean some parts of the world, particularly low and middle-income nations, have lower vaccination rates. One-third of the global population remains unvaccinated, the vast majority of whom live in the Tropics (WHO, 2022a).

After two years of international border closures and community lockdowns, the world is beginning to re-open. However, many of the challenges that COVID-19 delivered are still being felt. School closures mean many children have lost up to two years of education with flow-on effects likely to be experienced over the long-term. Economic impacts are still playing out even with the re-opening of borders and easing of travel restrictions.

For many regions of the Tropics, the COVID-19 pandemic compounded existing health and economic burdens. As identified in the State of the Tropics 2020 report, prior to the pandemic, undernourishment had increased for the first time since the turn of the century, debt was again a concern for low-income countries, and there were more displaced people than ever in recorded history.

All aspects of human endeavour, from health to trade, employment, education, greenhouse gas emissions and travel have been significantly affected by the pandemic. Indirect societal effects occurred as international borders closed, lockdowns were imposed, and inter-connected economies went into downturn. Many communities that avoided the first waves of COVID-19 due to hard border closures and controls on community transmission of the virus still experienced the negative economic impacts of its spread. There have been other interesting side effects of the pandemic. The use of remote sensing and communication technologies has accelerated across the world. Community lockdowns and industry shutdowns saw the biggest reduction in CO_2 emissions in decades, and other air and water quality improvements provided insight into alternative mechanisms for better environmental quality.

This report focusses on the extent and impact of COVID-19 in the Tropics. It explores the direct impact of cases and mortality and their indirect effects on education, tourism, mental health and the environment. Perspectives from around the Tropics provide unique insights into the varied impacts of the pandemic. The long-term effects of COVID-19 will take decades to play out fully, but the hope is the global community will learn from the pandemic and work towards and invest in a more resilient future for everyone.

Professor Simon Biggs
Vice Chancellor & President, James Cook University
Convenor, State of the Tropics Project

SUMMARY

The emergence of a previously unknown coronavirus in China in late 2019 began a disease progression that rapidly spread across the globe. This virus was labelled SARS-CoV-2 and was responsible for the COVID-19 pandemic (WHO, 2022).

COVID-19 focussed attention on the inequalities that persist around the world, even in the most advanced nations. Most countries enacted home quarantine measures in the first half of 2020 to minimise the spread of COVID-19. Those workers, children and individuals with reliable internet access continued to work, learn and communicate. For those without access to digital technologies, many of these opportunities were not available. This inequality caused economic and health pressures on individuals, families and communities, with the consequences reflected globally. The pandemic highlighted the fragility of global societal systems. Public health systems in many nations proved incapable of meeting the pressures of patient loads driven by the pandemic.

Two years on, COVID-19 continues to affect communities, and the full effects may not be realised for many years. This report provides an initial assessment of the impacts of COVID-19 on the health, economics, environment and community resilience across the Tropics.

COVID-19 CASES, MORTALITY AND VACCINATION RATES IN THE TROPICS

- Caseloads have varied considerably among nations. On average, non-tropical regions reported around 8% of the population infected. Caseloads have generally been lower in the Tropics than in the rest of the world. South America has been hardest hit, with over 11% of the population infected by March 2022.
- In contrast, North Africa and the Middle East have reported caseloads of just over 0.3% of their population, although there are indications of major underreporting in these regions.
- Re-opening of international borders at the same time as the emergence of the Omicron variant has seen exponential rises in caseloads across most regions of the world since the beginning of 2022.
- Mortality as a proportion of caseloads has been much higher in tropical regions. Oceania has been the only tropical region to have mortality rates below 1% of cases.
- Globally, the first COVID-19 wave between February and June 2020 was the most lethal, with up to 7.5% mortality. Central America had the highest mortality in this first wave, with 14% of reported cases dying in the first months to May 2020.
- Although caseloads are similar between men and women, mortality rates have been higher in men. Mortality is strongly age related in high-income nations, but the same relationship does not occur in lower income nations.
- Vaccination rates vary among tropical regions. Central and Southern Africa, and Northern Africa and the Middle East both have vaccination rates below 15% compared to 68% in the rest of the world.

IMPACTS ON ALLIED HEALTH

- The management of COVID-19 placed constraints on the provision of other healthcare services and increased risks to many people with underlying medical conditions during the pandemic.
- Populations exposed to Human Immunodeficiency Virus (HIV), tuberculosis (TB) and malaria face a higher risk of COVID-19 complications and comorbidities. The pandemic has resulted in reductions in support for these diseases with a disproportionate impact on people living in poverty-stricken regions.
- Increased pressures on public health systems from COVID-19 meant that an additional 4 million children missed out on basic immunisations in 2020.
- The combination of stresses from social distancing, lockdowns and loss of employment has led to a decline in mental wellbeing, with community-based cultures experiencing greater impacts. Many low-income tropical communities have reported an associated increase in domestic violence.
- Extreme weather posed challenges for COVID-19 management in some tropical settings. Climate change heightens these challenges and will make responses to these crises even more difficult.

EDUCATION AND LITERACY

- The COVID-19 pandemic has increased literacy poverty. The number of 10 year-olds without basic literacy skills has increased by 17% since the beginning of the pandemic.
- Even before the onset of COVID-19, the consistency of schooling in many regions was challenging. The causes of this were myriad, but the impact of COVID-19 has exacerbated the education divide. Many students lost two years of schooling in 2020 and 2021, with the effects expected to be carried through an entire generation.
- Even with schools gradually re-opening globally, many children are not returning, leading to long-term literacy issues.
- Schools in most tropical regions were closed for longer periods in 2020 and 2021 than their counterparts in the rest of the world.
- Shifting to remote learning approaches during the pandemic disenfranchised many rural and poor students who did not have reliable access to the necessary technology.
- The extended school closures increased drop-out rates in many areas, particularly in the upper secondary schools.
- Many schools in low- and middle-income nations through the Tropics provide regular school meals to alleviate malnutrition. School closures meant this was not available to many students. To overcome this, some countries transitioned to alternative approaches to ensure that students had continued access to adequate nutrition.

TRAVEL AND TOURISM

- Tourism is a major economic driver of global employment and Gross Domestic Product (GDP). Changes to this sector have the potential to severely affect local economies.
- In 2019, over 5.5 billion people travelled by air across the globe. Over 70% of that travel was outside the Tropics.
- In 2020, passenger movements decreased by at least 50% across most tropical regions. The only two regions that did not experience major decreases were Northern Africa and the Middle East, and South East Asia. Both these regions have major airport hubs, including Hong Kong, Singapore and Saudi Arabia, which may be responsible for the higher passenger numbers.
- International and national border closures caused 60% of passenger aircraft to be grounded in 2020. The reduction in aircraft movements was higher in the Tropics, with the greatest decrease occurring in Northern Africa and the Middle East.
- Eight of the 10 nations most heavily dependent on tourism as an export earner are in the Tropics. Of these, The Maldives is considered the most vulnerable, with 79% of total exports coming from tourism. Four of the 10 tourism-vulnerable countries are in the Caribbean.
- Up to 2019, cruise ship tourism was one of the fastest-growing sectors within the tourism industry. The most popular cruise destination was the Caribbean representing nearly 40% of total itineraries. The pause in the industry in 2020 was responsible for GDP losses of up to 10% across the region.

TRADE, UNEMPLOYMENT AND GDP IMPACTS

- Unemployment increased globally by 15% between 2019 and 2021. The Tropics' unemployment rate increased from 6.6 to 8.1% over this period, an increase of 22% overall.
- Regionally, the impact on unemployment was uneven, with Central America, South America and South East Asia having relative unemployment increases from 2019 of over 30%. Contrastingly, Central and Southern Africa, Northern Africa and the Middle East, and the rest of the world had relative increases below 15%.
- Female unemployment, already higher than male unemployment, increased to a greater extent during the pandemic. This risks increasing gender inequality in the future.

- Both maritime and air trade contracted during the pandemic, but for maritime trade, at least, 2021 saw some recovery. The medium-term outlook suggests that maritime trade will not regain pre-pandemic levels.
- Migrant labour was heavily compromised during the pandemic through increases in unemployment, in-country strandings and increased exploitation. Despite this, remittances did not decrease as much as expected, and in some regions, increased over the pandemic.

COVID-19 IMPACTS ON TROPICAL ENVIRONMENTS

- Globally, CO_2 emissions decreased by almost 5% between 2019 and 2020 due to economic lockdowns and border closures. However, this reduction was only temporary, with emissions increasing back to pre-COVID levels by the end of 2021.
- CO_2 emissions in the Tropics decreased by almost 6% over this period, with emissions in Central America decreasing by 17%. The decrease in CO_2 emissions in the rest of the world was lower despite having higher overall emissions.
- Other reductions in noise and air pollution during the pandemic have been linked with behavioural changes in some migratory birds. Increases in bird diversity and increased residence times were observed in India and Colombia.
- Major increases in plastic waste from discarded Personal Protective Equipment (PPE) and food containers have reversed many of the plastic recycling gains made in recent years.
- Wildlife trafficking and tropical deforestation increased in Brazil, Colombia and Cambodia.
- Weakened enforcement and regulation during the pandemic saw increases in illegal activities, including mining, fishing and poaching. However, much of this illegal activity has been driven by a loss of jobs and incomes in communities with few other economic options.

CASE STUDIES

The Impacts of COVID-19 Pandemic in Thailand
Provides a summary of the impacts of COVID-19 on the health and community sectors in Thailand. The study looks at key areas of resilience and support offered by the public sector.

Community Resilience Innovations in Food Security: Towards Resilient Recovery from the COVID-19 Pandemic and Climate Disasters in the Philippines
Summarises community resilience in the face of multiple global threats, COVID-19 and climate change. The focus of this case study is on food security and how community vulnerability can be mitigated through innovation. The success of urban community garden programs is being used as a platform to demonstrate community resilience in the face of natural disasters.

COVID-19: Personal Insights on Working Transnationally During a Pandemic
Compares and contrasts responses to COVID-19 at an individual and community level across two nations. COVID-19 has impacted the oil and gas sector across the globe, with projects being wound back or shelved due to supply-chain issues, border closures and other public health directives. This has affected both direct and indirect employment. The resilience of communities, employees and employers to public health directives are discussed from both the benefit and cost perspectives.

The Impact of COVID-19 on Kenyan Communities and the Fisheries Sector
Summarises how COVID-19 affected communities in Kenya. It lays out a timeline of events and government and community responses to these events. It also provides insights into how COVID-19 affected the Kenyan fisheries industry.

LIST OF FIGURES

LIST OF TABLES

PHOTO: STEPHAN GLADIEU, WORLD BANK

1

INTRODUCTION

In late December 2019, reports emerged of a new 'flu-like' virus circulating in the Hubei province of China. Initial reports suggested the source was the Haunan Seafood Market in Wuhan city (Maxmen, 2022). This disease, a coronavirus identified as SARS-CoV-2 and named COVID-19, is a respiratory illness with incubation periods of up to two weeks (WHO, 2022). COVID-19 is part of the coronavirus family, which is responsible for diseases including the common cold, Severe Acute Respiratory Syndrome (SARS) and Middle East Respiratory Syndrome (MERS) (CDC, 2021). Due to its virulence and transmissibility between people, the World Health Organization (WHO) declared the outbreak a Public Health Emergency of International Concern at the end of January, and on 11th March 2020, formally declared COVID-19 a global pandemic (WHO, 2022).

Most countries around the world issued home quarantine measures in the first half of 2020 to minimise the spread of the disease. Many workers and their families transitioned to mobile phone and internet connectivity to continue to work and learn (ITU & UNESCO, 2020). During the height of the crisis, 90% of governments closed schools and implemented remote learning practices (UNICEF, 2020). At their peak, school closures affected 1.5 billion school students from pre-primary to upper secondary levels.

In many ways, the pandemic has accelerated technological change, forcing human interactions to shift online, growing e-commerce, online education and remote work (World Economic Forum, 2021). These shifts promise benefits to society well beyond the pandemic, but they also risk creating and exacerbating inequalities. For those without reliable access to these digital technologies, the gaps in skills and capabilities can worsen societal fractures and limit recovery prospects (World Economic Forum, 2021).

The rate of technological change in response to the pandemic has been so rapid that any publication of this kind will be out of date before it is published. Even the most comprehensive overview will have significant gaps. Nevertheless, it remains important to understand how things were prior to the pandemic and what the impacts of COVID-19 mean for the Tropics. Due to the ever-changing nature of the pandemic, some of the data presented here will lack current events but will still allow us to draw comparisons between regions and understand how COVID-19 has affected progress in the Tropics.

The COVID-19 pandemic has had a major influence on global and national efforts to meet the UN Sustainable Development Goals (SDG). Even in the absence of the pandemic, internal conflict and other identified state fragility have challenged the capacity to meet many of the SDG (Hughes et al., 2021). The pandemic created additional pressures and caused development progress to slow or reverse in many areas. This has led to increased poverty, decreased literacy in children, reduced health outcomes, and greater gender inequality. These increased pressures have resulted in many SDG falling further behind and reducing the viability of the 2030 targets. Bringing the SDG back on track will require a concerted effort by all nations in both the short and medium term.

ABOUT THIS REPORT

This report looks at the effects of the COVID-19 pandemic across different regions of the Tropics, considering both fragility and resilience within societal systems. It presents a broad-ranging statistical analysis of a set of indicators relating to pandemic data collated from existing datasets. These datasets derive from several authoritative and multi-lateral sources, including various United Nations agencies, the World Bank, the Food and Agriculture Organization and other repositories. The report considers direct health outcomes, impacts on allied health, education and literacy, travel and tourism, unemployment, GDP and environmental outcomes. It also includes case studies discussing the personal impacts COVID-19 has had on people and communities.

Regions of the Tropics

With most of the world's biological and cultural diversity and a range of socio-political and economic systems, the world's tropical zone is defined by its diversity. Nonetheless, the region is united by shared characteristics and challenges. To facilitate meaningful analyses and reporting, coherent groupings that ideally have some degree of commonality or internal homogeneity were required. There are several ways that this could be done, including by climate (wet, dry or temperate tropics) and by national borders. As the majority of data available are reported on a national basis, it makes sense that 'nations' are the basis of regional aggregations (Figure 1.1). The regional groupings used in the State of the Tropics reporting are listed below, and the nations that comprise each region are listed in Appendix A.

- Central America
- Caribbean
- South America
- Northern Africa and Middle East
- Central and Southern Africa
- South Asia
- South East Asia
- Oceania

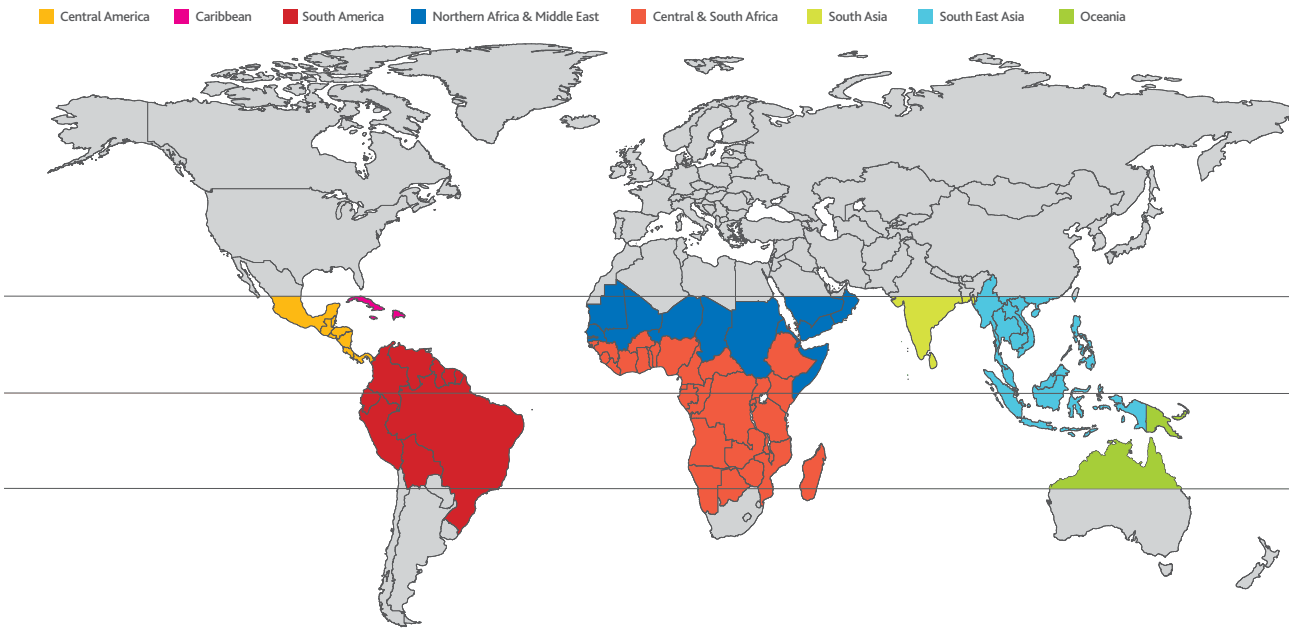

Figure 1.1 Tropical regions of the world used in State of the Tropics analyses.

Nations of the Tropics

In assessing which nations and territories should be included in the report, two processes were applied. The first used a population-based decision tool to assess whether nations partially in the Tropics should be included in the report, and the second reviewed data availability to assess whether sufficient data is available to warrant a nation's inclusion in the report.

The geographic area that is the Tropics is clearly defined as the region between the Tropics of Cancer and Capricorn. However, national borders do not neatly align with these latitudinal lines, and there are many nations and territories that straddle the zone.

The following practical approach has been applied to select nations and territories to be included in the report:

- Nations that are wholly within the Tropics are included.
- Nations partially within the Tropics are included if
  - the majority of the national population (i.e., more than 50%) lives in the Tropics (e.g., Brazil and India), or
  - the proportion of the national population living in the Tropics comprises 5% or more of the total regional population living in the Tropics (e.g., Australia and China) (see Appendix B).

Using this decision tool, 134 nations and territories were assessed as being in the Tropics (see Appendix A).

THE STATE OF THE TROPICS PROJECT

In early 2011, a group of leading research institutions with a common interest in the future of the tropical world came together to examine the condition of life in the Tropics. Their goal was to examine the condition of life in the Tropics and answer the underlying question: is life in the Tropics getting better?

The State of the Tropics 2014 Report was the first product of that collaboration. By assessing a broad range of environmental, social and economic indicators, it illuminated the people and issues of the tropical world and contributed to efforts to improve the lives and environments in the Tropics.

To answer the question of whether life is improving in the Tropics, progress was evaluated on national, regional and global scales. In this case, progress referred to increases in the sustainable and equitable wellbeing of a society. It is multidimensional and includes economic, social and environmental factors along with other areas considered important to the quality of life (e.g., culture or the quality of governance). The 2014 report identified that life in the Tropics is indeed getting better, but progress was uneven and often at the expense of the natural environment.

Since the 2014 report, the State of the Tropics Project has continued to bring together leading research institutions from across the

tropical world to examine the implications of the immense changes being experienced in the Tropics. In doing so, it aims to build effective partnerships between tropical research institutions, build local research capacity and argue for the critical importance of the tropical zone in achieving a sustainable, prosperous and equitable global future.

In 2016, the State of the Tropics Project welcomed the United Nation's decision to declare 29 June as the International Day of the Tropics. The initiative was spearheaded by the Australian Government in close collaboration with the institutions involved in the State of the Tropics Project. The International Day of the Tropics was designated to raise awareness of the specific challenges faced by tropical areas, the far-reaching implications of the issues affecting the world's tropical zone and the need, at all levels, to raise awareness and emphasise the vital role that countries in the Tropics will play in achieving the SDG. The date chosen for the International Day of the Tropics is the anniversary of the launch of the first State of the Tropics report by Nobel Laureate Daw Aung Sun Suu Kyi.

In 2017, a second report was published focussing on sustainable infrastructure development in the Tropics. This report explored the tropical infrastructure gap and the challenges of meeting infrastructure needs while balancing environmental change and impacts on health and wellbeing.

Also in 2017, the State of the Tropics Project brought together a diverse group of distinguished researchers, private sector representatives, practitioners and policymakers through a Rockefeller Bellagio Center Workshop to help shape a strategic road map to strengthen the State of the Tropics consortium of universities and other institutions. The consortium agreed to work together to drive productivity through better educational outcomes, improved health, greater equity and more informed policy leading to sustainable development in the Tropics. This will be achieved by having an orientation to the future, a clear timeframe for success and a focus on the youth of the Tropics creating connectivity between regions of the Tropics grounded in targeted and reliable data.

In 2019, a report on Health in the Tropics was published. This report took stock of the current and historical status of health and wellbeing across different regions of the Tropics. It considered infectious diseases, non-communicable diseases, maternal and child health, mental illness, substance abuse and accident and injury. The stresses and health of the workforce in the Tropics were also explored.

In 2020, another major report on the State of the Tropics was published. This report provided an update on the 2014 report and came at a critical time for the Tropics and its people. As the world faced the COVID-19 pandemic of 2020, it was an important time to stop and take stock once again. How far have we come? How far do we need to go? How will we get there? How will the Tropics overcome one of the greatest challenges facing the world in 100 years? The 2020 report provides a baseline from which to measure the true impact of this world-changing event on the Tropics.

In 2021, a focus report addressing the digital inequality across the Tropics was published. As COVID-19 spread across the world, this was a timely assessment of the importance of digital technologies in helping to sustain health, education and communication across communities during the global crisis.

The 2022 report sets out to provide the first insight into how the COVID-19 pandemic has affected the Tropics. This report assesses how nations in the Tropics have responded and adapted to the pandemic across a range of indicators. It also looks to comprehend the resilience of tropical communities in the face of global crises.

All State of the Tropics reports are available to download from jcu.edu.au/state-of-the-tropics.

REFERENCES

CDC. 2021. Basics of COVID-19. Centers for Disease Control and Prevention, Online fact sheet. Available: https://www.cdc.gov/coronavirus/2019-ncov/your-health/about-covid-19/basics-covid-19.html [Accessed May 2022].

HUGHES, B.B., HANNA, T., MCNEIL, K., BOHL, D.K., & MOYER, J.D. 2021. Pursuing the sustainable development goals in a world reshaped by COVID-19. Frederick S. Pardee Center for International Futures and United Nations Development Programme.

ITU & UNESCO. 2020. The state of broadband: Tackling digital inequalities, a decade for action. International Telecommunication Union and United Nations Educational, Scientific and Cultural Organization.

MAXMEN, A. 2022. Wuhan market was epicentre of pandemic's start, studies suggest. Nature, 603, 15-16.

UNICEF. 2020. COVID-19: Are children able to continue learning during school closures? A global analysis of the potential reach of remote learning policies. United Nations Children's Fund, Online publication. Available: https://data.unicef.org/resources/remote-learning-reachability-factsheet/ [Accessed April 2022].

WORLD ECONOMIC FORUM. 2021. The Global Risks Report 2021—16th Edition. Insight Report. ISBN: 978-2-940631-24-7. https://www.weforum.org/reports/the-global-risks-report-2021/

WHO. 2022. Timeline: WHO's COVID-19 response. World Health Organization. Available: https://www.who.int/emergencies/diseases/novel-coronavirus-2019/interactive-timeline#event-17 [Accessed May 2022].

2

COVID-19 CASES, MORTALITY AND VACCINATION UPTAKE

SUMMARY

- Case numbers have varied considerably among nations. On average, non-tropical regions reported around 8% of their population infected. Caseloads have generally been lower in the Tropics than in the rest of the world. South America has been hardest hit, with over 11% of the population infected by March 2022.
- In contrast, North Africa and the Middle East have reported caseloads of just over 0.3% of their population, although there are indications of major underreporting in some countries.
- Re-opening of international borders at the same time as the emergence of the Omicron variant has seen exponential rises in caseloads across most regions of the world since the beginning of 2022.
- Mortality as a proportion of caseloads has been much higher in tropical regions. Oceania has been the only tropical region to have mortality rates below 1%.
- Globally, the first COVID-19 wave between February and June 2020 was the most lethal, with up to 7.5% mortality.
- Central America had the highest mortality in the first wave of the pandemic, with 14% of reported cases dying in the first five months to May 2020.
- Although caseloads are similar between men and women, mortality rates have been higher in men. Mortality is strongly age related in high-income nations, but this relationship does not extend to many lower income nations.
- Vaccination rates vary among tropical regions. Central and Southern Africa and Northern Africa and the Middle East have vaccination rates below 15%, compared to 68% in the rest of the world.

PHOTO: HENITSOA RAFALIA, WORLD BANK

INTRODUCTION

The first cases of COVID-19 were reported in China in December 2019 (WHO, 2020). The first case outside China was found in Thailand on 11th January 2020 with additional cases being reported for international travellers from Wuhan through the rest of January 2020 (WHO, 2022a). The initial global spread of the disease was through international travellers from Wuhan to other countries.

By the end of January 2020, almost all continents had reported at least one case of COVID-19. By 7th March 2020, global cases had passed 100,000, passing 1 million cases by 4th April 2020. Case numbers reached 5 million by early May 2020, with daily numbers exceeding 100,000 at this time. By the end of December 2020, 82.2 million cases had been recorded, along with 1.9 million deaths. By the 14th May 2022, a total of 521 million cases of COVID have been reported, along with 6.3 million deaths (Ritchie et al., 2020).

Initial management and control of the pandemic were through infection prevention and control with widespread closures of international borders and community lockdowns. The stringency of these measures varied among nations, with some countries imposing very strict restrictions on the movement of people while others opted for more flexible approaches.

Vaccine development was observed as a global priority, with pharmaceutical companies, universities and governments all focussing resources on the development of vaccines against the virus. Along with research and development priorities, there was a recognition that fair and equitable access to successful vaccines was a critical part of the development process. Protection of front-line healthcare workers and those most at risk were key to minimising both the health and wider economic impacts of the disease. The COVID-19 Vaccine Delivery Partnership (COVAX) was established to facilitate this delivery (WHO, 2022b).

TRENDS

COVID-19 caseloads

The first cases of COVID-19 were reported in December 2019, with the pandemic subsequently spreading through the global community in a series of waves. The first wave of the pandemic occurred between March and June 2020, followed by a second wave from October 2020 to January 2021. The second wave coincided with travel for winter celebrations in the northern hemisphere (Rothengatter et al., 2021). The third wave was linked to the emergence of the Delta variant in mid-July 2021. Since the end of December 2021, a fourth wave, linked to the combination of the emergence of the Omicron variant and the opening of international borders, has seen cases spike in many regions (see Figure 2.1, Figure 2.2). Globally, between 1st January 2022 and 14th May 2022, there has been a 45% increase in COVID-19 cases.

COVID-19 infection rates among tropical regions varied through 2020. By the end of 2020, South America had recorded infections in 3% of the population. In contrast, rates of infection in Northern Africa and the Middle East and Central and Southern Africa were 0.1% or lower (see Figure 2.1). By the end of 2020, infection rates in the Tropics were 0.6% of the population while the rest of the world was 1.4% (see Figure 2.2).

The emergence of the Delta variant in July 2021 saw COVID-19 cases rise dramatically in much of the Tropics (ABC News, 2021). Between 31st July 2021 and 30th September 2021, cases in Oceania increased by 80%, while the Caribbean and South East Asia reported increases of almost 70% (see Figure 2.1). A similar spike occurred at the end of December 2021 with the emergence of the Omicron variant of COVID-19. This variant, combined with the re-opening of international borders, saw case numbers increase dramatically. In Oceania, infections increased from 1.8% to 3.1% of the population between December 31, 2021, and January 31, 2022, an increase of almost 200 000 cases in one month. Caseloads in the rest of the world increased by 36% over this period (see Figure 2.2).

Although Brazil has one of the highest caseloads globally, there are indications that both caseloads and mortality have been under-reported, particularly in the favelas of Rio de Janeiro. This suggests the actual impacts of COVID-19 have been even greater than reported (Felter, 2021). The WHO analyses indicate that only 14% of COVID-19 cases in Africa are recorded (WHO, 2021). Therefore, caseloads in Central and Southern Africa could be as high as 3% of the population rather than the official rate of 0.4% (see Figure 2.1). From a global perspective, actual COVID-19 case numbers are likely much higher than what has officially been reported.

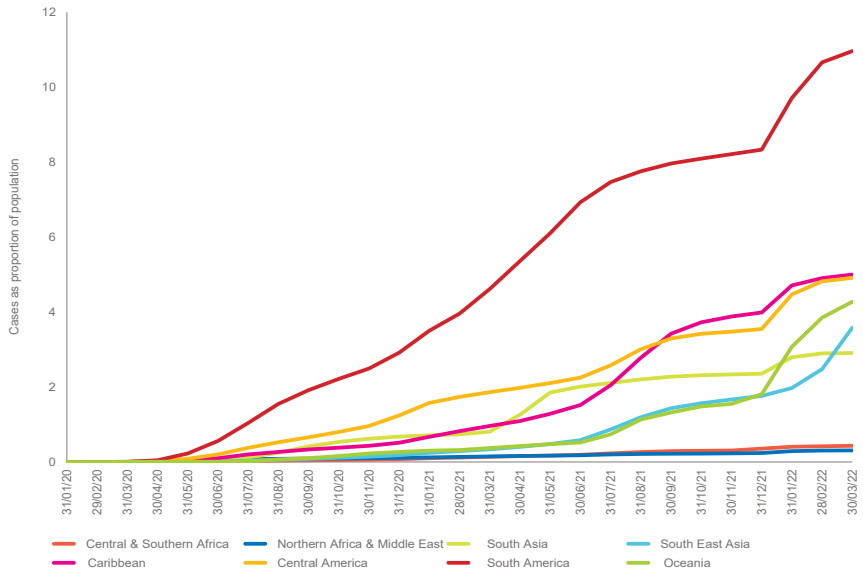

Figure 2.1 Monthly cumulative COVID-19 cases as a proportion of population by region.

Source: Ritchie et al. 2020

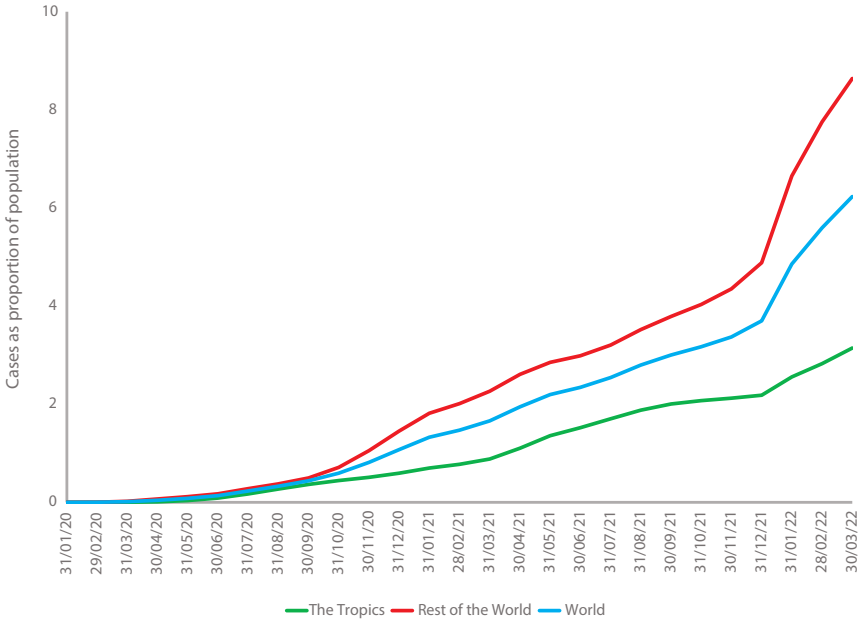

Figure 2.2 Monthly cumulative COVID-19 cases as a proportion of population across the Tropics, the rest of the world and globally.

Source: Ritchie et al. 2020

PUBLIC HEALTH MISTAKES WITH COVID	BOX 1.1

COVID-19 was declared a Public Health Emergency in January 2020 and a global pandemic in March 2020. Despite this, many nations and organisations were slow to act to contain the outbreak. Some nations were reluctant to send communities into lockdown due to risks to their economy or considered the pandemic to be of low risk to their country. This resulted in some countries refusing to impose region or nation-wide lockdowns and others being slow to impose other anti-pandemic measures, including mask-wearing, social distancing, sanitising and deep cleaning.

Initially, the WHO and other health authorities focussed on virus spread via respiratory droplets from an adjacent infected person (Lewis, 2022). Official guidelines recommended social distancing of over one metre and encouraged hand washing and surface disinfection. Initially, only indoor, crowded and inadequately ventilated spaces were considered areas of concern.

Some researchers were concerned that aerosols and airborne transmission were responsible for much of the virus spread. In July 2020, an open letter signed by 238 scientists was sent to WHO asking for recognition of the importance of aerosols and airborne transmission in the spread of the virus (Morawska & Milton, 2020). The response was slow, but by April 2021, the scientific advice was updated to reflect the role of airborne particles in virus transmission (Chamary, 2021). The general consensus now is that COVID-19 spreads through aerosols and fine particulate matter (Nor et al., 2021; Zhu et al., 2021).

COVID-19 mortality

The first death associated with COVID-19 was reported in China on 11th January 2020. By the end of January 2020, 213 deaths had been reported globally, including one death in the Tropics. As caseloads increased, so did mortality. The first wave of COVID-19 through to June 2020 resulted in higher mortality rates compared with later waves (see Figure 2.3, Figure 2.4). Mortality as a proportion of caseloads peaked globally in April 2020, with an average death rate among COVID-19 patients of 7.4%. Average mortality reported in the Tropics peaked at 6.8% in May 2020 (see Figure 2.3).

The Tropics, home to 42% of the global population, reported 30% of total deaths to June 2020. However, impacts among tropical regions varied considerably. Central America was the hardest hit, with around 1 in 7 COVID-19 patients succumbing to the disease (see Figure 2.3). Mexico was the nation hardest hit in Central America, with almost 35 000 deaths by June 2020. South America, with around 2.3% of the global population, reported 19% of global COVID-19 related deaths in June 2020.

The third wave of the pandemic was driven by the emergence of the Delta variant of COVID-19 and was first detected in India in late 2020. By June 2021, the Delta variant was considered the dominant strain circulating in the community (Lovelace, 2021). Although the Delta strain had higher transmission rates, proportional mortalities were lower. By the end of 2021, global mortality rates had dropped to 1.9%, although the Tropics were 50% higher than this at 2.7%. The increase in caseloads associated with the Omicron variant since December 2021 has not resulted in an increased mortality rate. However, the current mortality rate in the Tropics remains much higher than in the rest of the world (see Figure 2.4).

Among the tropical regions, Central America, South America and Northern Africa and the Middle East are still reporting mortality rates of 2.5% to 4.1% (see Figure 2.3). For Northern Africa and the Middle East, this contrasts with the low reported caseload (see Figure 2.1).

In high-income countries, COVID-19 mortality has had a strong age correlation, with around 87% of deaths in the 70+ age groups. In contrast, in low- and middle-income nations, only 37% of deaths associated with COVID-19 occur in people over 70 (Demombynes, 2020). In part, this can be attributed to differences in age demographics between higher and lower income nations. However, correlations between COVID-19 mortality and general mortality indicate the overall underlying health risks already present in the community can increase the risk of death from COVID-19 (Demombynes, 2020). Diseases including cardiovascular disease, obesity, smoking, diabetes and hypertension have also been linked with increased disease severity. When these factors are combined with older age demographics, the mortality risk also increases (Sanyaolu et al., 2020).

Despite initial concerns, preliminary assessments suggest malaria does not increase COVID-19 symptoms but may, in fact, modulate some of the more severe respiratory distress associated with the disease. Unfortunately, these same factors may increase viral loads and possibly viral transmission (Gutman et al., 2020). For HIV, the evidence is more variable. Several studies into co-infections of HIV and COVID-19 indicate a higher risk of dying; however, other comorbidities also influence this risk (Alcorn, 2022). Most studies were in agreement that co-infection between HIV and COVID-19 increased the risk of hospital admission. For those countries with high numbers of HIV infections, particularly in Africa, this can impose greater burdens on already-overstretched healthcare systems (Alcorn, 2021).

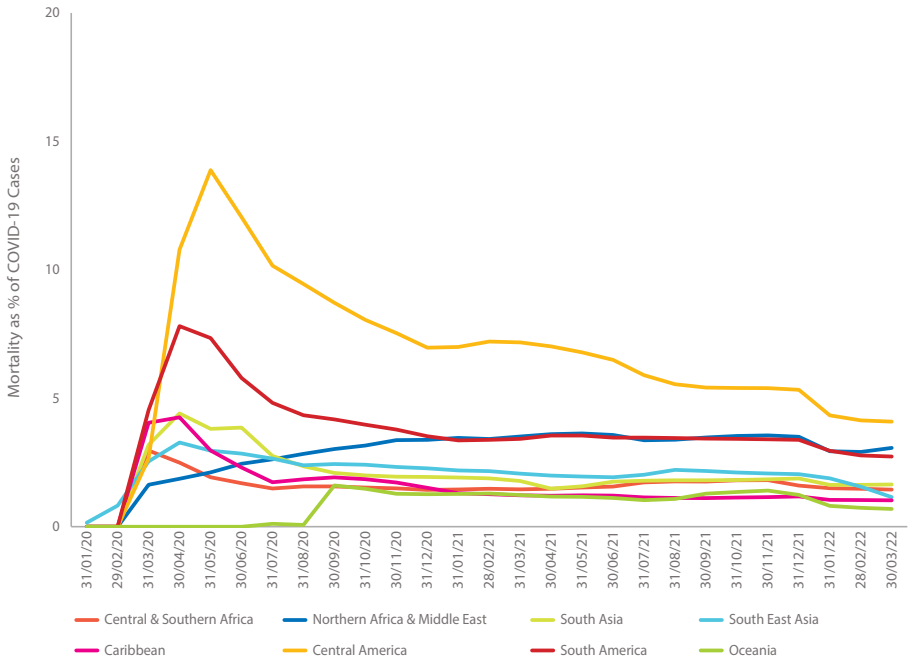

Figure 2.3 COVID-19 mortality as a proportion of cases across the tropical regions.

Source: Ritchie et al. 2020

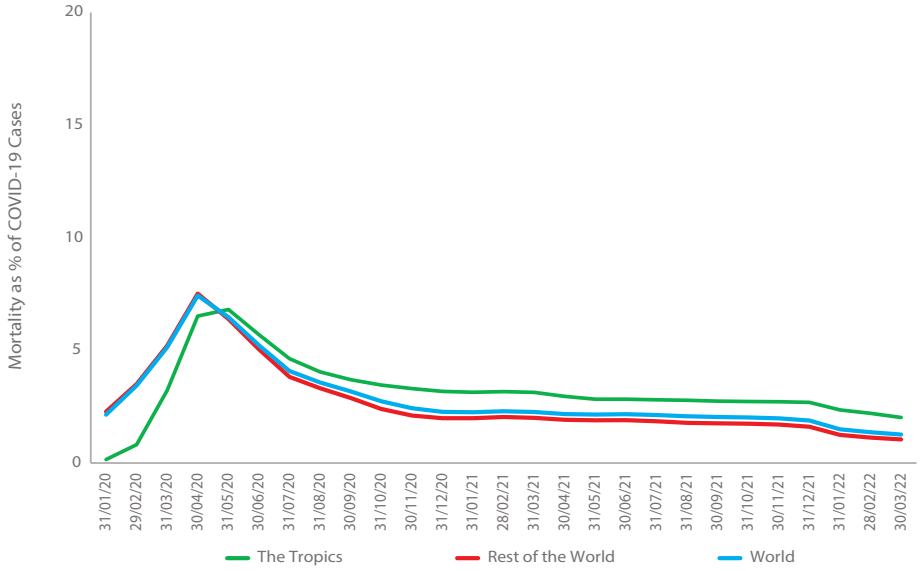

Figure 2.4 COVID-19 mortality as a proportion of cases between the Tropics, the rest of the world and globally.

Source: Ritchie et al. 2020

COVID-19 caseloads have been evenly split between men and women. However, mortality is higher in men than in women (57% compared to 43%) across most nations (WHO, 2021). Some studies suggest an even greater disparity, with estimates of male mortality as high as 77%, although this study focussed on mortality associated with the first wave of COVID-19 (Yanez et al., 2020). Males were also more likely to require intensive care than women. The reasons for this disparity are not clear. Some studies suggest a combination of issues, comprising both behavioural and biological factors, are driving the differences (Griffith et al., 2020; Peckham et al., 2020). Hormone-related protections were considered to confer a greater resilience to acute COVID-19 symptoms in women. Social behaviours, including smoking and reduced bathroom hygiene, are considered factors influencing mortality rates in men (Peckham et al., 2020).

Excess mortality and underreporting

During the pandemic, estimates of COVID-19 mortality have been considered a better measure of the true impact of the pandemic than caseloads, but underreporting of COVID-19 deaths is almost universal. Even before the onset of the pandemic, underreporting of specific disease-associated mortality, especially neglected tropical diseases, was considered a chronic issue (Whittaker et al., 2020).

The average excess mortality rate in 2020 varied across the Tropics (see Figure 2.5). Some regions, including Oceania, the Caribbean and South East Asia, had slightly lower than expected rates of mortality. These rates, expressed as a negative value, suggest mortality was lower than expected compared to baseline estimates. This is due to reduced deaths from other causes. All other regions had higher than expected excess mortality rates, indicating some level of underreporting. In 2021, excess mortality rates were higher across almost all of the Tropics. Only Oceania continued to report a negative mortality rate (see Figure 2.5). South America, Central America and the rest of the world have excess morality rates above 150 deaths per 100,000, suggesting chronic underreporting of deaths. Most of the excess mortality rate is likely to be associated with unreported COVID-19 deaths.

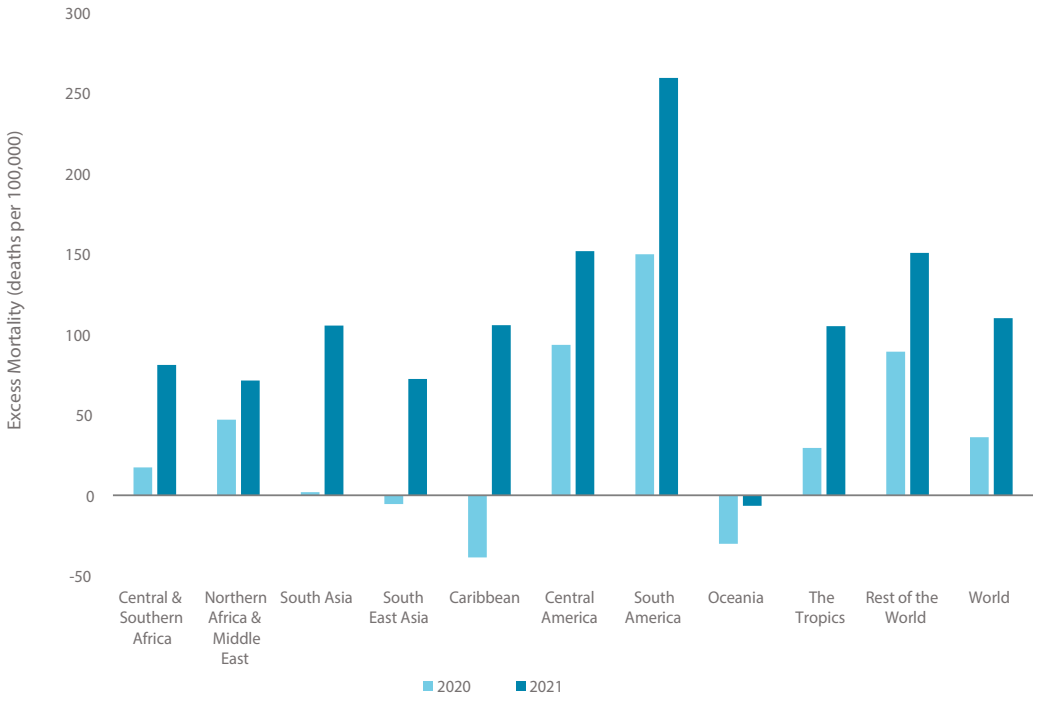

Figure 2.5 Estimates of excess mortality associated with the COVID-19 pandemic.

Source: WHO 2022c

Modelling of excess mortality suggests that the true COVID-19 related deaths could be between 50% and 75% higher than current official data (Whittaker et al., 2021). Recent assessments by the WHO suggest that deaths attributed to COVID-19 by the end of 2021 are around three times higher than the officially recorded 5.42 million (WHO, 2022d). Underreporting has been higher in parts of South East and South Asia, Europe and the Americas (WHO, 2022d), with middle-income countries having greater levels of underreporting. Low-income countries are considered to have the lowest incidence of underreporting of COVID-19 associated mortality.

Ecuador had the highest excess mortality rate in 2020 (Ortiz-Prado et al., 2021). During the first wave of the pandemic, the province of Guayas, Ecuador had the highest mortality rate in Latin America. Between March and April 2020, Guayas deaths increased from approximately 50 deaths per day from all causes in previous years to more than 700 per day (Fernandez-Naranjo et al., 2021). Mortality exceeded the health system capacities, leading to burials in mass graves. The overwhelming number of deaths and overloading of resources made it impossible to count the real number of COVID deaths, and to this day many families do not know the whereabouts of their loved ones (Faiola & Herrero, 2020).

One of the few positive outcomes from the pandemic is that public health directives have lowered deaths associated with some activities. Lockdowns, working from home and restrictions on travel have reduced traffic congestion, leading to improvements in air quality and fewer traffic accidents (Yasin et al., 2021). The limited contact between people also reduced the spread of other respiratory diseases including influenza in many countries.

Vaccination rates

Development of vaccines against SARS-CoV-2 began in January 2020 as an urgent international response to the COVID-19 pandemic. Globally, tens of billions of dollars were invested by governments, health organisations, universities and industry to develop effective protections against the virus. By March 2020, four vaccines had begun human trials. Both China and Russia announced initial approvals for two vaccines in June and August 2020, but access to these vaccines was limited (WHO, 2022a).

In November 2020, Pfizer/BioNTech submitted an approval request for emergency validation of its vaccine, which was granted by the WHO on the 31st December 2020. Other vaccines obtained regulatory approval through the beginning of 2021. The first official vaccination was recorded on 4th December 2020 (Ritchie et al., 2020). By 31st March 2022, almost 60% of the world had been fully vaccinated, with the vaccine rollout considered a success in protecting the global community from the worst of the pandemic (see Table 2.1). However, the proportion of people fully vaccinated varied by region.

Of the tropical regions, South America has recorded the highest vaccination rate, with almost 72% of its population fully vaccinated (see Table 2.1). Northern Africa and the Middle East, and Central and Southern Africa have recorded the lowest vaccination rates at 10% and 12%, respectively. In Central and Southern Africa, only 5 of 36 nations have full vaccine coverage for more than 50% of the population. Other tropical regions also have variable vaccination rates between nations.

Table 2.1 Proportion of the population fully vaccinated by 31st March 2022

Source: Ritchie et al. 2020.

REGION	% OF PEOPLE FULLY VACCINATED
Central and Southern Africa	12.2
Northern Africa and Middle East	10.2
South Asia	60.9
South East Asia	68.2
Caribbean	42.5
Central America	55.4
South America	71.7
Oceania	25.9
The Tropics	46.9
Rest of the World	67.8

Collectively, less than half the population in the Tropics are fully vaccinated, lagging behind the rest of the world, which has almost 70% of the population covered. This difference highlights some of the challenges associated with the rollout of a global vaccination program.

The COVID-19 Vaccine Delivery Partnership (COVAX) Facility was a program designed to facilitate the fair and equitable distribution of any vaccines developed to combat COVID-19 across all nations (WHO, 2022b). This program was adopted by over 150 nations in July 2020. Despite this commitment, there have been inequities in delivery. A WHO briefing on COVAX progress in February 2022 identified 34 nations with vaccination rates well below the 70% vaccination target set for June 2022 (WHO, 2022b). Of these, 32 nations are in the Tropics (see Figure 2.6).

A combination of supply-chain issues, vaccine hesitancy, health care expenditure and misinformation have restricted distribution and adequate vaccination coverage across all nations. In addition to external constraints on vaccine delivery for many low-income nations, the financial burden to ensure coverage of 70% of the population can be as high as 57% of their health care budget. In contrast, most high-income nations will need to increase health care expenditure by less than 1% to achieve the same goal (UNDP, n.d.).

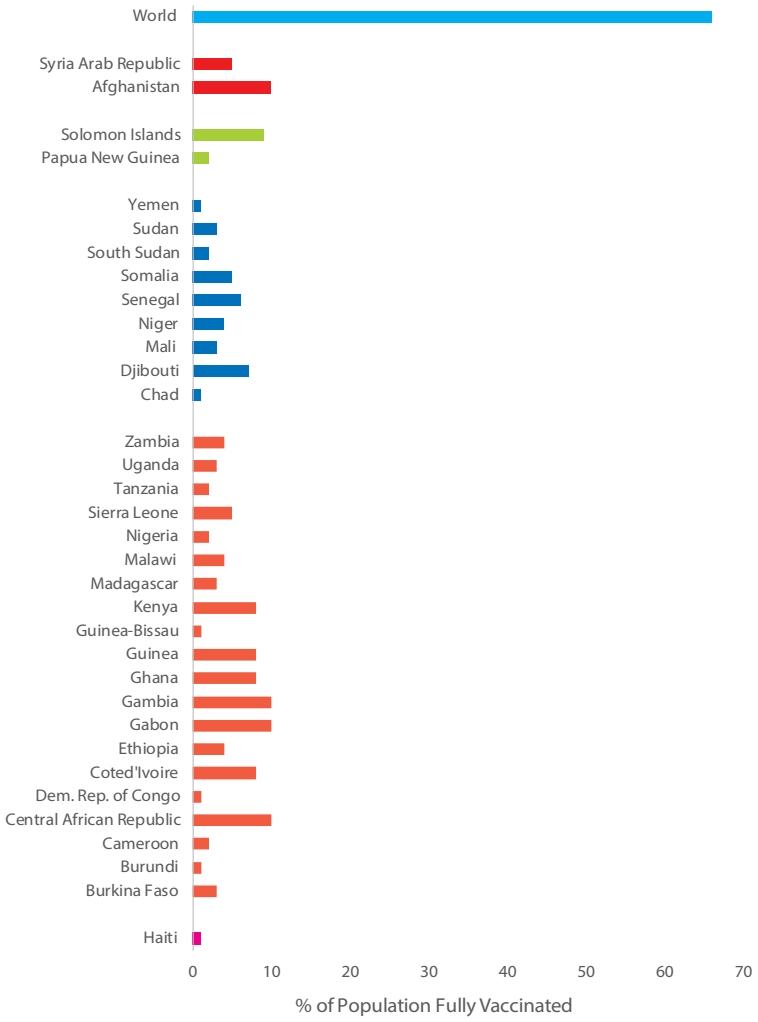

Figure 2.6 COVID-19 vaccination coverage for countries off-track to meet WHO targets by June 2022 along with current global coverage.

Source: WHO 2022b

Vaccine hesitancy and misinformation

In January 2019, the WHO listed vaccine hesitancy as one of the top 10 global health threats, alongside armed conflict, air pollution and climate change (WHO, 2019). The reasons people choose not to vaccinate are complex. Concerns stem from a range of social, cultural and historical factors. Due to historical injustices,

minority groups and marginalised communities often lack trust in government-directed healthcare systems. These concerns can be the result of a lack of public trust, especially when information originates from an empowered authority.

The lack of consistent public health messages during the pandemic has led to increased public uncertainty and increased social anxieties regarding COVID-19. This has increased vaccine hesitancy in many locations, particularly those with a history of political injustice and strong religious and cultural beliefs.

Many low-income tropical nations experience poor public trust in governing bodies due to the lack of employment security and poor working and living conditions. Greater levels of dispossession and insecurity can engender trust issues in healthcare systems and associated health and vaccination interventions. In a study of over 5,000 participants from South East Asia, around half of the participants expressed COVID-19 vaccine hesitancy (Marzo et al., 2022). These hesitancies were linked to a range of socio-economic factors, including employment type and education level, and varied between countries.

Unemployed participants and those living in rural areas were more likely to express hesitancy, while students or those with tertiary education were more likely to accept the vaccines (Marzo et al., 2022). This indicates both education and community engagement are necessary for effective engagement in vaccination programs.

Concerns about the use of animal products and the potential for harm initially hindered the acceptance of the vaccines in many nations (Mardian et al., 2021). Both pork gelatine and squalene (oil sourced from shark livers) have been used historically in vaccine manufacture, causing concern about the Halal status of COVID-19 vaccines (Carusi, 2020).

While digital technologies are useful tools, they have also been providing a means of disseminating misinformation and conspiracy theories associated with COVID-19 via social media platforms (Adhikari & Cheah, 2021). In Papua New Guinea (PNG), only 3% of residents are fully vaccinated, despite concerted efforts to improve vaccine coverage (Reuters, 2022). Surveys of PNG residents indicate that the main concerns are potential side effects and a lack of trust in the vaccine (Manoka, 2022). Much of this hesitancy has stemmed from misinformation promoted on social media, including stories claiming that there are microchips present in the vaccine (The Guardian, 2021). Other factors influencing vaccine hesitancy are linked to traditional cultural beliefs (Fox & Faa, 2021; Macdonald, 2021). Despite national policies directed at increasing vaccination coverage, there has been limited uptake in PNG. A 'no jab, no job' policy to encourage vaccination uptake instead led to mass resignations and the circulation of fake vaccination certificates. Some people also felt their basic human rights were being targeted through this policy (Kenneth, 2021; Loop, 2021).

A similar study in Africa found that many respondents expressed beliefs that COVID-19 was a man-made disease, did not exist, was exaggerated and/or did not pose a serious threat (Africa CDC, 2020). However, the same study found that 80% of respondents would be willing to receive a COVID-19 vaccination if it were deemed safe and effective (Africa CDC, 2020). Safety was their primary consideration, with personal health the main driver.

TROPICAL PERSPECTIVE

The Tropics have had a lower COVID-19 caseload burden than the rest of the world. However, there are concerns that underreporting may be masking the real impacts of the disease on tropical communities. Although case numbers have generally been lower, mortality rates in the Tropics have been higher, resulting in COVID-19 being more deadly to tropical communities.

Although there has been a global commitment to fair and equitable access to vaccines, the reality has been quite different. Of the 34 nations with under 10% of the global vaccination targets, 32 are in the Tropics (WHO, 2022b). The combination of supply disruption, distribution challenges and vaccine hesitancy has led to many of these nations struggling to ensure their populations are effectively protected.

LOOKING FORWARD

The COVID-19 virus is continuing to evolve and infect people on a daily basis, with patients continuing to die from the disease. There are ongoing concerns about the emergence of new variants and uncertainty about how effective vaccinations may be in the long term. Some countries are now reducing their monitoring and reporting activities, so data reliability in the future may be compromised. Low vaccination rates in some areas have the potential to contribute to the emergence of new variants driving new outbreaks. Current reports indicate that in Australia, COVID-19 may become one of the top three causes of death by the end of 2022, and it is likely that this will be a global effect (ABC News, 2022). Longterm, this disease is expected to become endemic in the global community.

REFERENCES

ABC NEWS. 2021. Indonesia records 100,000 confirmed COVID deaths as Delta variant grips the nation. *ABC News*, Online news story. Available: https://www.abc.net.au/news/2021-08-05/indonesia-records-100000-covid-deaths-delta-variant-arrives/100351284 [Accessed April 2022].

ABC NEWS. 2022. COVID-19 infections in Australia hit worldwide highs — and experts predict another Omicron variant spike is coming. *ABC News*, Online news story. Available: https://www.abc.net.au/news/2022-05-15/covid-infections-in-australia-among-worlds-highest/101062364 [Accessed May 2022].

ADHIKARI, B., & CHEAH, P. Y. 2021. Vaccine hesitancy in the COVID-19 era. *The Lancet Infectious Diseases*, 21(8), 1086.

AFRICA CDC. 2020. Majority of Africans would take a safe and effective COVID-19 vaccine. *Africa Centres for Disease Control and Prevention*. Available: https://africacdc.org/news-item/majority-of-africans-would-take-a-safe-and-effective-covid-19-vaccine [Accessed April 2022].

ALCORN, K. 2021. People with HIV should be prioritised for COVID-19 vaccination due to higher risk, WHO recommends. *nam aidsmap*. Available: *https://www.aidsmap.com/news/jul-2021/people-hiv-should-be-prioritised-covid-19-vaccination-due-higher-risk-who-recommends* [Accessed May 2022].

ALCORN, K. 2022. COVID-19 and coronavirus in people living with HIV. *nam aidsmap*. Available: https://www.aidsmap.com/about-hiv/covid-19-and-coronavirus-people-living-hiv [Accessed May 2022].

CARUSI, A. 2020. Coronavirus: the three types of vaccine hesitancy authorities need to combat. *The Conversation*. Available: https://theconversation.com/coronavirus-the-three-types-of-vaccine-hesitancy-authorities-need-to-combat-146730 [Accessed April 2022].

CHAMARY, J.V. 2021. *Forbes*. WHO Finally Admits Coronavirus Is Airborne. It's too late. Available: https://www.forbes.com/sites/jvchamary/2021/05/04/who-coronavirus-airborne/?sh=58c5b6a54472 [Accessed May 2022].

DEMOMBYNES, G. 2020. COVID-19 age-mortality curves are flatter in developing countries. Policy Research Working Paper 9313. *World Bank Group, Human Development Global Practice*. Available: http://www.worldbank.org/prwp [Accessed April 2022].

FAIOLA, A., & HERRERO, A.V. 2020. Bodies lie in the streets of Guayaquil, Ecuador, emerging epicenter of the coronavirus in Latin America. *The Washington Post*. Available: https://www.washingtonpost.com/world/the_americas/coronavirus-guayaquil-ecuador-bodies-corpses-streets/2020/04/03/79c786c8-7522-11ea-ad9b-254ec99993bc_story.html [Accessed April 2022].

FELTER, C. 2021. By how much are countries underreporting COVID-19 cases and deaths? *Council on Foreign Relations*. Available: https://www.cfr.org/in-brief/how-much-are-countries-underreporting-covid-19-cases-and-deaths [Accessed May 2022].

FERNANDEZ-NARANJO, R.P., VASCONEZ, E., SIMBANA-RIVERA, K., LISTER, A, LANDAZURI, S., & ORTIZ-PRADO, E. 2021. The world's deadliest outbreak during the COVID- 19 pandemic: A proposed analytical approach to estimate excess mortality in Ecuador during the first year of the pandemic. Research Square DOI: https://doi.org/10.21203/rs.3.rs-739011/v1

FOX, L., & FAA, M. 2021. Health workers face death threats as COVID-19 vaccine hesitancy takes hold in PNG. *ABC News*. Available: https://www.abc.net.au/news/2021-09-10/png-vaccine-hesitancy-papua-new-guinea-covid-19/100444380 [Accessed April 2022].

GRIFFITH, D.M., SHARMA, G., HOLLIDAY C.S., ENYIA, O.K., VALLIERE M., SEMLOW, A.R., STEWRT, E.C., & BLUMENTHAL, R.S. 2020. Men and COVID-19: A biopsychosocial approach to understanding sex differences in mortality and recommendations for practice and policy interventions. *Preventing Chronic Disease*,17, 200247.

GUTMAN, J.R., LUCCHI, N.W., CANTEY, P.T., STEINHARDT, L.C., SAMUELS, A.M., KAMB, M.L., KAPELLA, B.K., MCELROY, P.D., UDHAYAKUMAR, V., & LINDBLADE, K.A. 2020. Malaria and parasitic neglected tropical diseases: Potential syndemics with COVID-19? *The American Journal of Tropical Medicine and Hygiene*, 103, 2, 572–577.

KENNETH, G. 2021. Fake Vax Warning. PNG Post-Courier. Available: https://postcourier.com.pg/fake-vax-warning [Accessed April 2022]

LEWIS, D. 2022. Why the WHO took two years to say COVID is airborne. *Nature*, 604, 7 April 2022.

LOOP. 2021. "No Jab, no job" causing chaos: Namah. Loop PNG, Online news story. Available: https://www.looppng.com/coronavirus/%E2%80%98no-jab-no-job%E2%80%99-causing-chaos-namah-106353 [Accessed April 2022].

LOVELACE, B. Jr., 2021. *CNBC*. WHO says delta is becoming the dominant COVID variant globally. Available: https://www.cnbc.com/2021/06/18/who-says-delta-is-becoming-the-dominant-covid-variant-globally.html [Accessed May 2022].

MACDONALD, F. 2021. Just 1.7% of people in PNG are vaccinated against COVID. Why is resistance so fierce? *The Conversation*. Available: https://theconversation.com/just-1-7-of-people-in-png-are-vaccinated-against-covid-why-is-resistance-so-fierce-170876 [Accessed April 2022].

MANOKA, A. 2022. Why many Papua New Guineans reject the COVID-19 vaccine, and why I changed my mind. *Development Policy Centre*. Available: https://devpolicy.org/png-vaccine-hesitancy-and-why-i-changed-my-mind-20220208 [Accessed April 2022].

MARDIAN, Y., SHAW-SHALIBA, K., KARYANA, M., & LAU, C.-Y. 2021. Sharia (Islamic Law) perspectives of COVID-19 vaccines. *Frontiers in Tropical Diseases*, 2.

MARZO, R.R., SAMI, W., ALAM, M.Z., ACHARYA, S., JERMSITTIPARSERT, K., SONGWATHANA, K., PHAM, N.T., RESPATI, T., FALLER, E.M., BALDONADO, A.M., AUNG, Y., BORKAR, S.M., ESSAR, M.Y., SHRESTHA, S., & YI, S. 2022. Hesitancy in COVID-19 vaccine uptake and its associated factors among the general adult population: A cross-sectional study in six Southeast Asian countries. *Tropical Medicine and Health*, 50(1).

MORAWSKA, L., & MILTON, D.K. 2020. It is time to address airborne transmission of coronavirus disease 2019 (COVID-19). *In Clinical Infectious Diseases*. Invited Commentary, 2020:71 (1 November).

NOR, N.S.M., YIP, C.W., IBRAHIM, N., JAAFAR, M.H., RASHID, Z.Z., MUSTAFA, N., HAMID, H.H.A., CHANDRU, K., LATIF, M.T., SAW, P.E., LIN, C.Y., ALHASA, K.M., HASHIM, J.H., & NADZIR, M.S.M. 2021. Particulate matter (PM2.5) as a potential SARS-CoV-2 carrier. *Scientific Reports*, 11(1).

ORTIZ-PRADO, E., SIMBANA-RIVERA, K., BARRENO, L.G., DIAZ, A.M., BARRETO, A., MOYANO, C., ARCOS, V., VASCONEZ-GONZALEZ, E., PAZ, C., SIMBANA-GUAYCHA, F., MOLESTINA-LUZURIAGA, M., FERNANDEZ-NARANJO, R., FEIJOO, J., HENRIQUEZ-TRUJILLO, A.R., ADANA, L., LOPEZ-CORTEZ, A., FLETCHER, I., & LOWE, R. 2021. Epidemiological, socio-demographic and clinical features of the early phase of the COVID-19 epidemic in Ecuador. *PLoS Neglected Tropical Diseases*, 15(1).

RITCHIE, H., MATHIEU, E., RODÉS-GUIRAO, L., APPEL, C., GIATTINO, C., ORTIZ-OSPINA, E., HASELL, J., MACDONALD, B., BELTEKIAN, D., & ROSER, M. 2020. "Coronavirus Pandemic (COVID-19)". Published online at OurWorldInData.org. Retrieved from: 'https://ourworldindata.org/coronavirus [Online Resource] [Accessed April 2022].

PECKHAM, H., DE GRUIJTER, N.M., RAINE, C., RADZISZEWSKA, A., CIURTIN, C., WEDDERBURN, L.R., ROSSER, E.C., WEBB, K., & DEAKIN, C.T. 2020. Male sex identified by global COVID-19 meta-analysis as a risk factor for death and ITU admission. *Nature Communications*, 11, 6317 (2020).

REUTERS. 2022. Reuters COVID-19 tracker: Papua New Guinea. *Reuters*, Online news story. Available: https://graphics.reuters.com/world-coronavirus-tracker-and-maps/countries-and-territories/papua-new-guinea [Accessed May 2022].

ROTHENGATTER, W., ZHANG, J., HAYASHI Y., NOSACH, A., WANG, K., & OUM, T.H. 2021. Pandemic waves and the time after Covid-19 – Consequences for the transport sector. *Transport Policy*, 110, 225–237.

SANYAOLU, A., OKORIE, C., MARINKOVIC, A., PATIDAR, R., YOUNIS, K., DESAI, P., HOSEIN, Z., PADDA, I., MANGAT, J., & ALTAF, M. 2020. Comorbidity and its impact on patients with COVID-19. SN *Comprehensive Clinical Medicine*, 2(8), 1069–1076.

THE GUARDIAN. 2021. Mass burial to relieve overflowing Papua New Guinea morgue as COVID cases surge. *The Guardian*, Online news story. Available: https://www.theguardian.com/world/2021/oct/26/mass-burial-to-relieve-overflowing-papua-new-guinea-morgue-as-covid-cases-surge [Accessed April 2022].

UNDP. n.d. Global dashboard for vaccine equity. *UNDP*. Available: https://data.undp.org/vaccine-equity [Accessed May 2022].

WHITTAKER, C., WALKER, P.G.T, ALHAFFAR, M., HAMLET, A., DJAAFARA, B.A., GHANI, A., FERGUSON, N., DAHAB, M., CHECCHI, F., & WATSON, O.J. 2020. Under-reporting of deaths limits our understanding of true burden of COVID-19. *British Medical Journal*, 375, n2239.

WHO. 2019. Ten threats to global health in 2019. *World Health Organization*. Available: https://www.who.int/news-room/spotlight/ten-threats-to-global-health-in-2019 [Accessed April 2022].

WHO. 2020. Ending the neglect to attain the Sustainable Development Goals: a road map for neglected tropical diseases. *World Health Organization*. Available: http://apps.who.int/bookorders [Accessed April 2022].

WHO. 2021. Six in seven COVID-19 infections go undetected in Africa. *World Health Organization*. Available: https://www.afro.who.int/news/six-seven-covid-19-infections-go-undetected-africa [Accessed May 2022]

WHO. 2022a. Timeline: WHO's COVID-19 response. *World Health Organization*. Available: https://www.who.int/emergencies/diseases/novel-coronavirus-2019/interactive-timeline#event-17 [Accessed May 2022].

WHO. 2022b. WHO member state briefing – COVID-19 vaccine delivery partnership, 3rd February 2022. *World Health Organization*. Available: https://apps.who.int/gb/COVID-19/pdf_files/2022/03_02/Item3.pdf [Accessed May 2022].

WHO. 2022c. Estimates of excess mortality associated with COVID-19 pandemic (as of 25 March 2022). *World Health Organization*.

WHO. 2022d. 14.9 million excess deaths associated with the COVID-19 pandemic in 2020 and 2021. *World Health Organization*. Available: https://www.who.int/news/item/05-05-2022-14.9-million-excess-deaths-were-associated-with-the-covid-19-pandemic-in-2020-and-2021 [Accessed May 2022].

YASIN, Y.J., GRIVNA, M. & ABU-ZIDAN, F.M. 2021. Global impact of COVID-19 pandemic on road traffic collisions. *World Journal of Emergency Surgery*, 16, 51.

YANEZ N.D., WEISS, N.S., ROMAND, J.-A., & TREGGIARI, M.M. 2020. COVID-19 mortality risk for older men and women. *BMC Public Health*, 20, 1742.

ZHU, C., MAHARAJAN, K., LIU, K., & ZHANG, Y. 2021. Role of atmospheric particulate matter exposure in COVID-19 and other health risks in human: *A review. Environmental Research*, 198.

1

THE IMPACTS OF COVID-19 PANDEMIC IN THAILAND

DR HISHAM AHMED IMAD AND DR JETSUMON SATTABONGKOT PRACHUMSRI
MAHIDOL VIVAX RESEARCH UNIT, FACULTY OF TROPICAL MEDICINE, MAHIDOL UNIVERSITY, THAILAND

PHOTO: TRINN SUWANNAPHA, WORLD BANK

The COVID-19 pandemic has affected over two million people and caused over twenty thousand fatalities in Thailand since the beginning of the pandemic (Ministry of Public Health, 2021a). The nation is currently enduring the sixth successive transmission wave COVID-19, and is preparing to relax mobility restriction measures to revive the tourism industry. The tourism industry is the primary economic river that drives many small and medium size enterprises, both in the formal and informal sectors in Thailand. This sector was one of the hardest hit during the pandemic and continues to face challenges from both the disease and the associated mitigation strategies.

Thailand has been a popular tropical travel destination with millions of people visiting the Kingdom each year. In 2019, 39.7 million tourists visited Thailand. One quarter were travellers from mainland China, the highest of all international travellers over the past five years. However, Thailand's popularity may have led to the introduction of Thailand's first COVID-19 case, one week into the New Year of 2020. This was the first reported case outside of the epicentre of Hubei, China after the initial COVID-19 outbreak in late December of 2019 (Okada et al., 2020). The early detection of the virus in a traveller reflected the degree of preparedness of the Thai government and its state agencies bracing for this new respiratory pathogen with pandemic potential (Wacharapluesadee et al., 2020)

The public health care system in Thailand is supported by a two-decade strong universal health coverage and a social security scheme, providing coverage and eligibility for almost everyone living in Thailand (Sumriddetchkajorn et al., 2019). Hospitals in Thailand act nationally, regionally and at community levels. Most of the public hospitals are governed by the Ministry of Public Health and others by different government agencies including the Thai military. Overall, there are well over a thousand hospitals across Thailand providing over 150,000 hospital beds and almost 8,000 critical care beds (Marome & Shaw, 2021). The hospital health care work force (doctors and nurses) is estimated to be 35 per 10,000 population, accounting for both the private and public sector hospitals in Thailand (Nittayasoot et al., 2021). The nation also has its own state-owned pharmaceutical manufacturing agency and private biotechnical companies with the infrastructure and innovation for mass production of medicines including vaccines.

Despite having in place fundamental public health measures for disease surveillance by screening, contact tracing, and strict quarantine and isolation measures, the first autochthonous case was detected at the end of January 2020 (Pongpirul et al., 2020). Overall cases remained low in the early quarter of the year and were mainly seen among travellers returning to Thailand. Fuelled by several large transmission clusters and super-spreading events, the community transmission of the first wave peaked in April 2020 (Triukose et al., 2021).

Here we describe the public health strategies implemented in Thailand in the advent of the COVID-19 pandemic, along with the economic and health effects on the society.

OUTBREAK PREPAREDNESS AND MITIGATION STRATEGIES

Like other parts of the world affected by the alpha variant of COVID-19, the primary preventive strategies deployed to flatten the epidemic curve in Thailand were to advocate for appropriate hand hygiene practice measures and cough etiquette, with

universal masking and physical distancing (Chiu et al., 2020). Mass public communication strategies were used to effectively engage and inform the public about the new disease and preventive measures (Intawong et al., 2021). A working case definition for individuals under investigation was developed to support the standard operating procedures at healthcare facilities (Bruminhent et al., 2020). Surveillance measures were stepped up at both public and private hospitals. Biometric sensors such as thermal surveillance at the four major international airports in Thailand, focussed on detecting cases arriving from hotspots elsewhere in Asia and Europe (Mungmunpuntipantip & Wiwanitkit, 2020). In addition, all incoming passengers to Thailand were required to self-isolate for a two-week period, and to notify authorities if symptoms developed. Designated clinics for acute respiratory illnesses were established across the country, testing was made available, and makeshift outdoor stations were assembled for specimen collection. More significantly, Thailand extended the use of telemedicine via artificial intelligence-based application technologies and the use of robotics across the country (Intawong et al., 2021). Several structural renovations were developed within hospitals to limit the transmission of the virus, along with segregation of COVID-19 patients to avoid disruption of routine services and to maintain patient flow.

Despite stringent pandemic preparedness, an exponential increase in positive cases led to extreme restrictions on domestic and international travel and on human movement in the form of lockdowns (Ministry of Public Health, 2021b). These consisted of night curfews, closure of schools, universities, government and non-government offices, non-essential businesses, religious services, festivities and public gatherings. Movements were limited to necessary essential workforce personnel, or frontline workers, to proceed without major disruption of routine work. Everyone was encouraged to remain at home. A mandatory stay-in-state quarantine facility was imposed on all arrivals to Thailand, and isolation of confirmed cases took place. The accelerated technological transformation to complete digitisation was effective with online schooling, working from home, and connecting with colleagues through virtual platforms. On the business side, several online shopping portals sprouted up, and restaurants transformed into take out services with a staggering expansion of delivery networks that merged with online banking for payment services.

The crisis management centre, also known as the Center for COVID-19 Situation Administration, was established to execute pandemic preparedness strategies. These strategies were undertaken in accordance with national framework and was centrally supported by five government ministries assigned with specific responsibilities and tasks (Srisawat et al., 2021). The Ministry of Interior and local government organisations oversaw and acted on imposing lockdowns and quarantine policies. Both the Ministries of Industry and Commerce escalated the production and distribution of medical supplies to increase stocks and prevent stocks running out. The Ministry of Finance mobilised state funds to support small and medium-sized enterprises, subsidise utilities and relax taxation policies. In addition, the Ministry of Public Health advocated for disease prevention and control measures by mobilising their surveillance and rapid response teams which included public health officers and epidemiologists (Issac et al., 2021). The Ministry of Public Health deployed over a million public health workers who engaged in door-to-door home visits to educate and increase awareness about the disease manifestations and preventive steps. In addition to identifying high-risk groups, they also aided in coordinating cases of COVID-19 in hospital care and recording health data (Krassanairawiwong et al., 2021). This vast dispersion of the public health personnel network was pivotal in monitoring and controlling the surges of cases within the country during the pandemic.

Additional healthcare measures were directed to case management, which included the development of a series of eligibility criteria for free testing and treatment if required (Nittayasoot et al., 2021). These criteria also determined whether an individual was a primary or secondary contact; the former required testing and self-isolation. A centralised mobile phone application was developed to support the contact tracing system. Everyone was requested to register before entering indoor venues. In addition, the Ministry of Public Health scaled up the capacity of testing and treatment modalities in all hospitals. Certified laboratories for molecular testing increased up to 65% nationwide and were committed to provide results within a day. Staff taking care of critical care patients were deployed in rotations to peripheral hospitals to support the surge capacity.

PHOTO: ATHIT PERAWONGMETHA, WORLD BANK


PHOTO: TRINN SUWANNAPHA, WORLD BANK

Clinical experiences from managing the initial COVID-19 cases from different hospitals were shared as publications (Ratanarat et al., 2020). These included observations and findings in COVID-19 patients at the Hospital for Tropical Diseases, a centre of excellence for the past six decades. Their findings suggested that the early courses of COVID-19 could manifest as an acute undifferentiated febrile illness, increasing the possibility of misdiagnoses as diseases caused by other common circulating viruses such as the dengue viruses (Joob & Wiwanitkit, 2020). Missed detection of COVID-19 increased the risk of nosocomial transmission. Additionally, other endemic pathogens could co-infect individuals with COVID-19 which complicated the course of disease and its outcome (Nasomsong et al., 2020). To negate the nosocomial infections, all febrile patients presenting to the hospitals required screening for COVID-19 and for suspected endemic pathogens based on the clinical findings and judgement of the attending physician. Hospitals were also listed as centres for clinical trials on COVID-19 therapeutics and diagnostics.

The holistic approach and swift actions by the Thai authorities proved effective, with the outbreak controlled during the first wave. By May 2020, the number of cases had significantly reduced and was detected only at the border surveillance systems until the end of the year. Mitigation measures were subsequently relaxed, and businesses were allowed to operate with droplet and contact preventive measures along with physical distancing.

COMMUNITY HEALTH AND SOCIO-ECONOMIC IMPACTS

The immediate positive effects of lockdowns to prevent human movement with masking and hygiene etiquette minimised other viral outbreaks. Diseases caused by influenza viruses, dengue viruses, norovirus, enteroviruses and the chickenpox virus were greatly reduced (Prasertbun et al., 2022; Yorsaeng et al., 2022). Further, the reductions in vehicle movements and restriction on the sale of alcohol contributed to decreased fatalities related to road accidents. In addition, the decreased vehicle movement contributed to less anthropogenic emissions and resulted better air quality and reduced pollution levels compared to previous years (Stratoulias & Nuthammachot 2020).

There was some disruption of routine services in hospitals, and elective procedures were relegated, which delayed diagnoses. Medical waste accumulated rapidly and exceeded the exiting capacity of incineration. Blood shortages occurred across the country as donations declined. Routine free testing and treatment services were temporarily discontinued and not accessible to the vulnerable population (Janyam et al., 2020). However, there were more problematic situations that resulted from the extreme mitigation measures. Mental health issues became more widespread, and increases in suicide rates were alarming (Mongkhon et al., 2021; Srichannil, 2020; Thaweerat et al., 2021).

The Government of Thailand was prompt in launching several social and economic relief packages following lockdown measures to counter the impact of the pandemic. As an economy heavily reliant on tourism and the agricultural sector, the immediate economic impact mirrored the social impact, pushing vulnerable groups into poverty and increasing existing social issues. Domestic and international lockdowns froze economic activities, lowering consumption. The lack of tourism disrupted businesses, increased unemployment, and decreased incomes in the workforce. Thailand's workforce stood at 37.6 million, of which more than half were in the informal sector and not covered under social security schemes. According to UN impact assessment reports, the sectors most affected by COVID-19 included accommodation and food services (2.8 million jobs with 63% informal), wholesale and retail trade (6.2 million jobs with 55% informal), construction (2.2 million jobs with 45% informal), transport, storage and communication (1.5 million jobs with 36% informal), and manufacturing (6.1 million jobs with 21% informal). Women and those from marginalised groups working in high-risk sectors (tourism, retail, accommodation, food, and manufacturing) were most heavily affected.

Agriculture, although the largest employer (11.8 million) with very high informality (92%), was the one sector was minimally impacted by COVID-19. Despite this, effects of the drought did reduce production.

Several stimulus packages were introduced through 2020 and 2021 to mitigate the impacts along with stringent public health measures. These included a total of 1.5 trillion baht (US $44 billion) in financial assistance in three phases for small and medium enterprises, tax relief and cash handouts,

loans, healthcare, economic rehabilitation, business liquidity, and corporate bond liquidity stabilisation. In addition to this, the government introduced an Equitable Education fund of $64 million supporting food for children from low-income families, reduced the rate of contribution to the National Social Security Fund, and reduced the national health premium from $760 to $460. Unemployment benefits were provided to workers covered by the Social Security Fund, along with wage subsidies for micro, small and medium enterprises. They announced universal coverage for emergency health response for all. These measures are in addition to the relief measures provided to the tourism sector and targeted fiscal packages.

The social impacts of the pandemic included increased poverty due to unemployment, reduced incomes, and disrupted social services, which heavily affected those in low-income and marginalised groups. Those most impacted were children, the elderly and those with disabilities or chronic illnesses. Informal sector workers were the most affected as they were not covered by the social security schemes and had fewer resources to mitigate the sudden income losses. The government's fiscal measures provided relief and safety for the poorest households, but poor targeting and registrations limited their reach. While Thailand has well-developed social protection provisions, including several social assistance and social insurance programs, these do not include informal sector workers. The combined effects of income losses and insecurities increased the exposure of children, women, marginal groups and migrant workers to violence and domestic abuse.

SUCCESSIVE WAVES, VACCINE ROLE OUT

Mitigation measures were gradually relaxed following the control of the first two waves due to devastating economic consequences. The third and fourth waves were super-spreading events resulting from people bypassing the border surveillance system (Kunno et al., 2021; Wilasang et al., 2022). Thailand shares multiple land borders with its neighbours, the most extensive border of which is shared with Myanmar, stretching several thousand miles. Although the land borders were closed, the maritime ports were open for shipping. In addition, a large workforce from Myanmar supports the fishing industry in Thailand (Marschke et al., 2020). The outbreak is believed to have been triggered in a region in the Gulf of Thailand where fishing is the leading business, with distribution networks supplying the rest of the country. Migrants also faced economic hardship and were vulnerable during the pandemic (Komin, 2020). Almost all migrant workers have dire living conditions unsuitable for preventing transmission (Kunpeuk et al., 2022). Further, unofficial or undocumented workers were reluctant to seek help fearing deportation or state punishment (Kunpeuk et al., 2022).

The additional mitigation strategy in controlling the successive waves was immunising individuals in regions where cases were escalating. Once vaccines against COVID-19 were globally available, the Thai authorities issued an accelerated review process and approval for emergency use. As a result, millions of doses were procured, and large venues were effectively transformed into vaccination centres. The Thai pharmaceutical industry expedited vaccine manufacture for mass immunisation across Thailand.

Supplementary testing devices were introduced, and screening was routinely performed using rapid test kits (Chaimayo et al., 2020). Gradually, schooling and work re-started with regular testing, universal masking and physical distancing (Muangman et al., 2022). Older school children, university students and academic staff were also vaccinated. Society slowly returned to regular life and was robust through preventive measures. International borders were opened, and commercial flights started operating again. All arrivals into Thailand required mandatory quarantine on disembarkation and only allowed to exit quarantine after a negative test result.

At present, strategies focussing on resilience are much needed. Pandemic preparedness and outbreak response require a combined effort involving multiple government agencies to change the trajectory of pandemic waves and contain outbreaks. These efforts are synergised by civil obedience in Thailand and increased public awareness with society's optimum adherence to disease preventive measures.

REFERENCES

CHIU, N.C., CHI, H., TAI, Y.L., PENG, C.C., TSENG, C.Y., CHEN, C.C., et al. 2020. Impact of wearing masks, hand hygiene, and social distancing on influenza, enterovirus, and all-cause pneumonia during the coronavirus pandemic: Retrospective national epidemiological surveillance study. *J Med Internet Res. 22*.

INTAWONG, K., OLSON, D., & CHARIYALERTSAK, S. 2021. Application technology to fight the COVID-19 pandemic: Lessons learned in Thailand. *Biochem Biophys Res Commun*, 538, 231–7.

ISSAC, A., RADHAKRISHNAN, R.V., VIJAY, V.R., STEPHEN, S., KRISHNAN, N., JACOB, J., JOSE, S., AZHAR, S.M., & NAIR, A.S. 2021. An examination of Thailand's health care system and strategies during the management of the COVID-19 pandemic. *J Glob Health*, 11.

JANYAM, S., PHUENGSAMRAN, D., PANGNONGYANG, J., SARIPRA, W., JITWATTANAPATAYA, L., SONGSAMPHAN, C., BENJARATTANAPORN, P., & GOPINATH, D. 2020. Protecting sex workers in Thailand during the COVID-19 pandemic: Opportunities to build back better. *WHO South East Asia J Public Health*, 9, 100–3.

JOOB, B., & WIWANITKIT, V. 2020. COVID-19 in medical personnel: Observation from Thailand. *J Hosp Infect*, 104, 453.

KRASSANAIRAWIWONG, T., SUVANNIT, C., PONGPIRUL, K., & TUNGSANGA, K. 2021. Roles of subdistrict health office personnel and village health volunteers in Thailand during the COVID-19 pandemic. *BMJ* Case Rep, 14.

KOMIN, W. 2020. Covid-19 and its impact on informal sector workers: A case study of Thailand. *Asia Pacific Journal of Social Work and Development*, 31, 80–8.

KUNNO, J., SUPAWATTANABODEE, B., SUMANASRETHAKUL, C., WIRIYASIVAJ, B., KURATONG, S., & KAEWCHANDEE, C. 2021. Comparison of different waves during the COVID-19 pandemic: Retrospective descriptive study in Thailand. *Adv Prev Med*, 2021.

KUNPEUK, W., JULCHOO, S., PHAIYAROM, M., SINAM, P., PUDPONG, N., LOGANATHAN, T., et al. 2022. Access to healthcare and social protection among migrant workers in Thailand before and during COVID-19 Era: A qualitative study. *Int J Environ Res Public Health*, 19.

MAROME, W., & SHAW, R. 2021. COVID-19 Response in Thailand and its implications on future preparedness. *Int J Environ Res Public Health*, 18.

MARSCHKE, M., VANDERGEEST, P., HAVICE, E., KADFAK, A., DUKER, P., ISOPESCU, I., et al. 2020. COVID-19, instability and migrant fish workers in Asia. *Marit Stud*, 1–13.

MINISTRY OF PUBLIC HEALTH, THAILAND. 2021a. *Department of Disease Control, Thailand*, Online notifications. Available: https://ddc.moph.go.th/en [Accessed April 2022].

MINISTRY OF PUBLIC HEALTH, THAILAND. 2021b. Strategic Plan: Covid-19. Managing the new wave of the Covid-19 epidemic. *Ministry of Public Health, Publication*. Available: https://ddc.moph.go.th/viralpneumonia/eng/file/main/en_Thailand%20Covid-19%20plan_MOPH_2021.pdf [Accessed April 2022].

MONGKHON, P., RUENGORN, C., AWIPHAN, R., THAVORN, K., HUTTON, B., WONGPAKARAN, N., et al. 2021. Exposure to COVID-19-related information and its association with mental health problems in Thailand: Nationwide, Cross-sectional Survey Study. *J Med Internet Res*, 23.

MUANGMAN, S., PIMAINOG, Y., KUNARATNPRUK, S., & KANCHANAPHUM, P. 2022. The prevalence of COVID-19 infection in students and staff at a private university in Thailand by Rapid SARS-CoV-2 Antigen Detection Assay. *J Environ Public Health*, 2022.

MUNGMUNPUNTIPANTIP, R., & WIWANITKIT, V. 2020. Spreading from hot foci of COVID-19 to another country: Observation from Thailand on disease importation by foreigner. *Int J Prev Med*, 11, 49.

NASOMSONG, W., LUVIRA, V., & PHIBOONBANAKIT, D. 2020. Case report: Dengue and COVID-19 coinfection in Thailand. *Am J Trop Med Hyg*, 104, 487–9.

NITTAYASOOT, N., SUPHANCHAIMAT, R., NAMWAT, C., DEJBURUM, P., & TANGCHAROENSATHIEN, V. 2021. Public health policies and health-care workers' response to the COVID-19 pandemic, Thailand. *Bull World Health Organ*, 99, 312–8.

OKADA, P., BUATHONG, R., PHUYGUN, S., THANADACHAKUL, T., PARNMEN, S., WONGBOOT, W., et al. 2020. Early transmission patterns of coronavirus disease 2019 (COVID-19) in travellers from Wuhan to Thailand, January 2020. *Euro Surveill*, 25.

PONGPIRUL, W.A., PONGPIRUL, K., RATNARATHON, A.C., & PRASITHSIRIKUL, W. 2020. Journey of a Thai taxi driver and novel coronavirus. *N Engl J Med*, 38, 1067–8.

PRASERTBUN, R., MORI, H., MAHITTIKORN, A., SIRI, S., & NAITO, T. 2022. Pneumonia, influenza, and dengue cases decreased after the COVID-19 pandemic in Thailand. *Trop Med Health*, 50, 27.

RATANARAT, R., SIVAKORN, C., VIARASILPA, T., & SCHULTZ, M.J. 2020. Critical care management of patients with COVID-19: Early experience in Thailand. *Am J Trop Med Hyg*, 103, 48–54.

SRICHANNIL, C. 2020. The COVID-19 pandemic and Thailand: A psychologist's viewpoint. *Psychol Trauma*, 12, 485–7.

SRISAWAT, N., IAMSIRITHAWORN, S., TANTAWICHIEIN, T., & THISYAKORN, U. 2021. COVID-19: Lessons from Thailand. *Ann Acad Med Singap*, 50, 96–8.

STRATOULIAS, D., & NUTHAMMACHOT, N. 2020. Air quality development during the COVID-19 pandemic over a medium-sized urban area in Thailand. *Sci Total Environ*, 746.

SUMRIDDETCHKAJORN, K., SHIMAZAKI, K., ONO, T., KUSABA, T., SATO, K., & KOBAYASHI, N. 2019. Universal health coverage and primary care, Thailand. *Bull World Health Organ*, 97, 415–22.

THAWEERAT, W., PONGPIRUL, W.A., & PRASITHSIRIKUL, W. 2021. Assessment of anxiety and depression among hospitalized COVID-19 patients in Thailand during the first wave of the pandemic: A cross-sectional study. *Egypt J Neurol Psychiatr Neurosurg*, 57, 106.

TRIUKOSE, S., NITINAWARAT, S., SATIAN, P., SOMBOONSAVATDEE, A., CHOTIKARN, P., THAMMASANYA, T., et al. 2021. Effects of public health interventions on the epidemiological spread during the first wave of the COVID-19 outbreak in Thailand. *PLoS One*, 16.

WACHARAPLUESADEE, S., BUATHONG, R., IAMSIRITHAWON, S., CHAIFOO, W., PONPINIT, T., RUCHISRISAROD, C., et al. 2020. Identification of a novel pathogen using family-wide PCR: Initial confirmation of COVID-19 in Thailand. *Front Public Health*, 8.

WILASANG, C., JITSUK, N. C., SARARAT, C., & MODCHANG, C. 2022. Reconstruction of the transmission dynamics of the first COVID-19 epidemic wave in Thailand. *Sci Rep*, 12, 2002.

YORSAENG, R., SUNTRONWONG, N., THONGPAN, I., CHUCHAONA, W., LESTARI, F. B., PASITTUNGKUL, S., et al. 2022. The impact of COVID-19 and control measures on public health in Thailand, 2020. *PeerJ*, 10.

3

ALLIED HEALTH IMPACTS OF COVID-19

SUMMARY

- Management of COVID-19 placed constraints on the provision of other healthcare services and increased risks to many people with underlying medical conditions during the pandemic.
- Populations exposed to HIV, TB and malaria face a higher risk of COVID-19 complications and comorbidities. The pandemic has resulted in reductions in support for these diseases with a disproportionate impact on people living in poverty-stricken regions.
- Increased pressures on public health systems from COVID-19 resulted in an additional 4 million children missing out on basic immunisations in 2020.
- The combination of stresses from social distancing, lockdowns and loss of employment has led to a decline in mental wellbeing, with community-based cultures experiencing greater impacts. Many low-income tropical communities have reported an associated increase in domestic violence.
- Extreme weather posed challenges for COVID-19 management in some tropical settings. Climate change heightens these challenges and will make responses to these crises even more difficult.

PHOTO: TOBIN JONES, UN

INTRODUCTION

Like most other aspects of the response to the COVID-19 pandemic, public health measures were beset with compromise. Medical resources were diverted away from routine health treatments to the more immediate demands of pandemic response. Manufacturing capacity and supply chains were re-directed to medical equipment, medicines and ultimately vaccines of the greatest benefit to preventing and managing COVID infections. At the same time, manufacturing and transport capabilities were being constrained by widespread disease transmission and lockdowns. At the peak of the pandemic, hospitals, doctors, nurses and medical support staff at all levels were increasingly overwhelmed by exponentially rising case numbers, intensive treatment burdens and the constant emotional drain, all the while needing to protect their own lives and patients and families from infection. For a time, hospitals became centres of transmission even as they served as the primary bulwark against the loss of life from the pandemic. This added a further load on medical systems as health personnel succumbed to illness and were forced to isolate. Wider isolation orders and lockdowns greatly reduced the community transmission of COVID-19 but also reduced access to healthcare services.

This chapter explores how the response to COVID-19 has impacted other primary healthcare in the Tropics. In particular, it will consider the impacts of COVID-19 on the management of diseases that are more prevalent in tropical regions than in the rest of the world: TB, HIV/AIDS and malaria. It will also examine the effects of lockdowns and isolation on mental health and other measures of societal wellbeing.

GENERAL HEALTHCARE

The COVID-19 pandemic caused widespread disruption to public health services across the world, including overwhelming demand on medical facilities and a slowing in supplies of medicines (Hogan et al., 2020). These impacts were exacerbated by the pressures placed on healthcare workers. Lack of governmental support, inadequate training and PPE, social stigmatisation, 'burnout' and other feelings of fear and guilt were common themes expressed by workers in most healthcare settings during the pandemic (Chemali et al., 2022). Negative outcomes were greatest in studies of nurses, including reports of unusually strict social standards directed solely at them and judgements that some nursing roles were less worthy of societal respect (Chemali et al., 2022). In some settings, these negative outcomes escalated to death threats (Fox & Faa, 2021).

The healthcare workforce is one of the primary building blocks of an effective health system and is key to system resilience (Chemali et al., 2022). Pressures on the workforce impact the integrity of the whole healthcare system. Most studies of the COVID-19 pandemic's effects on healthcare workers address outcomes in higher income countries where resourcing and post-pandemic resilience is likely to be strongest. Pandemic pressures in low- to middle-income settings highlighted greater fragility in many services. Pre-existing grievances in Kenya and Zimbabwe led to healthcare strikes during the pandemic over the lack of PPE and remuneration (Thekkur et al., 2021a; Mbithi et al., 2021). Locums brought in to address worker shortages in Zimbabwe were not familiar with the record-keeping and reporting requirements of wider healthcare programs (Thekkur et al., 2021a). Workers in India, Ecuador, Pakistan and Zimbabwe reported worsening infrastructure conditions characterised by poor water supply and ventilation and a lack of support facilities for staff (Chemali et al., 2022). The long-term consequences of the pandemic on the retention of healthcare workforces in the Tropics remain to be seen.

The imposition of community lockdowns to reduce the transmission of COVID-19, redirection of front-line healthcare workers to care for COVID-19 patients and prioritising the development and delivery of COVID-19 vaccines also placed constraints on the provision of other healthcare services. Reduced public transport, shortened opening hours, long queues at health service facilities, and temporary suspensions of some health services all contributed to declines in treatment potential (e.g., Thekkur et al., 2021a). As with many other indirect aspects of COVID-19, these factors disproportionally affected low-income communities where access to resources is already constrained. 'Tele-health' services were able to fill some of this treatment void even in relatively poor areas of East Africa (Eribake & Ring, 2021). However, these approaches remain dependent on investment in digital infrastructure and a reduction in the digital divide between rich and poor nations (State of the Tropics, 2021).

MANAGEMENT OF TROPICAL DISEASES

The disruptions caused by the COVID-19 pandemic are threatening research and progress on the management of other infectious diseases, including TB, HIV, malaria and neglected tropical diseases such as dengue fever and leprosy (Nargesi et al., 2021). These disease groups disproportionately impact people living in poverty-stricken regions (WHO, 2020). Researchers have predicted that increased death rates will follow these impediments, with related HIV deaths increasing by up to 10%, TB deaths by 20% and malaria by 36% compared with pre-pandemic levels (Hogan et al., 2020). These effects are likely to be compounded by high health system demand, weakened health care services and reduced likelihood of timely diagnosis and treatment, as well as reductions in planned management campaigns.

During the pandemic, many of the health services addressing TB were affected by the reallocation of resources to COVID-19 priorities (Fukunaga et al., 2019; McQuaid et al., 2021; Teo et al., 2021). While in lockdown, many countries also saw a significant drop in those coming in for treatment (Saunders & Evans, 2020). According to the WHO Global TB report (2021), around half of the people with TB either missed out on access to health care or were not included in the 2020 reporting. The most obvious impact was an 18% drop in the reported number of newly diagnosed cases from 7.1 million in 2019 to 5.8 million in 2020. Countries in tropical regions were the worst affected by these issues, particularly India, Indonesia and the Philippines (Arentz et al., 2022; WHO, 2021a).

Globally, the number of individuals who obtained treatment also dropped significantly from 3.6 to 2.8 million (21%). Reduced diagnosis and treatment resulted in an increase in TB deaths from around 1.2 million in 2019 to 1.3 million in 2020 (WHO, 2021a). Similar findings were reported in numerous countries, including Brazil, where the Ministry of Health recently reported an increased number of deaths and TB treatment dropouts (Maia et al., 2022). In Malawi, TB treatments decreased by 19% (Thekkur et al., 2021b). The COVID-19 pandemic has reversed years of progress in providing TB services and reducing the impact of the disease. Actions to mitigate this reversal are urgently required, particularly in the worst-affected tropical nations. Researchers have suggested that similar support and safety net programs to those implemented during the COVID-19 pandemic should be emulated for TB-affected communities to increase healthcare availability and reduce the significant impacts of the disease (Teo et al., 2021). As Director-General of the WHO, Dr Tedros Adhanom Ghebreyesus stated on 16th June 2021:

> *"Ending this debilitating disease remains a priority for WHO, and in recent years, we have made encouraging progress globally. …. But the COVID-19 pandemic has put these gains at risk. Not only does the virus pose an increased risk to people with TB, it has also caused severe disruption to services….*

PHOTO: DOMINIC CHAVEZ, WORLD BANK

> *With solidarity, determination and the equitable use of tools, we will defeat COVID-19. … And with the same solidarity, determination and equitable use of tools, we can end TB."*
> *Global drive to scale up TB prevention, 16th June 2021.*

The effects of the pandemic on the treatment and diagnosis of TB were replicated for HIV/AIDS. The WHO reported in 2020 that progress towards global HIV targets was stalling, and testing and prevention measures were not reaching the groups that needed them most. An estimated 8.3 million people across 24 nations were affected by interruptions to antiretroviral therapies (ARV) in 2020 due to the shutdown of transport services, drug shortages and health service disruptions (Chaib & Seale, 2020; WHO, 2020). Of the nine countries that reported ARV supply disruptions in 2021, seven of them were tropical nations (WHO, 2021b; Bertagnolio et al., 2021).

Other direct and indirect impacts are evident in the Tropics. In Malawi, there was a 39% decrease in the number of patients tested for HIV during the COVD-19 pandemic (Thekkur et al., 2021b). This suggests that there may be an increasing burden of undiagnosed cases in the community. In Uganda, maternal mortality rose by 82% during the pandemic, which researchers have attributed to the combined effects of COVID-19 and the HIV/AIDS burden (Bell et al., 2020). Separate research found that the risk of developing severe-to-fatal COVID-19 was 30% higher for people with HIV than people without (WHO, 2021d).

Collectively, these outcomes describe a shift in focus, where the overwhelming (global) challenge has obscured other more localised threats. For many at risk from HIV/AIDS, this represented an 'out of the frying pan and into the fire' scenario. In 2021, the WHO (2021c) called on countries to redouble their efforts to address global targets set by UNAIDS and prevent a rising wave of new HIV infections caused by HIV service disruptions during the pandemic.

Malaria rates also increased markedly during the COVID-19 pandemic (Weiss et al., 2021). It is estimated that there were an additional 14 million cases of malaria in 2020 compared with 2019 (WHO, 2021d). Most of this increase was in Africa. There were also an estimated 69,000 more deaths from malaria in 2020, with over 65% of those linked to disruptions in medical provisions and interventions due to the pandemic. Funding for control programs has been severely reduced, including government investment in mosquito nets and antimalarial drugs (Nakweya, 2022).

Much of the funding for tropical disease research and management is provided as foreign aid by richer nations where these diseases are not a direct concern. Coupled with highly focussed global attention on the origin and management of zoonotic pandemics, this has obvious implications for aid priorities and budgets. Regardless, the response to COVID-19 in wealthier nations has also demonstrated the benefits of fast and targeted action on effective disease containment and control. This sets a clear precedent for similar global attention to be focussed on the battle against tropical diseases.

While the overall trends in the management of TB, HIV/AIDS and malaria during the pandemic have largely been negative, it is important to understand that there have also been success stories highlighting the resilience of local health systems. COVID-19 initially caused some disruption to HIV services in Zambia, but the Ministry of Health managed to maintain sufficient testing and treatment capabilities to reach target goals in 2020 (WHO, 2021e). Similarly, despite initial declines in the early stages of the pandemic, recovery of HIV programs was swift and sustained in 11 sub-Saharan African countries, including Angola, Burundi, Cameroon, Côte d'Ivoire, the Democratic Republic of the Congo, Eswatini, Ethiopia, Kenya, Mozambique, South Sudan and Zambia (Harris et al., 2021).

CHILDHOOD IMMUNISATION

Pressures on public health systems during the pandemic have had flow-on impacts on childhood health. It is estimated that 23 million children missed out on the most basic immunisations against diphtheria, tetanus and pertussis (DTP) in 2020 (WHO, 2021f). This represents an increase of nearly four million from 2019. Around 17 million children received no protection at all, with an additional 5.6 million only receiving partial doses. Ten countries accounted for 62% of these un- or under-vaccinated children, including nine countries in the Tropics (WUENIC, 2020).

It is estimated that routine childhood immunisation currently prevents 3.5 to 5 million deaths a year and is one of the most effective health investments available (WHO, 2021g). Reductions in the delivery of these vaccines ultimately add a greater future burden on healthcare resources.

MENTAL HEALTH AND SUICIDE

COVID-19 lockdowns had substantial effects on mental health throughout the world. Factors such as unemployment, social isolation and financial insecurity led to an unprecedented drop in public mental wellbeing (OECD, 2021). Across the globe, mental health outcomes were worse for unemployed people than for those who remained at work during the pandemic (OECD, 2021). COVID-related suicides were most closely related to low-income rural areas (Goyal et al., 2020; Mamun

PHOTO: MASARU GOTO, WORLD BANK

& Griffiths, 2020) and healthcare workers (Gunnell et al., 2020; Reger et al., 2020). While many richer nations were able to provide additional governmental support and scaled-up mental health services, other, less wealthy nations suffered. Citizens of tropical regions were often impacted disproportionately due to fewer support mechanisms and the diversion of scarce health resources to the direct pandemic response.

Many tropical communities with very cohesive cultures were more heavily impacted by social distancing and isolation requirements than modern Western societies. In tight-knit communities, physical isolation can feel like one is being socially ostracised, increasing feelings of depression, loneliness and distress. A stigma also still exists around mental health in many settings. For example, in Kiribati, a Pacific Island nation, citizens believe that mental health is a spiritual issue that requires treatment with magic (Universal Health Coverage Partnership, 2022). In Indonesia, where mental health is still a relatively taboo subject, citizens have very limited access to mental health services and facilities in the community (Anindyajati et al., 2022). Despite these taboos, there has been increased identification and acknowledgement of declines in mental wellbeing during the pandemic. Medical staff are being trained in self-care to avoid burnout, and more people are seeking the treatment they require (Universal Health Coverage Partnership, 2022).

Studies during the first year of the COVID-19 pandemic found either a modest reduction or no change in suicide rates (Tandon, 2021). A global decline in suicide during the pandemic is not necessarily surprising, as a similar phenomenon has been observed with other crises, including terrorist attacks and wars (Claassen et al., 2010; Salib & Cortina-Borja, 2009; Thomas & Gunnell, 2010). In fact, external, catastrophic threats to the human population have been reported to increase social cohesion. This is referred to by some researchers as a 'honeymoon period' or a 'pulling together' phenomenon (John et al., 2020). However, pandemics and other catastrophes have also been linked with increased suicide rates in the aftermath of the event (Wasserman et al., 2020). Further, COVID-19 lockdowns saw an increased reliance on technology in many workplaces, which prevailed even after lockdown measures were lifted. Psychological researchers suggest that the more we lean into technology, the less we engage in relationships that aid mental support (Serenc, 2022).

To date, most studies of COVID-19-related suicide focus on high-income countries, and suicide rates in many developing nations have not been investigated, or relevant data is lacking (Acharya et al., 2022). Suicide rates in Nepal increased among both males and females during the pandemic, with the greatest increases during the initial period of steeply rising caseload and the associated intensive media coverage (Acharya et al., 2022). The increased rate of female suicides was sustained for longer, consistent with other reports of a gender differential in response to traumatic exposure. Another study of COVID-related suicides in India found that most suicides were male, with the social stigma of catching the disease and financial crises precipitated by COVID-19 being the leading causes of suicide during the pandemic (Dsouza et al., 2020).

Uncertainty around the mental illness and suicide burden caused by COVID-19 in many tropical nations suggests that further measures are warranted to address mental health risks in this region. Such measures will need to be sensitive to the contextual relationships between mental health, pandemic-related trauma and cultural, technological and media environments.

DOMESTIC VIOLENCE

It is recognised that environmental disasters, social unrest and other drivers of economic uncertainty can lead to increased violence against women and children (Campbell, 2020; Peterman et al., 2020; Usher et al., 2020; Usta et al., 2021). This link is also associated with mental wellbeing (Wasserman et al., 2020). A UN Women's study on domestic violence during the COVID-19 pandemic conducted surveys in 13 countries, including the tropical nations of Cameroon, Colombia, Côte d'Ivoire, Kenya, Nigeria and Thailand. Researchers found that since COVID-19 emerged, 45% of women reported that they or a woman they know had experienced some form of violence (United Nations, 2021). Of those who reported feeling unsafe at home during the pandemic, a majority (56%) were likely to be food-insecure, and almost half (48%) were women aged below 49 (United Nations, 2021).

Lockdowns have contributed to increased isolation and decreased access to social support, with some researchers referring to the combined impacts of COVID-19 and domestic violence as a 'syndemic' (Hall & Tucker, 2020). With reduced funding available to law enforcement and local women's organisations during the pandemic, there were also fewer support mechanisms available (United Nations, 2021). Similar trends have been observed in previous pandemics, such as the Ebola outbreak in West Africa in 2014–2016 and the Zika virus epidemic in Central America in 2015–2016 (Cepeda et al., 2016; International Rescue Committee, 2019).

Ultimately, researchers warn that the social impacts of disease pandemics are not gender neutral and disproportionately affect women and girls (Meinhart et al., 2021). Effective public health policies need to acknowledge this intersection between infectious disease outcomes and gender inequality. Indeed, there is a great need for scientifically-informed policies that recognise the various contextual and nuanced social contributors to health outcomes.

SYNERGISTIC EFFECTS OF THE PANDEMIC AND CONCURRENT NATURAL DISASTERS

In parts of the Tropics, COVID-19 control measures had to be set aside in the midst of the pandemic due to extreme weather events. In Vanuatu, social distancing measures were relaxed when people had to crowd into evacuation centres to take refuge from the Category 5 storm, Cyclone Harold (McAdam, 2020). The storm damaged 90% of homes and left 100,000 people living in temporary shelters (SBS News, 2020). Similarly, an earthquake and flash flooding in Haiti added another major burden to the already strained health care system in the impoverished country. The 7.2-magnitude earthquake, combined with landslides and flash flooding, killed over 2,000 people and injured another 13,000 (Crickx, 2021). Some 82 health facilities were damaged or destroyed, leaving hospitals extremely overcrowded and with few resources for protection and treatment against COVID-19 (Crickx, 2021). Around 140,000 homes were also destroyed, putting thousands more people in need of shelter (Crickx, 2021).

PHOTO: AUSTRALIAN EMBASSY

Border closures and strict quarantine measures hampered the delivery of emergency aid during these natural disasters. The geographical logistics of many tropical island nations mean that the provision of medical care is already challenging, with COVID-19 restrictions adding an extra layer of complication (McAdam, 2020). Despite the damage wrought by Cyclone Harold, Vanuatu maintained strict travel restrictions to prevent COVID-19 from reaching its islands and overwhelming the weak medical infrastructure. This made it very challenging for foreign humanitarian aid to be delivered to the one-third of Vanuatu's population in need of assistance after the cyclone (Gunia, 2020; Walden & Graue, 2020).

The combination of extreme weather and infectious disease can seed a major catastrophe. When infrastructure is badly damaged, and water supplies and sanitation are compromised, it becomes increasingly difficult to stop the spread of diseases. Climate change, in this context, presents as a 'threat multiplier': heightening existing challenges and making responses to these sorts of crises ever more difficult (McAdam, 2020). As the Secretary-General of the Pacific Islands Forum, Dame Meg Taylor, said:

> *"The COVID-19 public health emergency and its ensuing humanitarian and economic fallout offers us a glimpse of what the global climate change emergency can become – if it is left unchecked and if we do not act now."*
> The Interpreter, 27th October 2020.

THE TROPICAL PERSPECTIVE

Wealthier nations faced with an existential threat are able to call upon excess resources to confront that threat, often with minimal consequences for service provision or personal freedoms. Indeed, many of their citizens regularly place personal freedoms ahead of communal advantages. This option is rarely open to poorer, resource-limited societies that must always balance competing demands. Invariably, this involves compromise and diversion of scarce resources from one sector to another.

The attention focussed on the management of the COVID-19 pandemic presented clear challenges for healthcare services and healthcare workers across the world. A compromise was necessary for all settings, with unprecedented lockdowns, border closures and other restrictions imposed in most countries. However, the full burden of these compromises was not shared equally. Many tropical nations experienced significant reversals in control of TB, HIV/AIDS and malaria. Childhood immunisations also decreased in the Tropics, while mental health issues, domestic violence and gender inequality increased. Collectively, these placed additional stresses on already-stretched healthcare resources and risk embedding a cycle of decline in health outcomes if trends are not reversed.

LOOKING FORWARD

The key short-term objective for tropical nations will be to arrest declines in case detection and treatment for TB, HIV/AIDS and malaria. Many mechanisms have already been identified that can support this process, including increased surveillance frequency, particularly at sentinel sites; integrating control programmes for COVID-19 and other diseases; shared screening processes, testing algorithms and diagnostic tools; provision of additional health information and mobilising community support networks (Thekkur et al., 2021a). The best combination of approaches will vary between communities and require culturally sensitive approaches feeding into integrated data collection and reporting systems.

Greater use of digital platforms has been recommended as a way forward for case finding, medical advice, drug adherence, management of adverse drug reactions and training. Development of HIV self-testing and home-based HIV testing services have allowed HIV testing numbers to rebound in some other African countries. This needs to continue while concurrently ensuring that numbers and results are recorded and reported (Thekkur et al., 2021b).

REFERENCES

ACHARYA, B., SUBEDI, K., ACHARYA, P., & GHIMIRE, S. 2022. Association between COVID-19 pandemic and the suicide rates in Nepal. *PLoS ONE*, 17(1), e0262958.

ANINDYAJATI, G., MARDIASMO, D. R., SEKARASIH, L., SUSILARADEYA, D., TAKWIN, B., PELUPESSY, D.C., & DIATRI, H. 2022. The right to health: COVID-19 Pandemic and the opportunity to transform mental health inequalities in Indonesia. *Frontiers in Public Health*, 10.

ARENTZ, M., MA, J., ZHENG, P., VOS, T., MURRAY, C.J.L., & KYU, H.H. 2022. The impact of the COVID-19 pandemic and associated suppression measures on the burden of tuberculosis in India. *BMC Infectious Diseases*, 22(1).

BELL, D., HANSEN, K.S., KIRAGGA, A.N., KAMBUGU, A., KISSA, J., & MBONYE, A.K. 2020. Predicting the impact of COVID-19 and the potential impact of the public health response on disease burden in Uganda. *American Journal of Tropical Medicine and Hygiene*, 103(3), 1191–1197.

BERTAGNOLIO, S. THWIN, J.J., SILVA, R., FORD, N., BAGGALEY, R., VITORIA, M., JASSAT. W., & DIAZ. J. 2021. Clinical characteristics and prognostic factors in people living with HIV hospitalized with COVID-19: Findings from the WHO Global Clinical Platform. *IAS 2021 – the 11th IAS Conference on HIV Science, Conference presentation.* Available: https://theprogramme.ias2021.org/PAGMaterial/PPT/3307_4871/IAS_2021_e_poster_3.pdf [Accessed April 2022].

CAMPBELL, A.M. 2020. An increasing risk of family violence during the Covid-19 pandemic: Strengthening community collaborations to save lives. *Forensic Science International: Reports*, 2, 100089.

CEPEDA, Z., ARENAS, C., VILARDO, V., HILTON, E., DICO-YOUNG, T., GREEN, C., & ÖZERDEM, A. 2016. Dominican Republic gender analysis: A study of the impact of the Zika virus on women, girls, boys and men. *Oxfam Policy & Practice, Research report*. Available: https://policy-practice.oxfam.org/resources/dominican-republic-gender-analysis-a-study-of-the-impact-of-the-zika-virus-on-w-620261 [Accessed April 2022].

CHAIB, F., & SEALE, A. 2020. WHO: Access to HIV medicines severely impacted by COVID-19 as AIDS response stalls. World Health Organization, News release. Available: https://www.who.int/news/item/06-07-2020-who-access-to-hiv-medicines-severely-impacted-by-covid-19-as-aids-response-stalls [Accessed April 2022].

CHEMALI, S., MARI-SÁEZ, A., EL BCHERAOUI, C., & WEISHAAR, H. 2022. Health care workers' experiences during the COVID-19 pandemic: A scoping review. Human Resources for Health, 20(27).

CLAASSEN, C.A., CARMODY, T., STEWART, S.M., BOSSARTE, R.M., LARKIN, G.L., WOODWARD, W.A., & TRIVEDI, M.H. 2010. Effect of 11 September 2001 terrorist attacks in the USA on suicide in areas surrounding the crash sites. British Journal of Psychiatry, 196(5), 359–364.

CRICKX, J. 2021. Securing health in Haiti when the earthquake ruined hospitals. UNICEF, Article. Available: https://www.unicef.org/lac/en/stories/securing-health-haiti-when-earthquake-ruined-hospitals [Accessed April 2022].

DSOUZA, D. D., QUADROS, S., HYDERABADWALA, Z. J., & MAMUN, M. A. 2020. Aggregated COVID-19 suicide incidences in India: Fear of COVID-19 infection is the prominent causative factor. Psychiatry Research, 290(2020), 113145.

ERIBAKE, A., & RING, S. (2021). Covid-induced telehealth boom in East Africa is picking up pace. Bloomberg [Online news service]. Available: https://www.bloomberg.com/news/articles/2021-08-20/covid-induced-telehealth-boom-in-east-africa-is-picking-up-pace [Accessed May 2022].

FOX, L., & FAA, M. 2021. Health workers face death threats as COVID-19 vaccine hesitancy takes hold in PNG. ABC News [Online news service]. Available: https://www.abc.net.au/news/2021-09-10/png-vaccine-hesitancy-papua-new-guinea-covid-19/100444380 [Accessed April 2022].

FUKUNAGA, R., GLAZIOU, P., HARRIS, J.B., DATE, A., FLOYD, K., & KASAEVA, T. 2019. Epidemiology of tuberculosis and progress toward meeting global targets - worldwide, 2019. *Centers for Disease Control and Prevention, Morbidity and Mortality Weekly Report*, 26 March 2021, 70(12).

GOYAL, K., CHAUHAN, P., CHHIKARA, K., GUPTA, P., & SINGH, M.P. 2020. Fear of COVID 2019: First suicidal case in India! *Asian Journal of Psychiatry*, 49(2020), 101989.

GUNIA, A. 2020. This tiny nation has zero coronavirus cases. After a devastating cyclone, it's refusing foreign aid workers to keep it that way. Time [Online magazine]. Available: https://time.com/5820382/coronavirus-cyclone-harold-vanuatu [Accessed April 2022].

GUNNELL, D., APPLEBY, L., ARENSMAN, E., HAWTON, K., JOHN, A., KAPUR, N., KHAN, M., O'CONNOR, R.C., PIRKIS, J., CAINE, E.D., CHAN, L.F., CHANG, S. SEN, CHEN, Y.Y., CHRISTENSEN, H., DANDONA, R., EDDLESTON, M., ERLANGSEN, A., HARKAVY-FRIEDMAN, J., KIRTLEY, O.J., … YIP, P.S. 2020. Suicide risk and prevention during the COVID-19 pandemic. *The Lancet Psychiatry*, 7, June 2020.

HALL, B.J., & TUCKER, J.D. 2020. Surviving in place: The coronavirus domestic violence syndemic. *Asian Journal of Psychiatry*, 53 (2020) 102179.

HARRIS, T.G., JASZI,E., LAMB, M.R., LAUDARI, C.A., FURTADO, M.L.M., NIJIRAZANA, B., AIMÉ, N., LONI EKALI, G., EBIAMA LIFANDA, L., BROU, H., EHUI, E., MALELE BAZOLA, F., MBOYO, A., SAHABO, R., ADVOCATE DLAMINI, N., MELAKU, Z., GETACHEW MESELU, M., HAWKEN, M., NGUGI, C., … EL-SADR, W.M. 2021. Effects of the coronavirus disease 2019 pandemic on human immunodeficiency virus services: Findings from 11 Sub-Saharan African countries. *Clinical Infectious Diseases*.

HOGAN, A.B., JEWELL, B., SHERRARD-SMITH, E., VESGA, J., WATSON, O.J., WHITTAKER, C., HAMLET, A., SMITH, J., AINSLIE, K., BAGUELIN, M., BHATT, S., BOONYASIRI, A., BRAZEAU, N.F., CATTARINO, L., CHARLES, G., COOPER, L.V, COUPLAND, H., CUOMO-DANNENBURG, G., DIGHE, A., … HALLETT, T.B. 2020. Report 19: The potential impact of the COVID-19 epidemic on HIV, TB and malaria in low- and middle-income countries. *Imperial College COVID-19 response team*.

INTERNATIONAL RESCUE COMMITTEE. 2019. Everything on her shoulders: Rapid assessment on gender and violence against women and girls in the Ebola outbreak in Beni, DRC. *International Rescue Committee*, Report. Available: https://www.rescue.org/report/everything-her-shoulders-rapid-assessment-gender-and-violence-against-women-and-girls-ebola [Accessed April 2022].

JOHN, A., PIRKIS, J., GUNNELL, D., APPLEBY, L., & MORRISSEY, J. 2020. Trends in suicide during the COVID-19 pandemic. The British Medical Journal, 371, m4352.

MAIA, C.M.F., MARTELLI, D.R.B., SILVEIRA, D.M.M.L.D.A., OLIVEIRA, E.A., & JÚNIOR, H.M. 2022. Tuberculosis in Brazil: The impact of the COVID-19 pandemic. *Brazilian Journal of Pulmonology*, 48(2), e20220082.

MAMUN, M.A., & GRIFFITHS, M.D. 2020. First COVID-19 suicide case in Bangladesh due to fear of COVID-19 and xenophobia: Possible suicide prevention strategies. *Asian Journal of Psychiatry*, 51.

MBITHI, I., THEKKUR, T., CHAKAYA, J.M., ONYANGO, E., OWITI, P., NJERI, N.C., KUMAR, A.M.V., SATYANARAYANA, S., SHEWADE, H.D., KHOGALI, M., ZACHARIAH, R., RUSEN, I.D., BERGER, S.D., & HARRIES, A.D. 2021. Assessing the real-time impact of COVID-19 on TB and HIV services: The experience and response from selected health facilities in Nairobi, Kenya. *Tropical Medicine and Infectious Disease*, 2021, 6, 74.

MCADAM, J. 2020. The twin calamities of climate change and COVID-19. Kaldor Centre for International Refugee Law, UNSW Sydney, Editorial. Available: https://www.kaldorcentre.unsw.edu.au/publication/twin-calamities-climate-change-and-covid-19 [Accessed April 2022].
MCADAM, J., & PRYKE, J. 2020. Preparing for when climate change drives people from their homes. *The Interpreter*, Lowy Institute. Available: https://www.lowyinstitute.org/the-interpreter/preparing-when-climate-change-drives-people-their-homes [Accessed April 2022].

MCQUAID, C.F., VASSALL, A., COHEN, T., FIEKERT, K., & WHITE, R.G. 2021. The impact of COVID-19 on TB: A review of the data. International *Journal of Tuberculosis and Lung Disease*, 25(6), 436–446.

MEINHART, M., VAHEDI, L., CARTER, S.E., POULTON, C., MWANZE PALAKU, P., & STARK, L. 2021. Gender-based violence and infectious disease in humanitarian settings: Lessons learned from Ebola, Zika, and COVID-19 to inform syndemic policy making. *Conflict and Health*, 15(1).

NAKWEYA, G. 2022. COVID-19 and climate change hit malaria response. Nature Africa, Article. Available: https://www.nature.com/articles/d44148-022-00038-3 [Accessed April 2022].

NARGESI, S., BONGOMIN, F., & HEDAYATI, M.T. 2021. The impact of COVID-19 pandemic on AIDS-related mycoses and fungal neglected tropical diseases: Why should we worry? *PLOS Neglected Tropical Diseases*, 15(2), e0009092-.

OECD. 2021. Tackling the mental health impact of the COVID-19 crisis: An integrated, whole-of-society response. Publication. Available: https://read.oecd-ilibrary.org/view/?ref=1094_1094455-bukuf1f0cm&title=Tackling-the-mental-health-impact-of-the-COVID-19-crisis-An-integrated-whole-of-society-response [Accessed April 2022].

PETERMAN, A., POTTS, A., O'DONNELL, M., THOMPSON, K., SHAH, N., OERTELT-PRIGIONE, S., & VAN GELDER, N. 2020. Pandemics and violence against women and children. *Centre for Global Development*, Working Paper 528, April 2020.

REGER, M.A., STANLEY, I.H., & JOINER, T.E. 2020. Suicide mortality and coronavirus disease 2019-a perfect storm? *JAMA Psychiatry*, 77(11), 1093–1094.

SALIB, E., & CORTINA-BORJA, M. 2009. Effect of 7 July 2005 terrorist attacks in London on suicide in England and Wales. *British Journal of Psychiatry*, 194(1), 80–85.

SAUNDERS, M.J., & EVANS, C.A. 2020. COVID-19, tuberculosis and poverty: Preventing a perfect storm. *European Respiratory Journal*, 56, 2001348.

STATE OF THE TROPICS. 2021. *The Digital Divide in the Tropics*. Townsville, Australia, James Cook University.

SBS NEWS. 2020. Tropical Cyclone Harold-hit Vanuatu still unable to get enough aid because of coronavirus restrictions. *SBS News* [Online news service]. Available: https://www.sbs.com.au/news/article/tropical-cyclone-harold-hit-vanuatu-still-unable-to-get-enough-aid-because-of-coronavirus-restrictions/sod6gow3h [Accessed April 2022].

SERENC, M. 2022. Confronting pre-COVID mental health demons. James Cook University, News release. Available: https://www.jcu.edu.au/news/releases/2022/april/confronting-pre-covid-mental-health-demons [Accessed April 2022].

TANDON, R. 2021. COVID-19 and suicide: Just the facts. Key learnings and guidance for action. *Asian Journal of Psychiatry*, 60 (2021) 102695.

TEO, A.K. J., ONG, C.W.M., & HSU, L.Y. 2021. COVID-19 and TB: A progression-regression conundrum. *International Journal of Tuberculosis and Lung Disease*, 25(6), 421–423.

THEKKUR, T., TAKARINDA, K.C., TIMIRE, C., SANDY, C., APOLLO, T., KUMAR, A.M.V., SATYANARAYANA, S., SHEWADE, H.D., KHOGALI, M., ZACHARIAH, R., RUSEN, I.D., BERGER, S.D., & HARRIES, A.D. 2021a. Operational research to assess the real-time impact of COVID-19 on TB and HIV services: The experience and response from health facilities in Harare, Zimbabwe. *Tropical Medicine and Infectious Disease*, 6, 94.

THEKKUR, T., TWEYA, H., PHIRI, S., MPUNGA, J., KALAU, T., KUMAR, A.M.V., SATYANARAYANA, S., SHEWADE, H.D., KHOGALI, M., ZACHARIAH, R., RUSEN, I.D., BERGER, S.D., & HARRIES, A.D. 2021b. Assessing the impact of COVID-19 on TB and HIV programme services in selected health facilities in Lilongwe, Malawi: Operational research in real time. *Tropical Medicine and Infectious Disease*, 6, 81.

THOMAS, K., & GUNNELL, D. 2010. Suicide in England and Wales 1861-2007: A time-trends analysis. *International Journal of Epidemiology*, 39(6), 1464–1475.

UNITED NATIONS. 2021. Measuring the shadow pandemic: Violence against women during COVID-19. *United Nations Women*, Publication. Available: https://data.unwomen.org/sites/default/files/documents/Publications/Measuring-shadow-pandemic.pdf [Accessed April 2022].

UNIVERSAL HEALTH COVERAGE PARTNERSHIP. 2022. Stories from the field: Special series on the COVID-19 response - Pacific island countries. *Universal Health Coverage Partnership*, Online story. Available: https://www.uhcpartnership.net/story-pics-kiribati [Accessed April 2022].

USHER, K., BHULLAR, N., DURKIN, J., GYAMFI, N., & JACKSON, D. 2020. Family violence and COVID-19: Increased vulnerability and reduced options for support. *International Journal of Mental Health Nursing*.10.1111/inm.12735.

USTA, J., MURR, H., & EL-JARRAH, R. 2021. COVID-19 Lockdown and the increased violence against women: Understanding domestic violence during a pandemic. *Violence and Gender*, 8(3), 2021.

WALDEN, M., & GRAUE, C. 2020. Australian aid to help Cyclone Harold relief efforts as COVID-19 frustrates response. ABC News, Online news story. Available: https://www.abc.net.au/news/2020-04-10/adf-plane-to-deliver-relief-to-vanuatu-after-cyclone-harold/12140456 [Accessed April 2022].

WASSERMAN, D., IOSUE, M., WUESTEFELD, A., & CARLI, V. 2020. Adaptation of evidence-based suicide prevention strategies during and after the COVID-19 pandemic. *World Psychiatry*, 19(3), 294–306.

WEISS, D.J., BERTOZZI-VILLA, A., RUMISHA, S.F., AMRATIA, P., ARAMBEPOLA, R., BATTLE, K.E., CAMERON, E., CHESTNUTT, E., GIBSON, H.S., HARRIS, J., KEDDIE, S., MILLAR, J.J., ROZIER, J., SYMONS, T.L., VARGAS-RUIZ, C., HAY, S. I., SMITH, D.L., ALONSO, P.L., NOOR, A.M., … GETHING, P.W. 2021. Indirect effects of the COVID-19 pandemic on malaria intervention coverage, morbidity, and mortality in Africa: A geospatial modelling analysis. *The Lancet Infectious Diseases*, 21(1), 59–69.

WHO. 2020. WHO: access to HIV medicines severely impacted by COVID-19 as AIDS response stalls. World Health Organization, Online news release. Available: https://www.who.int/news/item/06-07-2020-who-access-to-hiv-medicines-severely-impacted-by-covid-19-as-aids-response-stalls [Accessed April 2022].

WHO. 2021a. Global Tuberculosis Report 2021. *World Health Organization*.

WHO. 2021b. Countries reporting on ARV disruptions due to COVID-19, March 2021. *World Health Organization*, Data map. Available: https://www.who.int/images/default-source/departments/hiv/countries-reporting-on-arv-disruptions-due-to-covid-19-november-2020.png?sfvrsn=d45dbe01_15 [Accessed April 2022].

WHO. 2021c. WHO warns that HIV infection increases risk of severe and critical COVID-19. *World Health Organization*, Online news release. Available: https://www.who.int/news/item/15-07-2021-who-warns-that-hiv-infection-increases-risk-of-severe-and-critical-covid-19 [Accessed April 2022].

WHO. 2021d. World Malaria Report 2021. *World Health Organization*.

WHO. 2021e. Strength in numbers: Data, partners and leadership create resilient HIV services during COVID-19 in Zambia. *World Health Organization*, Online news release. Available: https://www.who.int/news-room/feature-stories/detail/strength-in-numbers-data-partners-and-leadership-create-resilient-hiv-services-during-covid-19-in-zambia [Accessed April 2022].

WHO. 2021f. WHO information fact sheet: Immunization coverage. *World Health Organization*, Online fact sheet. Available: https://www.who.int/news-room/fact-sheets/detail/immunization-coverage [Accessed April 2022].

WHO. 2021g. WHO health topics, vaccines and immunization. *World Health Organization*. Available: https://www.who.int/health-topics/vaccines-and-immunization#tab=tab_1 [Accessed April 2022].

WUENIC. 2020. Progress and challenges with sustaining and advancing immunization coverage during the COVID-19 pandemic. *2020 WHO/UNICEF Estimates of national immunization coverage*, Online publication. Available: https://cdn.who.int/media/docs/default-source/immunization/progress_and_challenges_final_20210715.pdf?sfvrsn=787f03ad_5 [Accessed May 2022].

PHOTO: ERIC SALES, ASIAN DEVELOPMENT BANK

2

COMMUNITY RESILIENCE INNOVATIONS IN FOOD SECURITY: TOWARDS RESILIENT RECOVERY FROM THE COVID-19 PANDEMIC AND CLIMATE DISASTERS IN THE PHILIPPINES

PROFESSOR EMMA PORIO
ATENEO DE MANILA UNIVERSITY AND SCIENCE RESEARCH FELLOW, MANILA OBSERVATORY , THE PHILIPPINES

PHOTO: DOMINIC CHAVEZ, WORLD BANK

The Philippines is hit by around 20 typhoons each year, as well as occasional fires, earthquakes, floods and droughts. Food security in urban-rural poor communities is negatively impacted by the damage and losses caused by natural disasters. The livelihood of farmers, fisher folk and other groups such as informal settlers in urban areas are particularly vulnerable. During the COVID-19 pandemic, mitigating these impacts has become more complicated, particularly among vulnerable and marginalised communities. As in many developing economies, 60% of employment in the Philippines is provided by the informal sector, where conditions of work are not highly remunerative nor desirable (ILO, 2009). In Metropolitan (Metro) Manila alone, about 40–60% of people derive their income and livelihood from the informal economy. The COVID-19 pandemic, coupled with climate disasters, has exacerbated their adverse impacts on our already fragile health, social and political-economic systems. It also highlights the uncertainties we face as a nation when calamities, social-political conflicts, accelerations in technology and climate change intersect.

COVID-19 LOCKDOWN IMPACTS ON FOOD SECURITY

According to Foodlink Advocacy Cooperative of the Philippines, Metro Manila seemed 'to have incurred both the greatest health impact from COVID-19 and critical supply-chain disruption in terms of food demand and consumption' (Palo et al., 2020). Restrictions on transport and mobility created supply-chain bottlenecks for the production and distribution of produce. The enforced community quarantine severely affected the food commodity chains, and Palo et al. (2020) noted that 'despite the large number of women engaged along these food commodity chains, there has been no targeted response designed to support them, particularly in the processing and retail segments' of the economy. Those in the informal sector—jeepney/pedi-cab drivers, barkers, sidewalk vendors, beggars and service workers suffered most from these disruptions in food retail and distribution. This finding has been supported by several ethnographic reports (e.g., Racelis, 2020a, 2020b) based on key informant Zoom interviews with urban poor leaders and members.

COVID-19 PANDEMIC AND CLIMATE DISASTERS: CONTEXTUAL DRIVERS OF RISK AND RESILIENCE

The COVID-19 pandemic and subsequent community lockdowns from 16th March 2020 in the Philippines resulted in adverse social-political disruptions to the people, particularly those from basic, vulnerable sectors of society. Two months later, in May 2020, fires ravaged several informal settlements in Manila, leading to the loss of homes and livelihood bases for hundreds of residents, putting stress on evacuation centres that were already unable to properly accommodate and serve evacuees (i.e., through physical distancing, hygiene and sanitation facilities). In June 2020, Typhoon Ambo raged through the Western seaboard of the Philippines, displacing many communities and damaging their livelihood bases. Towards the end of 2020, Typhoons Goni/Rolly and Vampo/Ulysses ravaged the Eastern Visayas to the Cagayan Valley, resulting in heavy damage to agriculture, infrastructure and the homes of thousands of people in several regions of both urban and rural areas.

Climate change, has been increasingly multiplying economic and livelihood risks, particularly for those in regions highly exposed to natural disasters. The cumulative effects of COVID-19 community lockdowns and natural disasters have created complications in the Cagayan Valley and the Bicol region, which faced deadly flooding and landslides. This further exacerbated the human security needs of vulnerable and marginalised communities. In general, the Post Disaster Needs Assessments undertaken by both the government and humanitarian agencies only measure the damage and losses incurred by infrastructure, agriculture, the environment and human lives. In a sense, Post Disaster Needs Assessments typically underestimate the damage and losses from climate disasters, as they do not include measurements at a household level.

The biological hazard of COVID-19 adds complexity to the cascading risks from floods, typhoons, droughts and earthquakes, which have incrementally multiplied the vulnerability of farmers, fishers, landless workers in rural areas and informal settler families in urban areas. This has resulted in the loss of jobs and compromised mobility, along with hunger/food insecurity, especially among vulnerable and marginalised groups. Thus, these factors have complicated the pandemic responses and recovery efforts, both of local government units and the poor living in dense, flood-prone informal settlements of the city as well as in geographically isolated and disadvantaged areas (Porio, 2021). These new normal conditions have deprived the poor and marginalised groups such as women, children, the elderly, and persons with disabilities of enjoying their basic human rights and claims to food security, health services and other basic services (Porio, 2020, 2021). Both national and local governments recognise that the pandemic-related restrictions have led to millions of jobs lost. Informal workers could not work, and regular workers became under-employed. Contractual work proliferated without sufficient income for a family's basic needs, including food, utilities, rent and medicine. With no work, particularly in the urban poor communities, hunger and food insecurity impacted health and education. Poor health among mothers has also compromised childcare. Hunger, malnourishment and stunting among children compromise their brain development and learning abilities, leading to education inequality between less-endowed families and those with better resource capacity.

EXAMPLE: FOOD SECURITY IN A POST-ONDOY RESETTLEMENT COMMUNITY: WOMEN-LED INTEGRATED COMMUNITY FOOD PRODUCTION OF DISIPLINA VILLAGE-BIGNAY, VALENZUELA CITY, METRO MANILA

In 2009, Typhoon Ondoy hit Metro Manila, affecting over 1,000 families in Valenzuela City. This pushed the Valenzuela City Local Government Unit (VC-LGU) to allocate two hectares to comprehensive resettlement and housing program within the city, its first 'Disiplina Village', located in Barangay Ugong.

Based on its 2015 Community-Based Monitoring System, Valenzuela City's resettlement program identified over 3,000 informal settlement families in need of housing. This paved the way for a second Disiplina Village-Bignay, considered the largest in-city housing in the country: 104 buildings on 11 hectares were built to accommodate the informal settlement families displaced by the 2009 Ketsana and 2012 Habagat floods as well as those displaced by government infrastructure projects (e.g., those sleeping under bridges, beside floodways, etc.). These resettlement projects are complete with facilities, including departments of police and security, health, social and gender welfare. Primary and secondary schools, wet markets and multi-purpose buildings and spaces are also available inside the resettlement community. Programs and training on waste management, vegetable farming, sewing, poultry farming and more have led to thriving livelihood activities for residents. These programs are implemented in partnership with the local government's Resettlement Office, Health, Agriculture, Environment and Social Welfare departments.

The Integrated Community Food Program (ICFP) of Disiplina Village-Bignay is just one of the community resilience programs of the city. In 2015, ICFP and the National Anti-Poverty Commission (NAPC) initiated urban farming to create a sustainable food source for families. NAPC organised the ICFP women's group and trained them to produce their own food crops, as well as supply the city's feeding program for underprivileged children. On top of being a

livelihood source for its members, the ICFP continues to ensure the production of fruits, vegetables, poultry products and seafood for the residents of the village. The food gardens of the ICFP have been the main supplier of the city's feeding program.

Further, the women of the ICFP often represent Valenzuela City's resettlement program in conferences outside the city to promote the products of their urban gardens. For example, during the 2019–2020 Coastal Cities at Risk Philippines (CCARPH) conferences on 'Bridging Science-Policy-Practice Nexus through Transdisciplinary Research and Resilience Innovations', the women of the ICFP opened a stall to sell their vegetables and seedlings to Non-Government Organisations (NGOs) and Community-Based Organisations (CBOs) from other cities. Here, they also demonstrated their food and garden initiatives with other conference delegates. Additionally, they discussed their development plans, which included capacity training on technology for community members in Valenzuela, the use of solar-powered systems, water purification and sustainable farming to improve livelihoods and to increase the knowledge of ICFP officers. Through their stall, they demonstrated how their multi-stakeholder partnerships, which they had been holding since 2017, were working for their group.

With the imposition of community lockdowns on March 16, 2020, interactions between CCARPH and the ICFP proceeded digitally through the Urban Gardening chat group under the leadership of Precy Liza Labsan. Valenzuela City's Agriculture Office head agriculturist Dr Vincent Sison and community moderator April Joy Udto facilitated a series of digital meetings that culminated in the ICFP's presentation of their community gardens initiative in the online webinar series, Climate, Resource Management and Human Development: Focus on Community Resilience Initiatives in Asia 2020. During the lockdown, they expanded their food production, supplying other food co-ops in the city with their products. At the height of the COVID-19 surge in the first quarter of 2021, the ICFP women, with the support of CCARPH and the Valenzuela City Government, organised community pantries for other urban poor communities in the city.

To summarise, the ICFP is an all women-led project by the NAPC in partnership with the Valenzuela local government that creates a sustainable food source for families. By educating and aiding families in cultivating crops, they can generate produce for their own communities. Before the pandemic, the ICFP women's group supplied fruits and vegetables for the Valenzuela City school feeding program. The program ensured the availability of fruits, vegetables, fish and poultry while building the capacity of the women (376 members with 50 core members contributing sweat equity) in vegetable production and marketing. During the pandemic, the ICFP women's group even organised a regular community pantry to provide fruits and vegetables to other poor communities in the city.

Ultimately, the most important point to consider here is that convergent approaches to developing resilient community food systems involve multi-sectoral and interlocking engagements of community groups, national and local government agencies and the private sector.

PHOTO: DOMINIC CHAVEZ, WORLD BANK

CONCLUSION

The twin crises of our time, that of the climate crisis and rising social inequalities, have largely exacerbated the negative impacts of the COVID-19 pandemic. This paper argues that in addressing the food security needs of the vulnerable populations (i.e., women, children, the elderly and people with disabilities), post-COVID-19 recovery programs must be collaboratively forged by national and local governments in partnership with the private sector, civil society organisations and CBOs. Addressing the risk and protection of the most vulnerable sector from the human rights framework should be a major focus of investments of human, capital and infrastructural resources from all sectors of society.

Nonetheless, this case study demonstrates the capacities of urban poor communities to absorb, adapt and transform their structures and processes towards a resilient recovery from the negative impacts of the COVID-19 pandemic and climate disasters. Indeed, the COVID-19 pandemic unleashed the creative energies of these CBOs by proactively responding to the challenges of food security and the other needs of their community members. Through the sustained collective action of CBOs before and during the pandemic, these urban poor communities were able to build a strong community organisation and mobilise both internal and external resources, including alliance systems in their local governments, NGOs and CBOs and private sector groups.

REFERENCES

ILO. 2009. Globalization and informal jobs in developing countries. *International Labour Organization*. Geneva, Switzerland.

PALO, A.S.M., ROSETES, M.A., & CARIÑO, D.P. 2020. COVID-19 and food systems in the Philippines. *Australian Centre for International Agricultural Research*, Technical report. Available: https://www.aciar.gov.au/sites/default/files/2020-11/covid-chapter7.pdf [Accessed May 2022].

PORIO, E. 2020. Climate, COVID-19, and the city: Challenges to recovery and resilience. *15th Asia Pacific Sociological Association* 2020, 6–7.

PORIO, E. 2021. Climate, COVID-19 and city: Intersectional linkages of gender, ethnicity and class. Paper presented in the closing plenary session of the International Sociological Association (ISA). Porto Alegre Forum, 10–27.

RACELIS, M. 2020a. A reflection on Kap Mena, Estero de San Miguel, and the coronavirus. *Rappler*, Online news story. Available: https://www.rappler.com/voices/thought-leaders/opinion-reflection-estero-de-san-miguel-coronavirus [Accessed May 2022].

RACELIS, M. 2020b. Learning from Kagawad Jonjon Elago. *Rappler*, Online news story. Available: https://www.rappler.com/voices/thought-leaders/opinion-learning-kagawad-jonjon-elago-coronavirus [Accessed May 2022].

PHOTO: DAVE LLORITO, WORLD BANK

PHOTO: OLYMPIA DE MAISMONT, EUROPEAN UNION

4

COVID-19'S IMPACTS ON EDUCATION AND LITERACY

SUMMARY

- Schools in most tropical regions were closed for longer periods in 2020 and 2021 than their counterparts in the rest of the world.
- Shifting to remote learning approaches during the pandemic disenfranchised many rural and poor students who did not have reliable access to these technologies.
- The extended school closures increased drop-out rates in many areas, particularly in upper secondary schools.
- Many schools in low and middle-income nations through the Tropics provide regular school meals to alleviate malnutrition. School closures meant this was not available to many students. To overcome this, some countries transitioned to alternative approaches to ensure students continued to have access to adequate nutrition.

INTRODUCTION

Education is an essential part of civilization: it contributes to quality of life, economic growth and social equity. Well-educated people tend to live longer, make better-informed health choices and have higher incomes. Access to quality education for all people is one of the goals underpinning the 2030 Agenda for Sustainable Development.

Although there is no internationally agreed-upon definition of education equity, global organisations and governments have made commitments to provide global access to schooling. Efforts have included a focus on early childhood learning accessibility, the provision of basic level schooling and the implementation of equitable social environments in regard to race, gender, ethnicity, class and ability (Cairney & Kippin, 2022). Even before the COVID-19 pandemic, children from the poorest households were already almost five times more likely to be out of primary school than their wealthier counterparts, and in the Tropics, schooling rates for children were lower than the rest of the world (State of the Tropics, 2020).

The United Nations estimates that over half of all children around the world are not reaching the minimum criteria for literacy and numeracy (UN, 2022). It is projected that by 2050, the Tropics will be home to two-thirds of the world's children (State of the Tropics, 2020). Now more than ever, it is essential that tropical nations have resilient education systems that can meet the minimum learning requirements and endure challenges such as war, political conflict, climate crises and global pandemics.

Lockdowns and extended school closures during the pandemic have led to significant education interruptions across the world. Those nations with high rates of internet and digital communications access were able to transition to remote learning options in association with their education departments. For many nations in the Tropics, without access to these resources, closures have led to a loss of up to two years of education. With the forecast closure of schools to reduce COVID-19 transmission, 90% of nations committed to providing some form of remote educational policy, primarily in digital or broadcast format to minimise the impact of these closures. However, at least 31% of school children worldwide were unable to access these opportunities due to a lack of household resources (UNICEF, 2020). There were also major differences in access to school resources between urban and rural areas in many countries during lockdowns. Collectively, over 1.5 billion students from pre-primary to tertiary levels were disrupted by these closures (Aristovnik et al., 2020; Montoya, 2020; UNESCO, 2021).

Losses or interruptions to education have costs well beyond the simple loss of economic opportunity. The richness of lives and opportunities for progress towards equality is equally important (Hughes et al., 2021). For those students having limited or no access to the alternative education opportunities, the loss in learning has the potential to cause significant inter- and intra-generational disparities regarding literacy and numeracy. Direct measures of the impact of COVID-19 on literacy and numeracy across the Tropics are not yet available. However, the extent of school closures during the pandemic can be used as an indicator of the risk to literacy and numeracy skills in children.

TRENDS

School closures

School closures were used as an adaptation strategy in the early days of the COVID-19 pandemic to reduce the transmission of the virus (Buonsenso et al., 2021). While the WHO provided advice on reducing the transmission of the virus, individual countries determined the length and style of school closures.

Overall, complete school closures in the Tropics were 10% longer than in the rest of the world (see Figure 4.1). This pattern was uneven across the Tropics, with some regions having significantly longer closures than others. Schools were closed for at least 60% of 2020 and 2021 in South Asia, South East Asia, the Caribbean, South America and Central America (see Figure 4.1).

School closures in Oceania were the lowest for all regions. Full or partial closures were imposed for 22% of the 2020 and 2021 school years. Schools in island nations, including Kiribati, Marshall Islands, Tonga and Samoa spent less than 5% of the school year closed. This reflects the relatively low COVID-19 caseloads in this region (see Chapter 2). Rapid and hard international border closures for many nations in Oceania resulted in low caseloads and low rates of community transmission, providing more opportunities for traditional learning.

South America and Central America had the highest rates of school closures in 2020 and 2021 (see Figure 4.1). Both regions also reported high COVID-19 caseloads and mortality rates (see Chapter 2). The impacts of COVID-19 on morbidity and mortality in

Central America and South America severely hindered the capacity of governments to maintain normal societal structures, including education, throughout this period.

The impact of school closures from COVID-19 is also masking some of the pre-existing stresses on educational systems in these regions. Prior to the pandemic, a 20-year study in Central America identified a number of factors (including poverty, population, geographic proximity to cities and cultural identity) that greatly affected the likelihood of school completions (Adelman & Szekely, 2016). Inequality of education and lack of accessibility to learning opportunities are considered major factors affecting economic growth, quality of life and human capital, even in the absence of a global crisis like COVID-19.

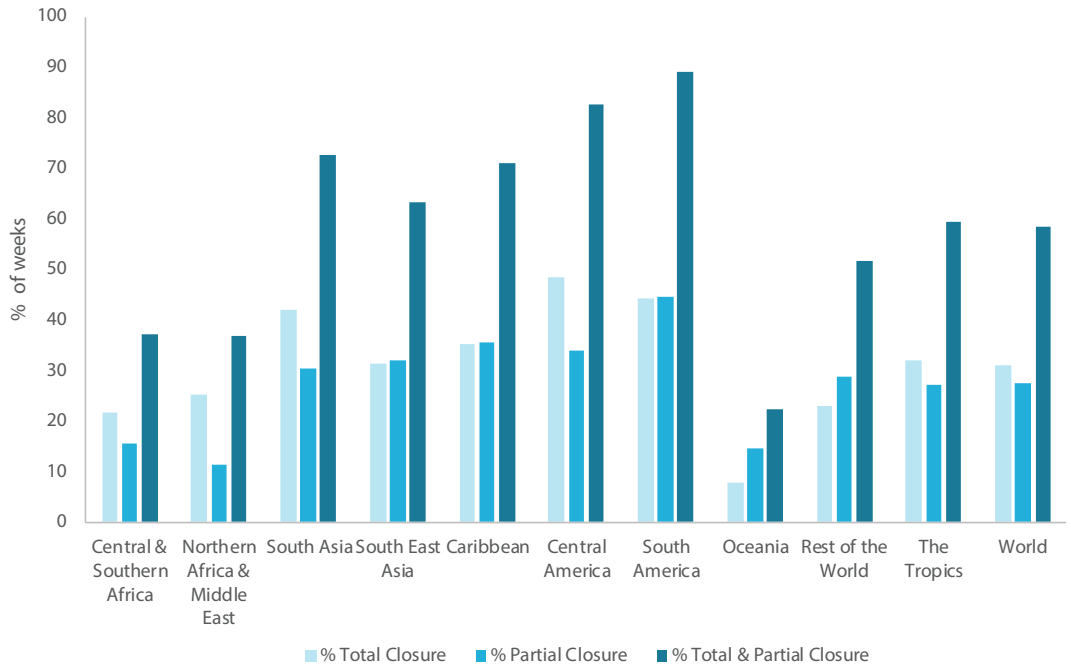

Figure 4.1 Proportion of school weeks subject to partial or total closures in 2020–2021 by region.

Source: Ritchie et al. 2022

In 2018, it was estimated that 258 million or around 17% of students were out of school worldwide (UIS, 2018). In 2020, this number increased by about 24 million, with almost all the increase linked to COVID-19 education disruptions (UNESCO, 2020b). Almost 50% of the increase was among students in South Asia, West Asia and sub-Saharan Africa. Even with schools re-opening in Kenya, it is estimated that up to 30% of adolescent girls and 25% of boys have not returned to school (World Bank, 2021). For girls in particular, socio-economic factors are often a key driver. With the increased disease burden from COVID-19 in the community and in family groups, employment demands, increased household and child-caring responsibilities, early or forced marriages and unplanned pregnancies increased the drop-out rate for girls in 2020 (UNESCO, 2020b).

For many communities, education not only represents an opportunity to alleviate poverty through increased opportunities but there is also frequently direct malnutrition reduction through the provision of school meals. Therefore, school closures not only represent a loss of education but also of nutrition, with up to 370 million children missing out on reliable nutrition through school meals in 2020 (Borkowski et al., 2021; UN News, 2021). In an effort to minimise this problem, around 50 countries, including Burkina Faso and Liberia, shifted to providing 'take-home-rations' programs to compensate for the loss of reliable school-based nutrition during the pandemic (Borkowski et al., 2021).

Other concerns arising from the extended school closures during the pandemic include child exploitation and increased child labour rates (UNICEF, 2021). Sadly, since 2016, child labour rates have been increasing, offsetting the gains made in the early 2000s. The pandemic has exacerbated this due to family job losses, school closures and other economic pressures. It is estimated that the impacts of COVID-19 could increase child labour by around 9 million children (UNICEF, 2021).

EDUCATION AND INNOVATION	BOX 4.1

Although not all communities have equal access to digital technologies to support remote education activities, many teachers have developed alternative methods to continue children's learning. In villages near the city of Tagkawayan, Philippines, volunteer teachers use trolley cars on old rail lines to deliver teaching programs to many of the children in the poorer areas. These are children with limited or no access to the internet (ABC News, 2022). Using donated materials, children sit alongside the rail lines for lessons up to three times a week, ensuring a level of education continuity even during lockdowns.

In Kiribati, internet access in rural and poorer areas is limited. The Ministry of Education decided that to ensure equitable access to education, remote learning lessons would be provided using the radio network, which is more accessible across the wider community. Even though this nation has had little direct impact from COVID-19, these efforts were put in place to ensure minimal disruption to children's education should lockdowns be necessary (UNICEF, 2021). Initial feedback on the program suggested not only high levels of participation from students but also that parents were actively engaged in the process (UNICEF, 2021).

THE TROPICAL PERSPECTIVE

Students from tropical regions lost more days of schooling in 2020 and 2021 than their counterparts in the rest of the world. South American and Central American students were particularly hard hit, losing almost two years of education during this period.

Although there have been efforts to address lost learning opportunities through remote education options, the World Bank estimates that up to 70% of 10-year-old children in low- to middle-income nations may not be able to read basic textbooks (World Bank, 2021). Even with the re-opening of schools post-lockdown, many children have not returned, increasing the risk of long-term literacy poverty and disempowerment.

LOOKING FORWARD

The impact of COVID-19 will have long-term impacts on literacy and numeracy globally. The increase in drop-out rates during the pandemic means an overall decrease in numeracy and literacy skills. This issue, combined with an increasingly rapid uptake of digital technologies and online communications, means that students who are unable to access these technologies risk being further disenfranchised. Without active interventions to ensure students from poorer nations and rural communities have similar access to these technologies moving forward, the potential for increases in educational inequality is likely to be realised.

Although the right to quality education is explicitly recognised in the UN SDG, the 2030 commitment to quality education for all was off-track even before the emergence of COVID-19 (Global Development Commons, 2020). With education losses through school closures during the pandemic, the opportunity to meet these targets is falling further behind. Without active intervention across nations, the impacts of COVID-19 on education are likely to be experienced for an entire generation.

REFERENCES

ABC NEWS. 2022. Trolley school helps Philippine children keep their education on track. *ABC News*, Online news story. Available: https://www.abc.net.au/news/2022-02-27/trolley-school-helps-philippine-children-keep-studies-on-track/100854128 [Accessed April 2022].

ADELMAN, M.A., & SZEKELY, M. 2016. School drop-out in Central America: An overview of trends, causes, consequences, and promising interventions. *World Bank*, Policy Research Working Paper, 7561.

ARISTOVNIK, A., KERŽIČ, D., RAVŠELJ, D., TOMAŽEVIČ, N., & UMEK, L. 2020. Impacts of the COVID-19 pandemic on life of higher education students: A global perspective. *Sustainability*, 12(20), 8438.

BORKOWSKI, A., CORREA, O., SANTIAGO, J., BUNDY, D.A., BURBANO, C., CHIKA, H., LLOYD-EVANS, E., NEITZEL, J., & REUGE, N., 2021. COVID-19: Missing more than a classroom. The impact of school closures on children's nutrition, *Innocenti* Working Papers no. 2021-01.

BUONSENSO, D., ROLAND, D., DE ROSE, C., VÁSQUEZ-HOYOS, P., RAMLY, B., CHAKAKALA-CHAZIYA, J.N.,… GONZÁLEZ-DAMBRAUSKAS, S. 2021. Schools closures during the COVID-19 pandemic: A catastrophic global situation. *The Pediatric Infectious Disease Journal*, 40(4), e146–e150.

CAIRNEY, P., & KIPPIN, S. 2022. The future of education equity policy in a COVID-19 world: A qualitative systematic review of lessons from education policymaking. *Open Research Europe*, 1(78), 78.

GLOBAL DEVELOPMENT COMMONS. 2020. Are countries on track to meet the SDG 4 indicators? *UNESCO*, Report. Available: https://gdc.unicef.org/resource/are-countries-track-meet-sdg-4-indicators [Accessed April 2022].

HUGHES, B., SULLIVAN, K.A., & GILMORE, L. 2021. Neuromyths about learning: Future directions from a critical review of a decade of research in school education. *Prospects*. https://doi.org/10.1007/s11125-021-09567-5

MONTOYA, S. 2020. The importance of monitoring and improving ICT use in education post-confinement. *UNESCO* Institute for Statistics, Online blog. Available: http://uis.unesco.org/en/blog/importance-monitoring-and-improving-ict-use-education-post-confinement [Accessed May 2022]

RITCHIE, H., MATHIEU, E., RODES-GUIRAO, L., APPEL, C., GIATTINO, C., ORTIZ-OSPINA, E., HASELL, J., MACDONALD, B., BELTEKIAN, D., & ROSER M. 2020. Coronavirus pandemic (COVID-19). *Our World in Data*, Online database. Available: https://ourworldindata.org/coronavirus [Accessed: March 2022].

STATE OF THE TROPICS. 2020. Exploring social, economic & environmental dimensions to answer: Is life getting better in the Tropics? *James Cook University*, Report. Available: https://sott.jcu.edu.au [Accessed: April 2022].

UN NEWS. 2021. UN backs plans to ensure regular, healthy school meals for every child in need by 2030. *UN News*. Available: https://news.un.org/en/story/2021/11/1105962 [Accessed April 2022].

UN. 2022. Quality education: Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all. *United Nations Department of Economic and Social Affairs, Statistics Division*, Online database. Available: https://unstats.un.org/sdgs/report/2019/goal-04 [Accessed: April 2022].

UNESCO. 2020a. Responding to COVID 19 and beyond—The Global Education Coalition in action. *UNESCO Open Access Repository, Online publication*. https://unesdoc.unesco.org/ark:/48223/pf0000374364 [Accessed April 2022]

UNESCO. 2020b. How many students are at risk of not returning to school? *UNESCO Open Access Repository*, Online publication. Available: https://unesdoc.unesco.org/ark:/48223/pf0000373992 [Accessed April 2022].

UNESCO. 2021. Reimagining our futures together: A new social contract for education. *International Commission on the Futures of Education*, Online publication. Available: https://unesdoc.unesco.org/ark:/48223/pf0000379707 [Accessed April 2022].

UNICEF. 2020. COVID-19: Are children able to continue learning during school closures? A global analysis of the potential reach of remote learning policies. *United Nations Children's Fund*, Online database. Available: https://data.unicef.org/resources/remote-learning-reachability-factsheet [Accessed April 2022].

UNICEF. 2021. COVID-19 and school closures: One year of education disruption. Online publication. Available: https://data.unicef.org/resources/one-year-of-covid-19-and-school-closures [Accessed April 2022].

WORLD BANK. 2021. World Bank: Pandemic threatens to drive unprecedented number of children into learning poverty. Press release. Available: https://www.worldbank.org/en/news/press-release/2021/10/29/world-bank-pandemic-threatens-to-drive-unprecedented-number-of-children-into-learning-poverty [Accessed April 2022].

PHOTO: SIMONE D MCCOURTIE, WORLD BANK

5

COVID-19'S IMPACTS ON TRAVEL AND TOURISM

SUMMARY

- In 2019, over 5.5 billion people travelled by air across the globe. Over 70% of that travel was outside of the Tropics.
- In 2020, passenger movements decreased by at least 50% across most tropical regions. The only two regions not to experience major decreases were Northern Africa and the Middle East and South East Asia. Both of these regions have major airport hubs in Hong Kong, Singapore and Saudi Arabia, which may be responsible for the higher passenger numbers.
- International and national border closures caused 60% of passenger aircraft to be grounded in 2020. The reduction in aircraft movements was higher in the Tropics, with the greatest decrease occurring in Northern Africa and the Middle East.
- Tourism is a major economic driver of global employment and GDP. Impacts on this sector have the potential to severely affect the economies of many nations.
- Eight of the 10 nations most heavily dependent on tourism as an export earner are in the Tropics. Of these, The Maldives is considered the most vulnerable, with 79% of total exports coming from tourism. Four of the 10 most tourism-vulnerable countries are in the Caribbean.
- Up to 2019, cruise ship tourism was one of the fastest-growing sectors within the tourism industry. The most popular cruise destination was the Caribbean, representing nearly 40% of total itineraries. The pause in the industry in 2020 was responsible for GDP losses of up to 10% across the region.

INTRODUCTION

In just over a century, the aviation industry has evolved from its first-ever flight to having over 100,000 commercial flights every day (ICAO, 2018). Aviation now provides a rapid global transport network for both goods and people. In 2020, COVID-19 severely affected the aviation industry. Following the initial outbreak in China, the transmission of the virus beyond China's borders was via international travellers (WHO, 2022). International airlines reacted quickly to the news of the disease, with 133 international carriers and 25 regional carriers either reducing or cancelling operations in mainland China in February 2020 (ICAO, 2020). During this same period, travel restrictions were introduced across all nations to help combat the spread of the disease (UNWTO, 2021). These restrictions saw major declines in aircraft movements across the globe (ICAO, 2022). By April 2020, more than 60% of the global passenger fleet had been taken out of service due to the pandemic (Gebicki, 2021).

Tourism is a major economic driver across large parts of the world. In 2019, it supported 10% of global employment and contributed over 10% to the global economy (Goretti et al., 2021; World Travel & Tourism, 2021). The cruise ship industry has been a rapidly increasing sector of the tourism market in recent decades. Its contribution to the tourist economy has been growing rapidly. In 2019, it employed over 1 million workers with an overall expenditure exceeding US$154 billion (BREA, 2020). The Caribbean is the single biggest cruising market accounting for around 35% of global capacity (BREA, 2020).

International tourism in both the aviation and cruise sectors were hard hit by the pandemic. International border closures restricted movements between countries, and community lockdowns restricted even local tourism activities. Loss of revenue from tourism had significant effects on many economies. Most tourism businesses were directly impacted, leading to income losses and increased unemployment. However, there were also wider impacts across communities that were reliant on the tourism sector.

Since the beginning of 2022, a re-opening of borders and the resumption of some international air travel has seen a rebound in the tourism sector and increases in aircraft movements. Despite concerns about the ongoing effects of the pandemic, the aviation and tourism industry are cautiously confident that travel and tourism will return to pre-COVID levels by the end of 2023.

TRENDS

Airline departures and passenger numbers

In 2019, air travel accounted for almost 5.5 billion passenger movements globally. The rest of the world accounted for almost 71% of these passenger movements. Of the tropical regions, South East Asia was the busiest for airline passenger transits in the Tropics. In 2019, more than 1 billion passengers travelled to or transited through South East Asia (see Figure 5.1). The Caribbean had the lowest number of passenger movements over this time.

In 2020, the pandemic stifled air travel, with passenger movements down by 57% globally (see Figure 5.2). However, passenger numbers in the Tropics fell by a smaller proportion over this period. The decline in passengers in the Tropics was 51% compared to 57% for the rest of the world (see Figure 5.2). Like so many of the other responses to the pandemic, the impact on passenger numbers was uneven across the Tropics. Although the Caribbean has the lowest passenger numbers overall, it experienced the greatest proportional decrease: a 70% drop. Central and Southern Africa (60%) and South America (60%) also reported proportional decreases higher than the rest of the world (see Figure 5.2).

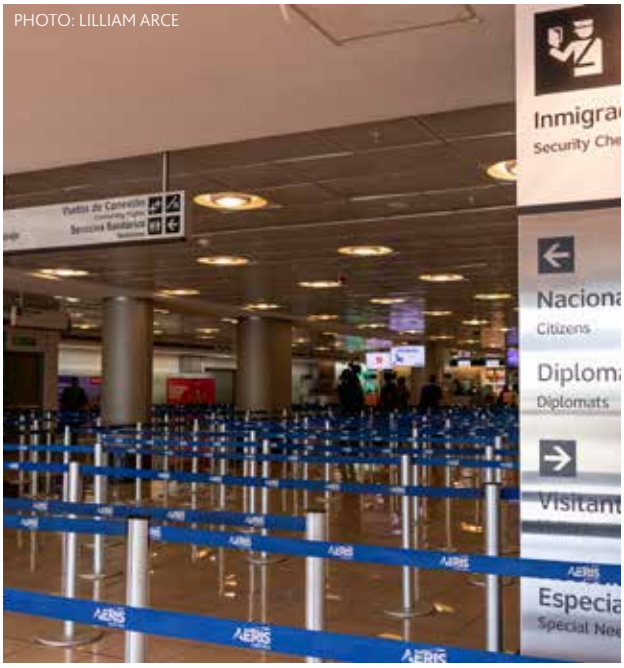

PHOTO: LILLIAM ARCE

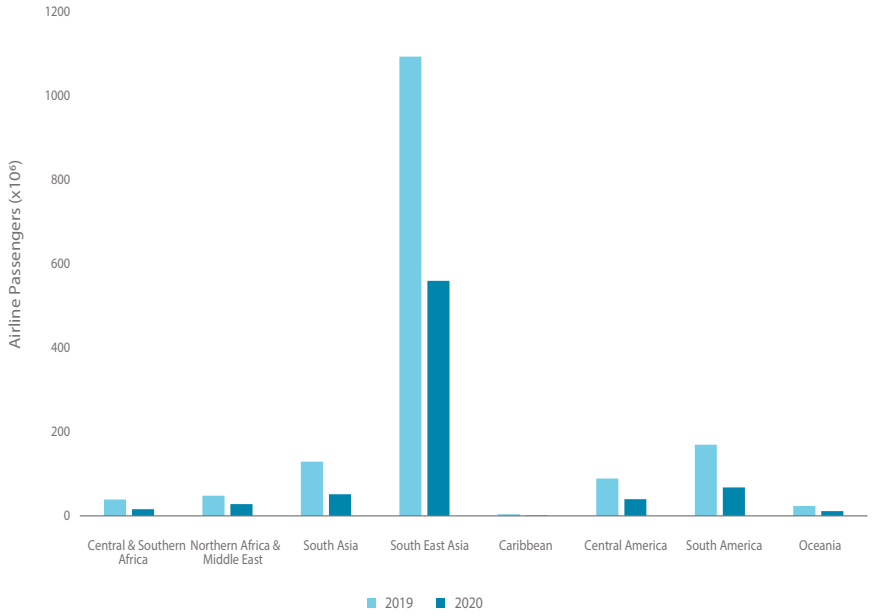

Figure 5.1 Recorded numbers of airline passenger numbers across the Tropics in 2019 and 2020.

Source: World Bank 2022

Northern Africa and the Middle East and South East Asia had the smallest decreases at 42% and 49%, respectively, reflecting their importance as key international airline hubs. These major air traffic hubs, based in locations including Hong Kong, Singapore, China, Saudi Arabia and Dubai, remained semi-operational during the pandemic. In 2020, Guangzhou Baiyun International Airport in the Guangdong Province, China, became the world's busiest airport in passenger numbers, relegating Atlanta Airport in Georgia, USA, to the second busiest (ACI, 2022). Despite the pandemic, Dubai retained its position as the busiest airport for international passengers in both 2020 and 2021 (ACI, 2022).

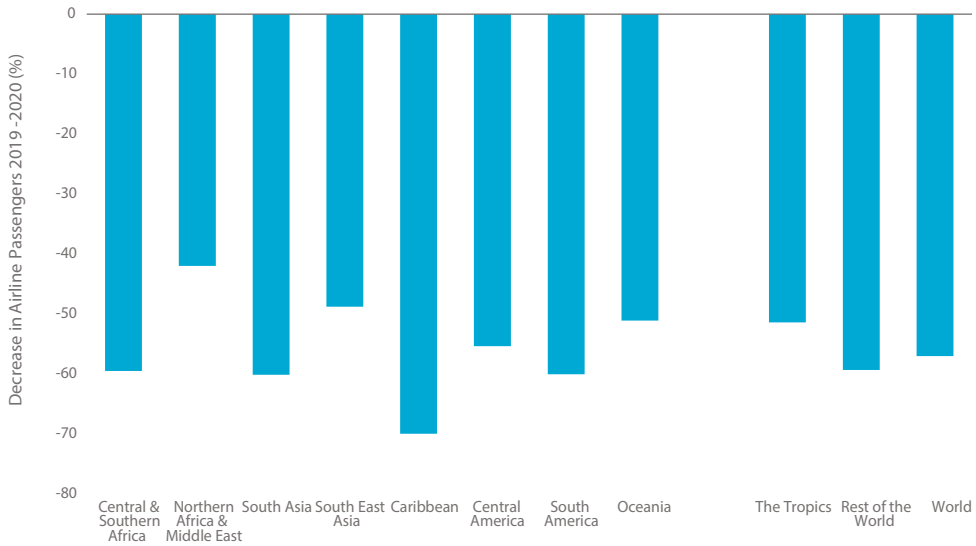

Figure 5.2 Decrease in airline passengers carried, 2019–2020.

Source: World Bank 2022

Unlike passenger numbers, the decreases in registered airline departures in the Tropics were higher than in the rest of the world in 2020. From 2019 to 2020, there was a 52% decrease in airline departures in the Tropics, compared to 48% in the rest of the world (see Figure 5.3).

The regional decreases in aircraft departures across the Tropics differed from decreases in passenger numbers. Northern Africa and the Middle East, which reported the smallest proportional decrease in passenger numbers, had the greatest decrease in aircraft departures (61%) (see Figure 5.3). A similar situation also occurred in South East Asia. This suggests that while there were fewer planes departing during this period, the number of passengers was higher per flight. As both these regions have major air traffic hubs, the increased number of passengers per flight may be a result of their role as transit points across regions.

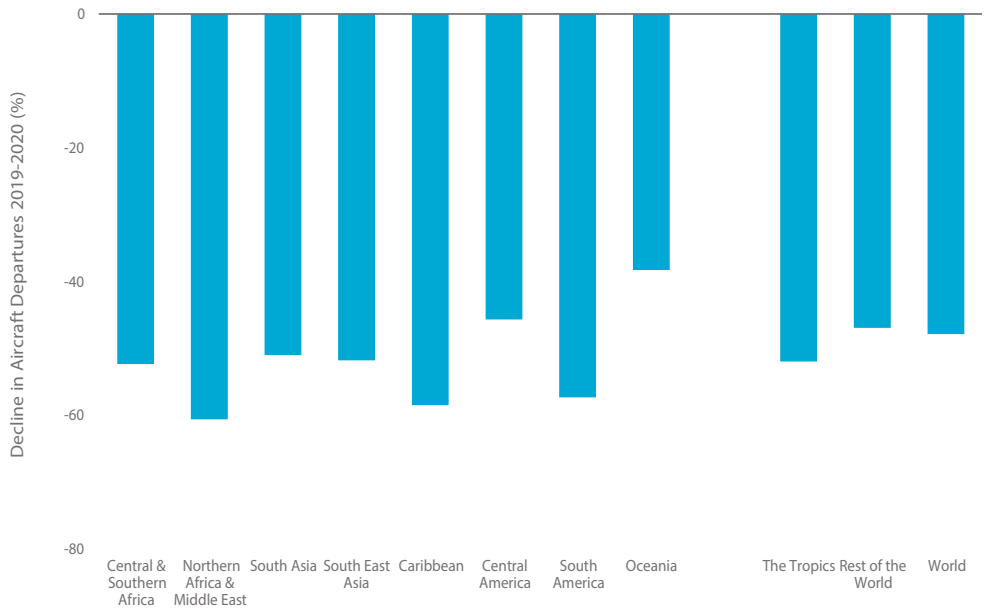

Figure 5.3 Decline in airline departures 2019–2020 across tropical regions.

Source: World Bank 2022

TOURISM

Many nations in the Tropics are reliant on tourism as a key driver of their economy and important export earners. International border closures and travel restrictions caused the global tourism industry to collapse in 2020. Between January and December 2020, international tourism arrivals decreased by 73% across the world (UNWTO, 2021). Ongoing closures and lockdowns saw a continuation of this through 2021, although there was some easing in late 2021.

Nations that source more than 50% of their export income from international tourism are considered very tourism dependent. Eight of the top ten tourism dependent nations are in the Tropics (see Figure 5.4). Of these, The Maldives is considered the most vulnerable, with 79% of total exports coming from tourism. Four of the 10 most vulnerable countries are in the Caribbean. For these nations, any downturns in the tourism market can severely affect their economies and GDP, particularly if they are sustained for any length of time.

With the imposition of international border closures, Oceania lost over 98% of international tourist arrivals between April and December 2020. This represented a significant loss of income for many of the island nations in this region. For Tonga, Vanuatu, the Cook Islands, and French Polynesia, this tourism represented more than 25% of their total exports. Hawaii also suffered significant losses, with visitor arrivals dropping by

almost 72% in 2020 compared with the first nine months of 2019 (Ige & Tatum, 2020). Although many of these nations had low COVID-19 caseloads and community transmission rates, they suffered significant economic losses due to international border closures in the early stages of the pandemic.

By mid-2021, many of the Pacific Island nations had the longest ongoing border closures compared to other parts of the world (Balasundharam & Koepke, 2021). Although this protected their communities from COVID-19, it came with severe economic costs. Unsurprisingly, by the end of 2021, many of these nations were eager to re-open their borders. Not wanting to jeopardise their low COVID-19 status, many were keen to establish travel bubbles with neighbouring countries with high vaccination coverage and, therefore, deemed lower risk of transmitting the virus (Balasundharam & Koepke, 2021). Although the Maldives was considered the most tourism vulnerable nation in terms of export income, they were very pro-active in managing both tourism and COVID-19 during the pandemic (Li & Mercer-Blackman, 2022). The government was active in re-opening borders as early as July 2020 with extremely strict hygiene protocols, and implemented one of the most rapid vaccination programs in the world. They have also been investing heavily in digital technologies to allow remote working and learning opportunities for international tourists who can still enjoy their holidays (Li & Mercer-Blackman, 2022).

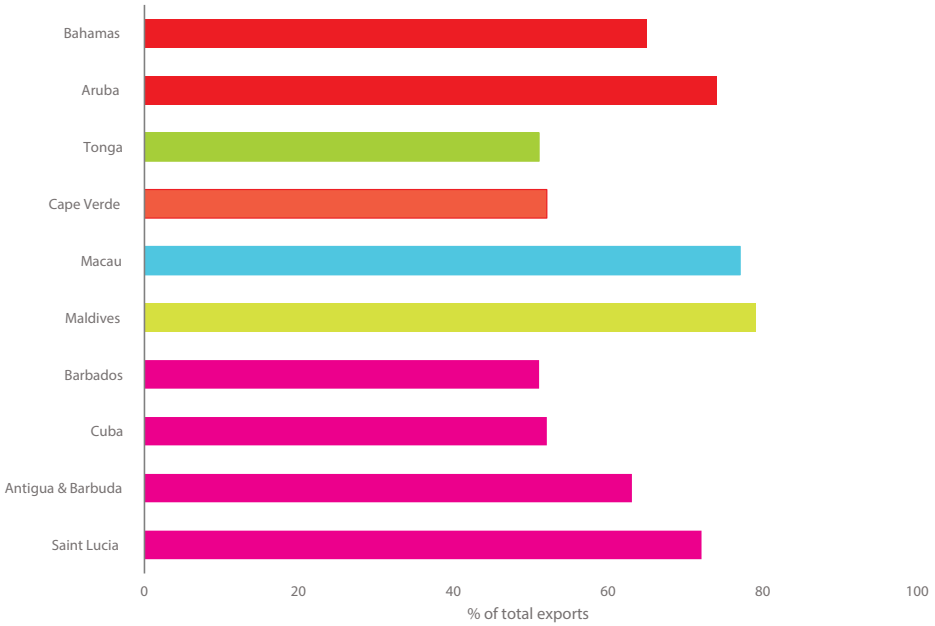

Figure 5.4 Top 10 countries reliant on tourism as a proportion of total exports (%).

Source: UNWTO 2022

Even among larger nations like Australia, regional areas dependent on tourism suffered significant downturns. The Cairns region in Far North Queensland suffered a major drop in travel and tourism in 2020, with the closure of international and national borders in response to the pandemic. International and domestic air passengers dropped by 99.9% and 96.5%, respectively. Business surveys reported sales had fallen by 52%, and 49% of businesses anticipated having to lay off staff due to the pandemic (Cairns Regional Council, 2020). The flow-on effects of the loss of tourism into increases in unemployment, drops in income and job insecurity were widespread through the region. The economic effects seen in this region are a reflection of the impacts that have occurred in the tourism sector globally.

Conservation-based tourism has also suffered economically through the pandemic. In 2019, wildlife tourism employed 21.8 million people and generated over $120 billion annually (Hockings et al., 2020; Roberts, 2020; World Travel & Tourism Council, 2019). With countries going into lockdown in 2020, many smaller tourism businesses could not continue operations. A recent survey of African safari tour operators found that nearly 90% had experienced declines of over 75% in bookings, while many indicated that they had no bookings at all (Beekwilder, 2022). These declines in revenue not only affect the tourism industry directly but their wider communities. Many programs in protected areas often share revenue benefits from tourism and other activities with the wider surrounding community. The mountain gorilla parks in Rwanda, Uganda and the Democratic Republic of the

Congo contribute a proportion of park fees to the local community (Maekawa et al., 2015). Similarly, the Mara Naboisho Conservancy in Kenya provided incomes for over 600 Maasai families, which has been lost due to the drop in tourism (Hockings et al., 2020). Tourism proceeds in these areas have also provided funding for many community projects, including beehives, school resources, health clinics and infrastructure improvements. Therefore, the loss of this income stream has implications not only for tourism directly but for the wider community.

CRUISES

Prior to the pandemic, cruise ship tourism was one of the fastest-growing sectors within the tourism industry (Holland et al., 2021). In 2019 there were nearly 30 million passenger embarkations globally (CLIA, 2021). Due to the pandemic, there was an 81% decrease in embarkations to less than 6 million in 2020 (CLIA, 2022). From mid-March to September of 2020, it is estimated that the suspension of cruise operations resulted in a loss of 518,000 jobs, US $23 billion in wages, and $77 billion in global economic activity (CLIA, 2021).

The most popular cruise destination prior to the pandemic was the Caribbean (CLIA, 2020), representing nearly 40% of total itineraries (Silva, 2021). Collectively, 34–48% of the Bahamas, Barbados and Jamaica's GDP stems from tourism, much of it coming from the cruise industry (Coley-Graham, 2020). In 2020, this region experienced a 72% decline in passenger volume from 2019 (CLIA, 2020). This decline caused losses in GDP of up to 10% in 2020 with associated economic and employment shocks for the island communities.

The pandemic has severely impacted the cruise industry and the countries that depend heavily on the sector, such as the Caribbean. Nevertheless, the cruise industry is optimistic that recovery will be rapid, with a full recovery projected for 2023 (CLIA, 2022).

COVID-19 AND THE CRUISE INDUSTRY — BOX 5.1

Just after the start of the pandemic, COVID-19 cases were spreading from China to the rest of the global community. At this stage of the pandemic, one of the major transmission areas was on luxury cruise ships. In February 2020, the Diamond Princess was quarantined off the coast of Japan due to the outbreak of COVID-19. At this time, more than half the known cases were on board the ship (Baraniuk, 2020). Ultimately, more than 700 passengers and crew members became infected, with the death of nine individuals (Silva, 2021).

Despite initial scepticism on management protocols with lockdowns and quarantining on the Diamond Princess, subsequent reviews consider these approaches were effective in containing the spread of the disease among passengers and crew. Interactions between the crew, particularly in communal areas and those interacting with COVID-19 positive cases, were highlighted as key vectors for transmission (Baraniuk, 2020). The lessons from these outbreaks established disease spread was greater and more rapid in confined areas such as communal dining areas and venues with limited ventilation. These learnings were later integrated into wider public health measures for high-risk locations such as aged care facilities, hotels and hospitals.

Other cruise ships, including the Greg Mortimer and MS Zaandam, reported outbreaks of COVID-19 at the start of 2020 among passengers and crew. The recurring outbreaks on cruise liners suggested they were hotbeds of infection. Management of the outbreaks was compounded by some nations closing their ports to these ships and refusing medical evacuations of sick passengers and crew (Goni, 2020; Greenfield & McCormick, 2020).

PHOTO: F LATIEF, ILO

THE TROPICAL PERSPECTIVE

Tourism is a major source of income for many tropical nations. Many island nations in particular tend to be very reliant on tourism-oriented revenue streams for a significant portion of their exports and GDP. This reliance on a single industry also creates greater vulnerability if there are disruptions or shocks to the wider global economy. The COVID-19 pandemic shone a spotlight on how fragile many of these economies were in the face of a global crisis. For many of the Pacific Island nations, the economic impacts of COVID-19 were much greater than the direct health impacts. They successfully prevented large-scale community transmission of the virus within their communities, but long-term international border closures severely impacted their tourism revenue.

For some regions, like the Caribbean and Central America, economic pressures were responsible for tourism opening up earlier than in other regions. While there are economic gains from this, many communities struggled with increasing COVID-19 caseloads as a consequence. Despite the increase in COVID-19 cases, a number of nations in the Caribbean and Central America are cautiously hopeful of a tourism rebound to pre-COVID-19 levels by the end of 2022. Of these, the Mexican travel market looks to be recovering rapidly, with a 95% return in airline passenger numbers by December 2021 (Matínez Garbuno, 2022). Similar recoveries are being observed in some South Asian nations, including the Maldives, who are actively adapting to new and sustainable tourism approaches.

GOING FORWARD

The economic impacts on the tourism market are likely to be felt in both the short and medium term. The Global Rescue and the World Travel and Tourism Council (2019) found that, on average, it takes almost two years for full economic recovery to occur after disease outbreaks (Hockings et al., 2020).

The cruise industry was one of the most affected tourism sectors during the pandemic. With changes to operations to minimise disease spread, development of improved management protocols and re-opening of borders, the industry is optimistic that recovery will be rapid. The peak body representing the cruise line industry (CLIA) is projecting full recovery in the cruise industry by 2023 (CLIA, 2022).

To date, the global tourism industry has not recovered from the economic and employment downturns caused by the pandemic. However, ongoing uncertainty caused by the pandemic requires the wider tourism industry to be flexible in its operations to ensure a sustainable and ongoing recovery (Parkinson, 2022).

In some areas where borders are still restricted, digital solutions have been proposed as an alternative to promote virtual ecotourism opportunities (Great Apes Survival Partnership, 2020; UN, 2020). These innovative solutions have the potential to create alternative explorative opportunities and compensate for lost income. It may also provide a more sustainable option for some tourism operations to minimise their ecological footprint.

REFERENCES

ACI. 2022. The top 10 busiest airports in the world revealed. *Airport Councils International*, Press release. Available: https://aci.aero/2022/04/11/the-top-10-busiest-airports-in-the-world-revealed [Accessed April 2022].

BALASUNDHARAM, V., & KOEPKE, R. 2021. Diversion of tourism flows in the Asia & Pacific region: Lessons for COVID-19 recovery. *International Monetary Fund* Publication. Available: https://www.imf.org/en/Publications/WP/Issues/2021/08/20/Diversion-of-Tourism-Flows-in-the-Asia-Pacific-Region-Lessons-for-COVID-19-Recovery-464342 [Accessed April 2022].

BARANIUK, C. 2020. What the *Diamond Princess* taught the world about COVID-19. *BMJ*, 369, m1632.

BEEKWILDER, J. 2022. The impact of the coronavirus pandemic on the safari industry. *Safari Bookings*, Survey. Available: https://www.safaribookings.com/blog/coronavirus-outbreak [Accessed April 2022].

BREA. 2020. The global economic contribution of cruise tourism 2019. *Business Research & Economic Advisors*, Report. Available: https://cruising.org/-/media/research-updates/research/global-cruise-impact-analysis---2019-final.ashx [Accessed May 2022].

CAIRNS REGIONAL COUNCIL. 2020. Cairns economy impacts from COVID-19. Online Report. Available: https://www.cairns.qld.gov.au/__data/assets/pdf_file/0015/340512/Cairns_COVID_19_Impacts_Report23_6_20_6414276.pdf [Accessed April 2022].

CLIA. 2020. South America market report 2020. *Cruise Lines International Association*, Publication. Available: https://cruising.org/en-gb/news-and-research/research/2021/june/clia-south-central-america-and-caribbean-passenger-report-2020 [Accessed April 2022].

CLIA. 2021. State of the cruise industry outlook 2021. *Cruise Lines International Association*, Publication. Available: https://cruising.org/en/news-and-research/research/2020/december/state-of-the-cruise-industry-outlook-2021 [Accessed April 2022].

CLIA. 2022. State of the cruise industry outlook 2022. *Cruise Lines International Association*, Publication. Available: https://cruising.org/en/news-and-research/research/2022/january/state-of-the-cruise-industry-outlook-2022 [Accessed April 2022].

COLEY-GRAHAM, T.-A. 2020. Weathering the coronavirus storm in the Caribbean. *Inter-American Development Bank*, Online report. Available: https://www.iadb.org/en/improvinglives/weathering-coronavirus-storm-caribbean [Accessed April 2022].

DE BEUKELAER, C. 2021. The COVID-19 seafarer crisis. *Pursuit*, Online publication. Available: https://pursuit.unimelb.edu.au/articles/the-covid-19-seafarer-crisis [Accessed May 2022].

EURONEWS. 2021. Cruise ships denied docking over COVID cases as more flights cancelled. *Euronews*, Online news story. Available: https://www.euronews.com/2021/12/28/cruise-ships-denied-docking-over-covid-cases-as-more-flights-cancelled [Accessed May 2022].

GEBICKI, M. 2021. Grounded aircraft during COVID-19 pandemic: What it takes to get a plane back in the air. *Traveller*, Online story. Available: https://www.traveller.com.au/grounded-aircraft-during-covid19-pandemic-what-it-takes-to-get-a-plane-back-in-the-air-h1zi0t [Accessed April 2022].

GONI, U. 2020. Cruise ship stranded off Uruguay says 60% onboard have Covid-19. *The Guardian, Australian Edition*, Online news story. Available: https://www.theguardian.com/world/2020/apr/07/uruguay-to-repatriate-australian-passengers-from-covid-19-stricken-ship [Accessed April 2022].

GORETTI, M.M., LEIGH, M.L.Y., BABII, A., CEVIK, M.S., KAENDERA, S., MUIR, M.D.V, NADEEM, S., & SALINAS, M.G. 2021. Tourism in the post-pandemic world: Economic challenges and opportunities for Asia-pacific and the Western Hemisphere. *International Monetary Fund*, Publication. Available: https://www.imf.org/en/Publications/Departmental-Papers-Policy-Papers/Issues/2021/02/19/Tourism-in-the-Post-Pandemic-World-Economic-Challenges-and-Opportunities-for-Asia-Pacific-49915 [Accessed April 2022].

GREAT APES SURVIVAL PARTNERSHIP. 2020. Great ape awareness goes viral. Online editorial. Available: https://www.un-grasp.org/great-ape-awareness-goes-viral [Accessed April 2022].

GREENFIELD, P., & MCCORMICK, E. 2020. Cruise operator says lives are at risk on Zaandam as nations 'turn their backs' on ship. *The Guardian, Australian Edition*, Online news story. Available: https://www.theguardian.com/world/2020/mar/31/cruise-ship-chief-zaandam-and-rotterdam-passengers-left-to-fend-for-themselves-covid-19-crisis [Accessed May 2022].

HOCKINGS, M., DUDLEY, N., ELLIOTT, W., FERREIRA, M.N., MACKINNON, K., PASHA, M.K.S., PHILLIPS, A., STOLTON, S., WOODLEY, S., APPLETON, M., CHASSOT, O., FITZSIMONS, J., GALLIERS, C., KRONER, R. G., GOODRICH, J., HOPKINS, J., JACKSON, W., JONAS, H., LONG, B., … YANG, A. 2020. Editorial essay: Covid-19 and protected and conserved areas. *Parks*, 26(1), 7–24.

HOLLAND, J., MAZZAROL, T., SOUTAR, G.N., TAPSALL, S., & ELLIOTT, W.A. 2021. Cruising through a pandemic: The impact of COVID-19 on intentions to cruise. *Transportation Research Interdisciplinary Perspectives*, 9, 100328.

ICAO. 2018. *Future of aviation*. Online story. Available: https://www.icao.int/Meetings/FutureOfAviation/Pages/default.aspx [Accessed May 2022].

ICAO. 2020. *Effects of novel coronavirus (COVID-19) on civil aviation*. Online publication. Available: https://www.icao.int/sustainability/Documents/ICAO%20Coronavirus%202020%2002%2021%20Econ%20Impact.pdf [Accessed May 2022].

ICAO. 2022. *Effects of novel coronavirus (COVID-19) on civil aviation: Economic impact analysis*. Online publication. Available: https://www.icao.int/sustainability/Documents/Covid-19/ICAO_coronavirus_Econ_Impact.pdf [Accessed April 2022].

IGE, D. Y., & TATUM, C. 2020. Fact Sheet: Benefits of Hawai'i's tourism economy. *Hawai'i's Tourism Authority*. Available: https://www.hawaiitourismauthority.org/media/4167/hta-tourism-econ-impact-fact-sheet-december-2019.pdf [Accessed April 2022].

LI, Y., & MERCER-BLACKMAN, V., 2022. The changing face of tourism and work: How Maldives is successfully adapting to the pandemic. *In World Bank Blogs* Available: https://blogs.worldbank.org/endpovertyinsouthasia/changing-face-tourism-and-work-how-maldives-successfully-adapting-pandemic [Accessed May 2022].

MAEKAWA, M., LANJOUW, A., RUTAGARAMA, E., & SHARP, D. 2015. Mountain gorilla ecotourism: Supporting macroeconomic growth and providing local livelihoods. *Livelihoods, Natural Resources, and Post-Conflict Peacebuilding*, 167.

MATÍNEZ GARBUNO, D. 2022. Full Recovery? Mexico's passengers reached 95% in December. Simple Flying, Online story. Available: https://simpleflying.com/mexico-passenger-recovery-95-percent [Accessed April 2022].

PARKINSON, B. 2022. Despite omicron variant, Caribbean tourism hopeful for gradual rebound. *Travel Pulse Canada*, Online story. Available: https://ca.travelpulse.com/news/destinations/despite-omicron-variant-caribbean-tourism-hopeful-for-gradual-rebound.html [Accessed May 2022].

ROBERTS, S. 2020. Africa's year of zero: A special report on the future of wildlife tourism. *Financial Times*. https://amp-ft-com.cdn.ampproject.org/c/s/amp.ft.com/content/6a4f6c76-8a00-46ef-a645-23a5eda58825 [Accessed April 2022].

SILVA, A. 2021. An overview of the impact of COVID-19 on the cruise industry with considerations for Florida. *Transp Res Interdiscip Perspect*, 10, 100391.

UN. 2020. What COVID-19 means for ecotourism. *United Nations Environment Programme*, Online story. Available: https://www.unep.org/news-and-stories/story/what-covid-19-means-ecotourism [Accessed April 2022].

UNWTO. 2021. COVID-19 and tourism 2020: A year in review. *World Tourism Organization*, Online publication. Available: https://www.unwto.org/covid-19-and-tourism-2020 [Accessed April 2022].

WORLD BANK. 2022. *World Bank Open Data*, Online database. Available: https://data.worldbank.org/ [Accessed April 2022].

WHO. 2022. Timeline: WHO's COVID-19 response. World Health Organization, Online resource. https://www.who.int/emergencies/diseases/novel-coronavirus-2019/interactive-timeline#event-17 [Accessed May 2022].

WORLD TRAVEL & TOURISM COUNCIL. 2019. Economic impact reports. *World Travel and Tourism Council*, Online database. Available: https://wttc.org/Research/Economic-Impact [Accessed April 2022].

WORLD TRAVEL & TOURISM COUNCIL. 2021. Travel & tourism economic impact 2021: Global economic impact and trends. *World Travel & Tourism Council*, Online publication. Available: https://wttc.org/Portals/0/Documents/Reports/2021/Global%20Economic%20Impact%20and%20Trends%202021.pdf [Accessed April 2022].

PHOTO: JOHN HOGG, WORLD BANK

6

COVID-19'S IMPACTS ON TRADE, UNEMPLOYMENT AND GDP

SUMMARY

- Unemployment increased globally by 15% between 2019 and 2021. The Tropics unemployment rate increased from 6.6 to 8.1% over this period, an increase of 22%.
- Regionally, unemployment impacts were very uneven, with Central America, South America and South East Asia having relative increases on 2019 rates of over 30%. In contrast, Central and Southern Africa, Northern Africa and the Middle East, and the rest of the world had relative increases below 15%.
- Female unemployment, already higher than male unemployment, increased to a greater extent during the pandemic. This risks increasing gender inequality into the future.
- Both maritime and air trade contracted during the pandemic, but for maritime trade, at least, 2021 saw a partial recovery. The medium-term outlook suggests maritime trade will continue below pre-pandemic levels.
- Migrant labour was heavily impacted during the pandemic through increases in unemployment, strandings in-country and increased exploitation. Despite this, remittances did not decrease as much as expected, and in some regions, increased over the pandemic.

INTRODUCTION

The global economy has been relatively stable over the last 10 years, with annual increases in GDP hovering around 3% (World Bank, 2022). The consequences of COVID-19 and efforts to contain it triggered the largest economic recession in history (Buffie et al., 2022). The flow-on effects, both domestically and internationally, were immense. Stringent measures to combat the pandemic caused negative economic growth, decreased trade, reduced business revenues and major increases in unemployment. The global economy contracted by 3.1% in 2020, but recovery in many economies was rapid, rebounding in 2021 (IMF, 2021; 2022).

Border closures and community lockdowns caused a significant increase in unemployment. People, especially migrant workers and others employed in the casualised or informal employment sector, were disproportionately affected by this. For those living close to the poverty line, this was sufficient to push them into extreme poverty. The United Nations suggests as many as 124 million extra people have been pushed into extreme poverty as a result of the pandemic (UN, 2021). This is the first rise in the number of people in extreme poverty since the Asian financial crisis in 1998 and reversed the improvements of the previous four years (UN, 2021).

TRENDS

Unemployment

The effects of the pandemic on employment were felt across the world in 2020 and 2021. Global unemployment has been stable since 2011 at around 5.4%. The 2020 pandemic and associated economic contractions saw global unemployment increase to 6.6% (see Figure 6.1). There was a slight improvement in global unemployment in 2021, although levels are still above pre-pandemic rates.

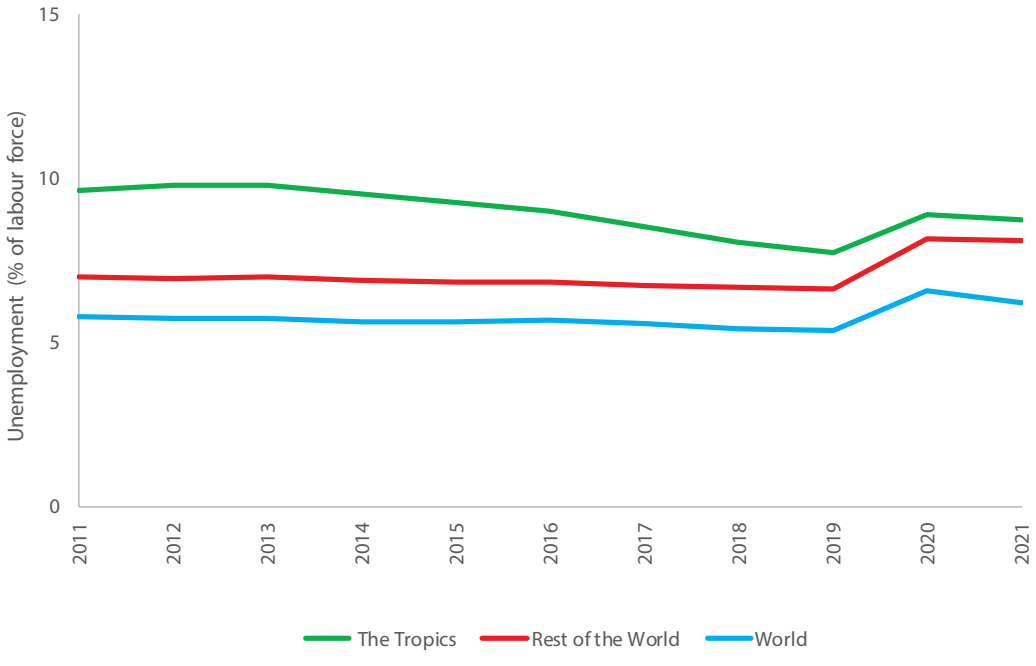

Figure 6.1 Unemployment as a proportion of the labour force 2011–2021 in the Tropics, the rest of the world and globally.

Source: World Bank 2022

Unemployment for the rest of the world has been steadily decreasing since 2011 but is higher than rates in the Tropics (see Figure 6.1). The pandemic saw unemployment in the rest of the world increase to 8.9% before recovering slightly in 2021 to 8.7%.

Prior to 2020, unemployment in a number of tropical regions was either stable or declining (see Figure 6.2). With border closures and lockdowns, unemployment rates increased across all tropical regions in 2020. The Tropics experienced a greater increase in unemployment in 2020. Employment recovery was patchy in 2021, with employment improving in some regions but not all. Overall, unemployment did not improve in 2021 in the Tropics.

Most tropical regions experienced significant rises in unemployment in 2020 (see Figure 6.2). Central America experienced a 54% increase in unemployment, with South America increasing by 38% and South Asia by 32% (see Figure 6.2). All three regions reported a slight improvement in 2021, but others continued to decline.

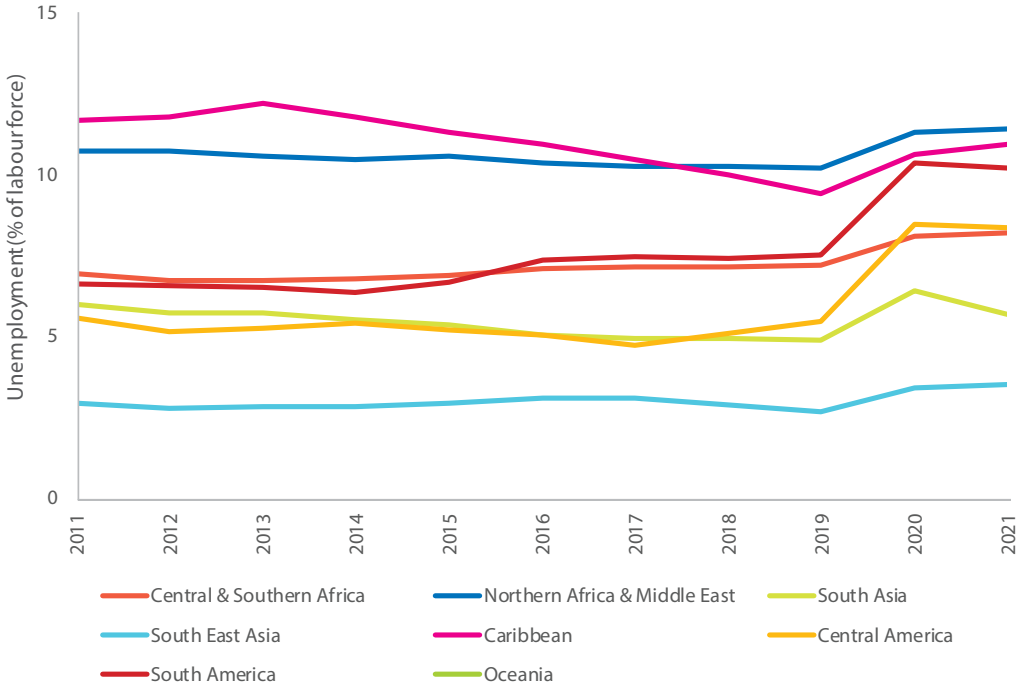

Figure 6.2 Unemployment as a proportion of the labour force 2011–2021 across tropical regions.

Source: World Bank 2022

Across employment sectors, hospitality and retail were the hardest hit due to lockdowns. These sectors are also responsible for a greater proportion of female employment. In regions highly dependent on tourism, unemployment rates were the highest. It is estimated that the tourism sector in the Caribbean made almost 25% of its workforce redundant during the pandemic (World Travel and Tourism Council, 2019).

Gender-related unemployment highlights the disparity between employment opportunities for men and women globally. Even before the outbreak of COVID-19, female unemployment rates were higher globally and across all tropical regions (see Table 6.1). In 2021, female unemployment rates had increased to a higher level compared to males across all tropical regions, with the exception of South Asia and Northern Africa and the Middle East (see Table 6.1). This has led some authors to label the employment and economic impacts of COVID-19 as a 'she-cession' (Fabrizio et al., 2021).

For many women, employment is more insecure, with a greater proportion of women employed in casual positions compared to their male counterparts. With the pandemic and associated lockdowns, women were more likely to lose either working hours or jobs. In Ecuador, there was a 20% increase in female unemployment primarily impacting those in lower paid positions or those self-employed (Esteves, 2020). Combined with the higher levels of job insecurity, school closures also placed a greater responsibility on women as the primary carers in their households. Collectively, these issues have contributed to increased gender divides in income and reversed some of the progress made towards gender equality in recent years (World Economic Forum, 2021).

PHOTO: SALAHALDEEN NADIR, WORLD BANK

Table 6.1 Gender unemployment rates as % of respective labour forces in 2019 and 2021.

Source: World Bank 2022

REGION	MALE 2019	MALE 2021	% INC	FEMALE 2019	FEMALE 2021	% INC
Central and Southern Africa	6.6	7.5	13	8.0	9.2	15
Northern Africa and Middle East	8.7	9.7	12	15.0	16.4	10
South Asia	4.3	5.1	19	5.8	6.6	13
South East Asia	2.6	3.4	31	2.8	3.6	31
Caribbean	8.8	10.1	16	10.1	11.9	17
Central America	4. 6	6.8	50	6.9	10. 7	55
South America	6.3	8.4	33	9. 7	12.7	38
Oceania	5.5	6.4	17	6.1	7.1	17
The Tropics	5.9	7.2	21	8.0	9.8	22
Rest of the World	7.1	8.0	12	9.4	10.7	14
World	6.2	7.4	19	8.3	10.0	20

GDP

Annual increases in GDP ranged from 1.5 to 5.3% across tropical regions in 2019. COVID-19's impacts on economic output and productivity sent annual GDP negative globally, including in all tropical regions in 2020 (see Figure 6.3). Prior to the pandemic, the annual GDP in the Tropics was 3.3% compared to 2.6% for the rest of the world. The pandemic impacted the Tropics to a greater extent, falling to –5.4%, while the rest of the world dropped to –5.0% (see Figure 6.3).

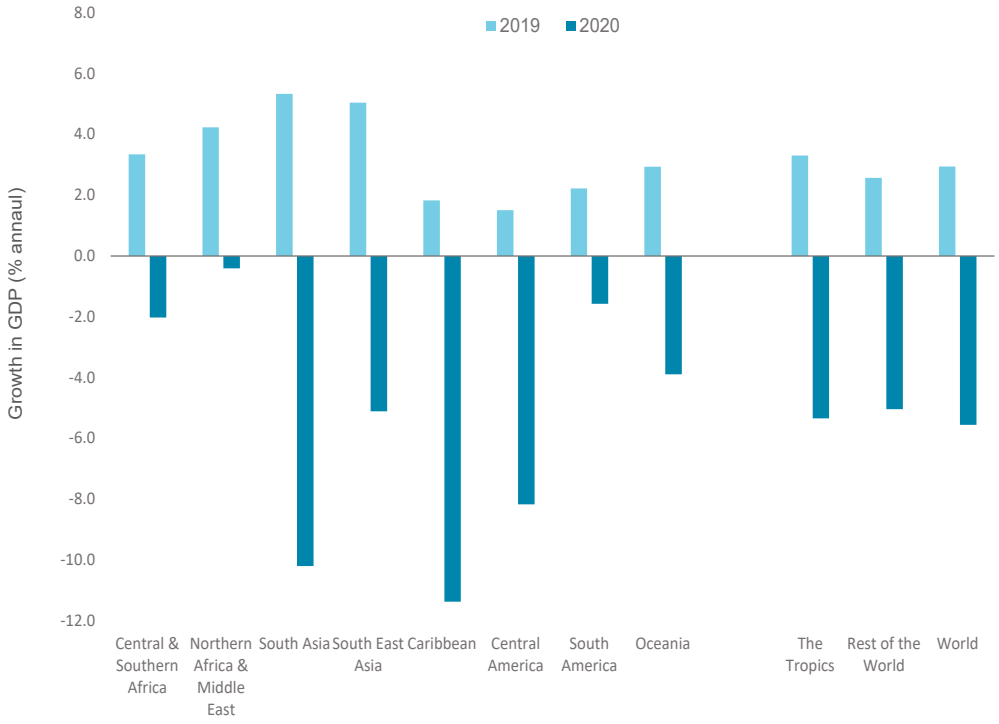

Figure 6.3 Growth in GDP as annual % for 2019 and 2020.

Source: World Bank 2022

South Asia was most severely impacted, with a drop from 5.3% in 2019 to –10.2% in 2020. The Caribbean reported the lowest GDP with a contraction, to –11.4%, in 2020 (see Figure 6.3). As a region heavily reliant on international tourism, the closure of international borders and the collapse of the aviation and cruise industries heavily impacted economic activity in the Caribbean (see Chapter 5). Northern Africa and the Middle East were the most resilient to the COVID-19-driven economic downturn, contracting from 4.2 to –0.4% over this period.

When economies contract, inequalities in income and wealth tend to increase. Outcomes indicate that the economic downturns experienced during the pandemic have pushed as many as 124 million extra people into poverty (UN, 2021). Economic recovery in 2021 was rapid, although inflationary pressures and ongoing supply-chain issues suggest that the global economy is still fragile. This does not provide a stable platform from which those pushed into poverty by the pandemic can recover.

Cargo movements

Cargo movements by air and by sea contracted during the pandemic in 2020. Globally, airfreight contracted by 19% from 2019, while the Tropics contracted by 36%. Like most other measures of COVID-19's impact, the effects across the tropical regions were variable. Airfreight in Northern Africa and the Middle East decreased by 68% over this period, while Central and Southern Africa recorded a modest 1% increase (see Figure 6.4). Central America, South East Asia and South Asia all recorded decreases above 30%.

Northern Africa and the Middle East are heavily dependent on food imports, with almost half of all food imported into the region (Le Mouël & Schmitt, 2018). The region is also a major exporter of natural resources, particularly fuel exports, accounting for 60% of export value in 2019 (WITS, 2022). This makes this region particularly vulnerable to supply-chain interruptions, such as they experienced during the pandemic.

Like the air transport industry, maritime trade contracted during the COVID-19 pandemic. In 2020, global maritime trade contracted by 3.8% (UNCTAD, 2021). During this time, a number of deficiencies in the maritime industry were exposed. These included deficiencies in infrastructure and labour shortages, both of which were compounded by the pandemic.

During the pandemic, many vessels reported outbreaks of COVID-19 among crew. This created issues with cargo and passenger transfers, with infected ships refused docking permissions in some ports due to the virus (Euronews, 2021). COVID-19 caused hundreds of thousands of maritime crew to be stranded at sea due to border shutdowns and flight restrictions. Crews coming off contract were unable to be repatriated to their home country or replaced (UNCTAD, 2021).In other instances, crews were required to continue working beyond their contracts due to difficulties in onboarding replacement personnel. The biggest effect of the maritime slowdown was on small island nations and low-income countries, who were especially dependent on maritime trade (UNCTAD, 2021).

Trade recovered to around 4% in 2021, but long-term projections suggest it will continue to operate at lower than pre-COVID levels in the medium term. These slow-downs are due to a range of factors, including trade tensions, increases in freight prices and shifts in trade patterns to address the lack of supply-chain resilience exposed by the pandemic (UNCTAD, 2021).

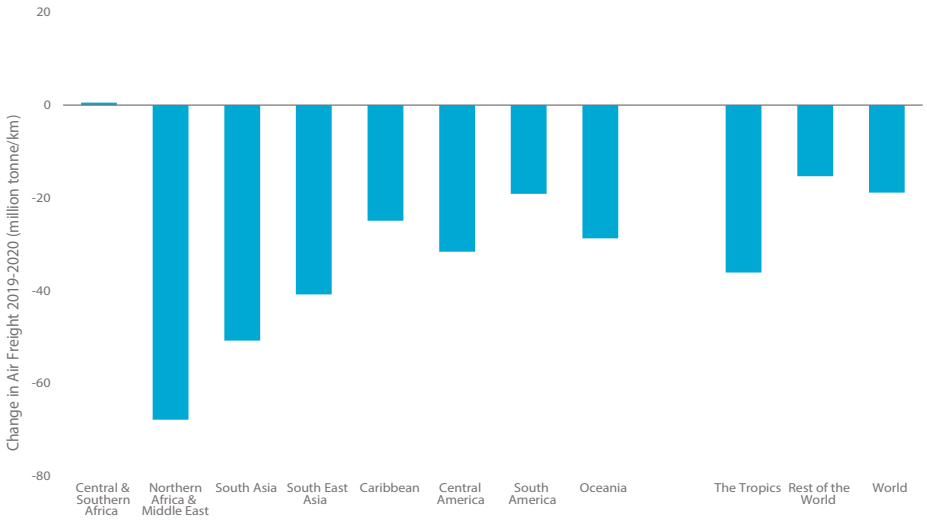

Figure 6.4 Decline in air freight carried between 2019 and 2020 (million T/km).

Source: World Bank 2022

As well as having direct impacts on freight and cargo movements, the pandemic also put a focus on the lack of reliance on the global economy due to limited inventory models. Those organisations reliant on 'just-in-time' economies suffered from a lack of inventory with pandemic driven supply-chain interruptions (UNCTAD, 2020). This caused flow-on interruptions through the wider trade sector.

Many of these organisations are now reviewing processes to redress some of these issues. This return to a more resilient inventory approach is likely to create its own issues in the short-term with ongoing inventory shortages while stocks are increased, but once established, should improve resilience in supply chains long-term.

LABOUR MIGRATION AND REMITTANCE FLOWS

Migrant labour is a major contributor to the workforce globally. It is estimated that there are around 244 million migrant workers around the world (ILO, 2022). For many of these workers, the need to travel for work is dictated by a range of non-choice directives, including displacement due to war, famine and climate change (ILO, 2021a). The migrant work community was heavily impacted by the pandemic in 2020. Due to the structure of the migrant worker market, they were more likely to lose their jobs during the pandemic, often without notice. The impacts were cumulative as they were often not eligible for social support networks

put in place by governments during the pandemic. Frequently, they were stranded in countries without work due to border closures, and if they could return to their own country, they were stigmatised as potential transmitters of COVID-19 (ILO, 2021b).

In Thailand, around 55% of female migrant workers were paid less than the minimum wage during the pandemic, with around 63% also reporting wage reductions. COVID-19 unemployment rates increased to 25% between April and June 2020, with women suffering higher levels of unemployment than men (IOM, 2021). For those migrant workers that did return home during the pandemic, life was not much better due to a lack of employment opportunities in their own country, meaning a lack of income for themselves and their families.

While migrant workers are often considered a marginalised sector within the community, the remittances they send home are a major source of foreign income for many countries. Remittance funding exceeds official development aid funding (Migration Data Portal, 2021).

Despite the challenges that occurred during the pandemic, remittances to low- and middle-income nations did not decrease anywhere near the expected amount. While remittance inflows fell for East Asia and the Pacific, inflows increased into Latin America, the Caribbean, South Asia and North Africa and the Middle East (World Bank, 2022). Sub-Saharan Africa's inflows decreased, but that was driven by declines in remittances to Nigeria alone (World Bank, 2021). This perceived mis-match largely reflects the shift of remittances from the unregulated sector into the regulated sector with reduced migrant movement during the pandemic.

THE TROPICAL PERSPECTIVE

Both economic and unemployment impacts in the Tropics from COVID-19 have been greater than in the rest of the world. This is continuing to drive inequity and inequality in low- and middle-income nations.

Migrant workers and women are the most vulnerable to exploitation under these conditions. The contributions that the migrant worker community provides to their home country through remittances are significant. This income is a major source of foreign income for many nations, making the migrant workforce a key contributor to national GDP.

Women are more likely to be employed in jobs that are insecure and poorly paid. This puts them at greater risk of being pushed into poverty when economic shocks like the COVID-19 pandemic occurs. They also bear a greater burden of responsibility for in-home care when education or childcare disruptions occur.

GOING FORWARD

The role of migrant workers in the global economy is critical, yet they continue to be marginalised and exploited in many places. Ensuring appropriate protections and support networks for them is critical to providing sustainable economic growth and guaranteeing that their human rights are protected.

The economic impacts of the pandemic will continue to be felt in both the short and medium term. One key outcome of the pandemic has been a drive to embrace digital technologies. Many industries and governments are embracing this shift as a way of increasing productivity and efficiencies in operations. However, there is a risk that these shifts to online platforms are likely to see the abolition of many existing jobs. How these jobs are transitioned to the new platforms will determine whether the shifts in wages and employment are positive or negative. If it is the latter, it risks further increasing income and gender inequalities, particularly for vulnerable sectors of the community (UN, 2020).

REFERENCES

BUFFIE, E.F., ADAM, C.S., ZANNA, L-P., & KPODAR, K.R. 2022. Loss-of-learning and the post-covid recovery in low-income countries. *International Monetary Fund* eLibrary. Available: https://www.elibrary.imf.org/view/journals/001/2022/025/article-A001-en.xml [Accessed May 2022].

ESTEVES, A. 2020. 'El impacto del COVID-19 en el mercado de trabajo de Ecuador', *Mundos Plurales - Revista Latinoamericana De Políticas Y Acción Pública*. 7 (2), 35–41.

FABRIZIO, S., GOMES, D.B.P., & TAVARES M.M. 2021. COVID-19 She-cession: The employment penalty of taking care of young children. *International Monetary Fund*. Working paper WP/21/58.

ILO. 2021a. Impact of COVID-19 on nexus between climate change and labour migration in selected South Asian countries: An exploratory study. *International Labour Organization*, web PDF, Available: https://www.ilo.org/wcmsp5/groups/public/---ed_protect/---protrav/---migrant/documents/publication/wcms_822838.pdf [Accessed May 2022].

ILO. 2021b. COVID-19 has made life even more precarious for migrant workers. *International Labour Organization*. Available: https://www.ilo.org/global/about-the-ilo/newsroom/news/WCMS_829452/lang--en/index.htm [Accessed May 2022].

ILO. 2022. International labour standards on migrant workers. *International Labour Organization*. Available: https://www.ilo.org/global/standards/subjects-covered-by-international-labour-standards/migrant-workers/lang--en/index.htm [Accessed May 2022].

IMF. 2021. World economic outlook: Recovery during a pandemic—Health concerns, supply disruptions, price pressures. *International Monetary Fund*, October 2021.

IMF. 2022. World economic outlook: War sets back the global recovery. *International Monetary Fund*, April 2022.

IOM. 2021. Socio-economic impact of COVID-19 on migrant workers in Cambodia, Lao People's Democratic Republic, Myanmar and Thailand. *International Organization for Migration*.

MIGRATION DATA PORTAL. 2021. Migration & development, remittances. *Migration Data Portal*, Online database. Available: https://www.migrationdataportal.org/themes/remittances [Accessed April 2022].

LE MOUËL, C., & SCHMITT, B. 2018. Food dependency in the Middle East and North Africa region: Retrospective analysis and projections to 2050. *Springer Dordrecht.* (eBook).

WORLD BANK. 2022. *World Bank Open Data*, Online database. Available: https://data.worldbank.org [Accessed April 2022].

WORLD ECONOMIC FORUM. 2021. Global gender gap report 2021 – Insight report.

UN. 2020. COVID-19 to slash global economic output by $8.5 trillion over next two years. *United Nations Department of Economic and Social Affairs*, Online news story. Available: https://www.un.org/development/desa/en/news/policy/wesp-mid-2020-report.html [Accessed May 2022]

UN. 2021. UNSTATS. *United Nations Department of Economic and Social Affairs*, Statistics Division, Online report. Available: https://unstats.un.org/sdgs/report/2021/goal-01 [Accessed May 2022].

UNCTAD. 2020. COVID-19 cuts global maritime trade, transforms industry. *United Nations Conference on Trade and Development*, Online news story. Available: https://unctad.org/news/covid-19-cuts-global-maritime-trade-transforms-industry [Accessed May 2022].

UNCTAD. 2021. Maritime trade weathers COVID-19 storm but faces far-reaching knock-on effects. *United Nations Conference on Trade and Development*, Online report. Available: https://unctad.org/news/maritime-trade-weathers-covid-19-storm-faces-far-reaching-knock-effects [Accessed May 2022].

WITS. 2022. Middle East & North Africa trade summary 2019. *The World Bank,* World Integrated Trade Solutions, Online database. Available: https://wits.worldbank.org/CountryProfile/en/Country/MEA/Year/LTST/Summarytext [Accessed April 2022].

WORLD TRAVEL & TOURISM COUNCIL. 2019. Economic impact reports. *World Travel and Tourism Council*, Online database. Available: https://wttc.org/Research/Economic-Impact [Accessed April 2022].

PHOTO: CHHOR SOKUNTHEA, WORLD BANK

COVID-19: PERSONAL INSIGHTS ON WORKING TRANSNATIONALLY DURING A PANDEMIC

MS ELVIERA PUTRI, ENVIRONMENTAL & REGULATORY ADVISOR, JAKARTA, INDONESIA

PHOTO: F LATIEF, ILO

As an Environmental and Regulatory Advisor collaborating with a multi-national corporation across multiple countries, I have had the opportunity to observe many of the challenges COVID-19 has had across diverse cultures and communities.

With the emergence of the COVID-19 pandemic in 2020, lockdowns in the USA, Middle East and South East Asia had major economic impacts on the oil and gas industry. As economies across the world shut down and energy use declined, demand for oil dropped sharply in 2020, leading to a drop in oil prices for many multi-national oil and gas companies, including ExxonMobil, BP and Chevron (Business Standard, 2021; Reuters, 2021). ExxonMobil responded by closing, shelving, or re-evaluating multiple projects. Other cost-cutting measures included the loss of 14,000 jobs across their operations, many in South East Asia (S&P Global, 2020; NS Energy, 2021; Reuters, 2021). These cost-cutting measures also had flow-on effects on many contractors and service companies providing supporting roles to these companies.

As an Environmental and Regulatory Advisor within ExxonMobil, I was seconded from Indonesia to Houston, USA, for a three-year program. During the secondment, I regularly commuted between Houston, Brazil, Malaysia and Indonesia. Completion of the secondment occurred in July 2020, in the middle of border closures and travel restrictions across much of the globe. Where previously flights between Houston and Jakarta were readily available via hubs in the Middle East (Doha, Dubai and Abu Dhabi), travel at that time was more complex. Due to limited flights, I was delayed in departure for a month. The actual flights required transits in unusual locations (in this case via Chicago), and layover locations imposed strict movement restrictions on passengers. Unlike previous trips, transit in Doha or Dubai was very surreal. As an air transport hub, the international airport was vibrant and busy prior to the pandemic. On this trip, there were very few businesses operational and very few travellers, creating a very quiet and slightly eerie experience.

In Jakarta, government-imposed lockdowns required a rapid transition to alternative working arrangements. This had both positive and negative effects on employees and the wider community.

Some of the positive aspects observed from changed workplace arrangements included higher productivity through less time spent commuting between home and work. The rapid transit to online communication options, including video conferencing, also increased productivity through reduced commutes between meeting venues. There were also observable improvements in air quality in Jakarta from reduced vehicle emissions. A recent survey of employees within my organisation indicated that around half would prefer to continue at least a partial working-from-home regime.

The increased productivity through working from home also had negative influences. Management expected continuous access to staff irrespective of the time of day. This impacted the work-life balance of many employees who felt pressured by this expectation from their supervisor. This caused increased anxiety and decreased the decision-making capability of some staff.

There are also some wider observations of the differences in community and individual responses to the pandemic between the USA and Indonesia. There was a greater level of individualism observed in the USA, shown by higher levels of concern from individuals about government directives on public health measures, including mask-wearing and vaccinations. Overt displays of non-compliance were common by individuals in many locations. Isolation, working from home and similar social aspects appeared, on the surface at least, to have less of a mental health impact on employees in the USA. Where mental health issues arose, employees were generally proactive in seeking advice and support.

In contrast, the Indonesian community is much more of a collective group, relying extensively on social interactions. Public health directives for lockdowns and isolation significantly impacted the mental health of employees and the wider Indonesian community. There were observations of increased mental health issues coupled with reports of increased domestic violence. As a nation, Indonesia considers discussions around mental health and domestic violence to be distasteful and objectionable, so the fact that these issues were raised indicates that they were high-level concerns.

Vaccination uptake rates were variable and slow in many parts of Indonesia. There was a combination of the spread of misinformation through social media, access limitations and religious concerns that impacted initial uptake rates. Over 85% of Indonesians identify as Muslim, and initial vaccine hesitancy was linked to concerns about whether the vaccinations were Halal. Public health challenges in vaccination uptake in Indonesia were managed by a range of initiatives, from activity and travel restrictions to withholding of social incentives. People who refused vaccinations were ineligible for social security and were banned from travel during key holiday periods, including Ramadhan. With the high level of vaccination that now exists in Indonesia, many of the previous restrictions are starting to ease, allowing a return to more normal, pre-pandemic activities.

PHOTO: F LATIEF, ILO

REFERENCES

BUSINESS STANDARD. 2021. Hit by Covid-19 pandemic, oil giants Exxon, BP post huge 2020 losses. *Business Standard*, Online news story. Available: https://www.business-standard.com/article/international/hit-by-covid-19-pandemic-oil-giants-exxon-bp-post-huge-2020-losses-121020300184_1.html [Accessed April 2022].

NS ENERGY. 2021. ExxonMobil to cut 300 jobs in Singapore due to Covid-19 impact. *NS Energy*, Online news story. Available: https://www.nsenergybusiness.com/news/exxonmobil-singapore-job-cuts-2021 [Accessed April 2022].

REUTERS. 2021. Exxon Mobil's total reserves drop by a third after COVID-19 oil price drop. *Reuters*, Online news story. Available: https://www.reuters.com/article/us-exxon-mobil-outlook-idUSKBN2AO2ZB [Accessed April 2022].

S & P GLOBAL. 2020. Total, Exxon demobilize PNG LNG expansion workers due to COVID-19: Oil Search. *S&P Global Commodity Insights*, Online news story. Available: https://www.spglobal.com/commodityinsights/en/market-insights/latest-news/natural-gas/072120-total-exxon-demobilize-png-lng-expansion-workers-due-to-covid-19-oil-search [Accessed April 2022].

PHOTO: KIBAE PARK, UN

7

COVID-19'S IMPACTS ON TROPICAL ENVIRONMENTS

SUMMARY

- Globally, CO_2 emissions decreased by almost 5% between 2019 and 2020 due to economic lockdowns and border closures. However, this reduction was only temporary, with emissions increasing back to pre-COVID levels by the end of 2021.
- CO_2 emissions in the Tropics decreased by almost 6% over this period, with emissions in Central America decreasing by 17%. The decrease in CO_2 emissions in the rest of the world was lower despite having higher overall emissions.
- Major increases in plastic waste from discarded PPE and food containers have reversed many of the plastic recycling gains made in recent years.
- Reductions in noise and air pollution during the pandemic have been linked with behavioural changes in some migratory birds. Increases in bird diversity and increased residence times were observed in India and Colombia.
- There are concerns that the increased production and use of sanitisers and disinfectants are having impacts on the ecology and health of soil and aquatic biota.
- Wildlife trafficking and tropical deforestation increased in Brazil, Colombia and Cambodia during the pandemic.
- Weakened enforcement and regulation during the pandemic saw increases in illegal activities, including mining, fishing and poaching. However, much of this illegal activity has been driven by the loss of jobs and incomes in communities with few other economic options.

INTRODUCTION

Many tropical environments face strong pressures from population growth, agricultural expansion, habitat loss and ecosystem fragmentation (Tilman, 1999; State of the Tropics, 2014). Globally, the human population is predicted to reach 11 billion by the end of this century, with the greatest population increases predicted to occur in developing tropical nations (Laurance et al., 2014). Some areas in Africa are predicted to double their population by 2050 (Paice, 2022).

These underlying stressors have been exacerbated by the effects of the COVID-19 pandemic. Loss of jobs and incomes and restrictions on movements have placed greater pressure on the ecosystem services used within each society. However, slow-downs in production and the movement of goods have also reduced ecosystem exports, offsetting other demands on the environment.

Environmental pressures exert their own feedback loop on global health risks. Researchers have found a significant relationship between forest clearing, poaching and the emergence of new zoonotic diseases (Allen et al., 2017; Rulli et al., 2017; Matthews, 2020; Zhang et al., 2020). Humans and animals living in close proximity increase the likelihood of transmission of zoonotic diseases. COVID-19 is the most recent and globally significant example of a zoonotic pandemic, but it follows a series of recent outbreaks, including SARS, MERS and Ebola.

TRENDS

CO_2 emissions

CO_2 emissions decreased across the globe during 2020 (see Figure 7.1). Central America had the biggest reduction in CO_2 emissions in the Tropics, with a 17% decrease from 2019 to 2020. Northern Africa and the Middle East had the smallest reduction in CO_2 emissions over this period, largely due to their key position in fossil fuel production. Overall, the Tropics decreased CO_2 emissions by 5.5%, while emissions in the rest of the world decreased by 4.4% over the same period.

Globally, the transport sector contributes around 20% of annual CO_2 emissions (Ritchie, 2020). It is estimated that road transport decreased by almost 50% in 2020 due to pandemic driven lockdowns and economic slow-down (IEA, 2020). The reduction in transport due to lockdowns and international border closures was a major driver of decreases in CO_2 emissions in 2020. Air transport experienced major decreases in 2020, with over 60% of the global passenger fleet being grounded due to the closure of international borders. Much of the reduction in CO_2 emissions in Central America and the Caribbean was caused by the almost complete shutdown of the cruise and air transport industry in these regions (see Chapter 5).

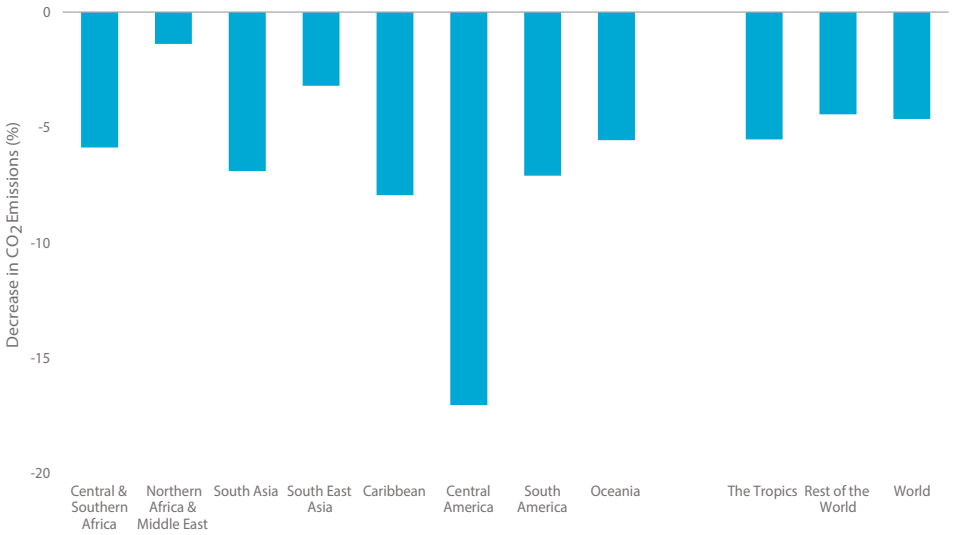

Figure 7.1 Decrease in CO_2 emissions (Mt CO_2) from 2019 - 2020.

Source: Friedlingstein et al. 2021

The 2020 decreases in CO_2 emissions were largely reversed in 2021 with a 4.9% increase (Adler, 2021). Increases in coal consumption by major CO_2 emitters, including China, India, the USA and the European Union, were the major contributors to the rebound in emissions in 2021 (Adler, 2021). To achieve net-zero by 2050, it is estimated that CO_2 emissions need to be reduced by 1,400 million tonnes per year—equivalent to the decrease in emissions in 2020.

FISHERIES AND OCEANS

The global fisheries industry has been impacted in a number of ways by the pandemic. Border closures, reduction of air traffic, lockdowns, compulsory PPE and social distancing, created a range of problems for the fishing industry. Overall, it is estimated that the global fishing industry contracted by 10% from 2018-19 (Dasgupta, 2020). This generated a chain of events that led to the collapse of many fisheries and fish markets, especially small-scale fisheries along with increases in illegal, unregulated and unreported (IUU) fishing in some areas.

The imposition of these restrictions not only generated problems at the individual level but also at the household and community level (Sultana et al., 2021). At the household level, many families were affected by malnutrition and/or violence due to income pressures, with these outcomes repeated across many countries in the Tropics (Sultana et al., 2021).

In Bangladesh, along with many other coastal regions in the Tropics, fish and fishing is an important income source as well as a primary source of protein for fishing families (Sunny et al., 2021). Around 11% of the population is involved directly or indirectly in the fisheries sector. The imposition of the 65-day lockdown meant most of these people were unable to catch, sell, harvest or process fish and fish products, placing extreme pressure on income sources (Department of Fisheries Bangladesh, 2020). Similar challenges have been reported for the fisheries sector in other nations, including Sri Lanka and Kenya (Azmy et al., 2021; Sunny et al., 2021).

The lockdowns also affected recreational fisheries in many countries. In April and May 2020, fishing for food was a permitted outdoor activity under strict movement controls in Queensland, Australia. During this time, boat numbers at many ramps were the highest on record as more people used fishing as both a recreational activity and food resource (Major, 2021). In contrast, Uruguay, although not imposing mandatory lockdowns, closed fishing ports led to reductions in recreational fish landings of up to 25% (Pita et al., 2021). In Saudi Arabia, the recovery of fish stocks and other marine organisms was attributed to reductions in pollution and commercial fishing pressures (Khan et al., 2021). In other regions though, there were reports of increases in IUU fishing activities. Both Indonesia and Argentina reported increases in illegal fishing activity by foreign vessels (Bennett et al., 2020). Some Caribbean nations saw increases in illegal small scale fisheries by locals to meet food requirements as a response to the tourism downturns due to COVID-19. Suspension of on-board observers hindered the capacity of monitoring of many commercial fisheries activities.

Some sectors of the fishing industry were less impacted by COVID-19-imposed closures and lockdowns. The seaweed industry in Indonesia increased during the pandemic. Although seaweed prices dropped by 27%, there were production increases to offset this (Langford et al., 2021). As a dried product, it was able to be stored for longer without deterioration, making it more resilient to some of the supply-chain issues (Langford et al., 2021). Some in the fishing industry who lost employment in their traditional areas have transitioned to this market as an alternative business opportunity.

Other improvements were observed in environmental quality in marine systems during the pandemic. Surveys of beaches in Colombia and Cuba found significantly lower levels of rubbish compared to pre-lockdown levels (Bates et al., 2021). Water quality improvements were observed along beaches in many high population areas of Bangladesh, Malaysia, Thailand, the Maldives, Indonesia and Mexico (Mousazadeh et al., 2021; Rume & Islam, 2020).

PHOTO: MARTINE PERRET, UN

PHOTO: MARTINE PERRET, UN

HUMAN INTERACTIONS WITH THE ENVIRONMENT

During the peak of worldwide lockdowns in April 2020, 4.4 billion people (or 57% of the world's population) were told to stay home (Bates et al., 2021). Researchers are referring to this period as the 'Great Pause' or the 'Anthropause' (Rutz et al., 2020). These global lockdowns provide a unique opportunity to examine some of the broad-ranging impacts of human activity on the environment.

The reduction in CO_2 emissions associated with the slow-down in worldwide travel presented a positive outcome for the environment. Other positive influences included reductions in wildlife interactions, air pollution, land surface temperatures, noise and industrial waste (Khan et al., 2021; Rume & Islam, 2020).

The COVID-19 lockdowns led to greatly reduced interactions between people and wildlife and decreased stress on wildlife in many areas. In Colombia, bird diversity in suburban areas of Cali increased by an average of 37% during the peak lockdown period (Bates et al., 2021). There have also been fewer vehicle interactions with wildlife. Studies of vehicle strikes found that pandemic traffic reductions resulted in fewer animal deaths on roads (Bittel, 2020).

Reduced traffic movements have also improved air and water quality in urban settings and in areas frequented by wildlife, leading to improved human health outcomes (Neupane, 2020).

In India, reductions in noise and air pollution have been linked to behavioural changes in some migratory bird species. Increased periods of residence in sanctuaries have had a corresponding benefit to the safety and security of these species (Bar, 2021). Reduction in the food fed to wildlife during marine tourism also brought about behavioural change in species recorded in the Bahamas during the lockdown (Bates et al., 2021). These outcomes generally represent positives for biodiversity from the perspectives of both a reduced human footprint and improved ecosystem conditions (Muche et al., 2022). A better understanding of ecosystem responses to changes in human behaviour can inform the policy roadmap for future sustainable development.

Decreases in global land surface temperatures were also attributed to reduced anthropogenic activity. This resulted in between a 5% and 75% reduction in forest fires with a concurrent increase in primary productivity in these areas (Lele et al., 2021).

On the downside, responses to the pandemic necessitated many trade-offs between environmental health and public health. Discarded PPE can become deadly when accidentally ingested by animals (Ankit et al., 2021). Mass use of sanitisers and disinfectants poses severe threats to soil ecosystems (Asayama et al., 2021;

Benson et al., 2021a; Klemeš et al., 2020; Zhu et al., 2020). Sodium hypochlorite, used for disinfection purposes on hard surfaces, is also extremely toxic to soil microorganisms (Atolani et al., 2020). Increased use of other sanitising agents can pollute groundwater and affect aquatic species (Ankit et al., 2021; Rume & Islam, 2020).

Some urban wildlife also suffered during the COVID-19 lockdowns, as closures of restaurants and the absence of food waste led to a reduction in food resources (Ankit et al., 2021). Another recurrent theme in many developing countries was the abandonment of pets by their owners for fear they might spread the virus (Ankit et al., 2021).

In many tropical countries, the COVID-19 lockdown adversely affected the implementation of environmental monitoring and surveillance activities. Home confinement meant that reporting functions and efforts to ensure transparency were compromised. In many areas, national park officials were unable to enforce environmental laws, which resulted in increases in illegal activities such as hunting and fishing (Bates et al., 2021).

Pangolins are already among the world's most heavily trafficked animals, but it is estimated that pangolin trafficking increased in South Asia by more than 500% during the pandemic (Aditya et al., 2021). Illegal pangolin trade was also reported in parts of South East Asia due to reduced protections during lockdowns (Aditya et al., 2021). This was despite recommended increases in pangolin protection by the WHO, the UN Environmental Programme (UNEP), and the International Organisation for Animal Health (OIE) to reduce the spread of the COVID-19 virus and reduce the risk of other novel zoonoses (Wildlife Conservation Society, 2022; Zhang et al., 2020).

Increases in poaching, bushmeat hunting and illegal logging increased biodiversity threats and deforestation across parts of Africa and Asia during the pandemic. Kenya recorded major increases in illegal ivory and bushmeat poaching and trade, while illegal logging and bushmeat harvesting led to increased environmental impacts in Cambodia (Conservation International, 2020). Poaching and bushmeat harvesting also posed an increased risk of exposure to other potential zoonoses. Similar increases in illegal activities were reported in many other nations including the Philippines during COVID-19 (Conservation International, 2020).

Tropical deforestation almost doubled in the first month following the global lockdown (Brancalion et al., 2020). At the same time, agricultural expansion accelerated deforestation and forest fires in Colombia during 2020 (Conservation International, 2020 ; Rueda, 2022). Tropical deforestation has been linked to an increased risk of exposure to emerging zoonotic diseases with pandemic potential (Allen et al., 2017; Rulli et al., 2017). Lockdowns caused many tropical conservation programs to be halted or relaxed, leading to increases in exploitation. The use of remote sensing and other alternative technologies have been recommended to address the shortfall in monitoring capabilities during the pandemic. Technologies with less reliance on field personnel, for example, satellite technology to track deforestation, may be essential in future lockdowns (Finer et al., 2018).

Unfortunately, many people, particularly in marginalised communities, do not have social support networks in times of crisis and are very vulnerable economically (Gardner, 2020). For these communities, natural resource extraction is often the only option for those who left in this position due to natural or health crises. Regardless of education level, subsistence fishing or harvesting can provide a food source. Fears about food security led many in the Caribbean to return to fishing as a livelihood (Higgs, 2021). The queen conch fishery in the Bahamas saw a threefold increase in landings in the weeks after lockdown. The majority of the catch (90%) were illegal-sized juvenile animals, below the minimum sustainable threshold (Higgs, 2021).

WASTE PRODUCTION

While many forms of pollution decreased during the pandemic, public health measures resulted in significant increases in the use of plastic. To meet the demand for PPE, many governments suspended bans on single-use plastics (Nowlin et al., 2020). Major increases in plastic waste have been linked to single-use PPE, including protective gowns, disposable masks and gloves. Other measures to reduce the spread of COVID-19 saw the increased use of single-use takeaway food packaging in aged care facilities, hospitals, restaurants and cafes (Ankit et al., 2021; Benson et al., 2021a; Klemeš et al., 2020).

Post-lockdown, abnormally large crowds in parks caused masses of plastic litter when outdoor activities were permitted (Bates et al., 2021). During the lockdown in Singapore from late April to June 2020, residents discarded an additional 1,470 tonnes of plastic waste from takeaway packaging and food delivery alone (Bengali, 2020). Increases in plastic waste pose a threat to wildlife by choking waterways and contaminating the food chain. Some 300 million tonnes of plastic waste is produced each year—almost equivalent to the weight of the entire human population (UNEP, 2022). Island nations in particular suffer direct impacts from plastic pollution in the oceans as fishing is the primary occupation for many people. Many argue that COVID-19 has reversed the momentum of the battle against plastic waste that has been building over the last three decades (Benson et al., 2021b; Buranyi, 2018).

THE TROPICAL PERSPECTIVE

The highest CO_2 emissions reduction in 2020 was recorded in the Tropics. Decreases in tourism-associated transport have driven most of the CO_2 emissions reductions in the Caribbean and South America (Climate Champions, 2021). The reductions in emissions have been temporary, with a rebound to pre-COVID levels in 2021.

There were environmental benefits and costs imposed by the COVID-19 pandemic in the Tropics. Lockdowns and reduced traffic activity improved air, noise and water quality in many areas and had both human health and environmental benefits. The lack of social safety nets in many low-income nations led many people with limited income opportunities to turn to illegal activities, including deforestation, poaching, fishing and mining, as an income source.

GOING FORWARD

The COVID-19 lockdowns have revealed the positive and negative roles that humans play as custodians of tropical environments. Much of the scientific literature refers to 'anthropogenic impacts' and 'anthropogenic climate change,' alluding to human activities being the primary causes of environmental decline (Moore, 2017). However, human action is also necessary for conservation in many areas, particularly through citizen science, conservation management, restoration and enforcement. It is evident that bottom-up socio-ecological systems are essential to support conservation programs and environmental recovery post COVID-19. Humans pose the greatest risk to the ecosystems, through over-exploitation but offer the chance to effectively manage and protect it through sustainable policy and environmental regulation.

PHOTO: CURT CARNEMARK, WORLD BANK

REFERENCES

ADITYA, V., GOSWAMI, R., MENDIS, A., & ROOPA, R. 2021. Scale of the issue: Mapping the impact of the COVID-19 lockdown on pangolin trade across India. *Biological Conservation*, 257.

ADLER, K. 2021. Global CO_2 emissions to rise by 4.9% in 2021: Global Carbon Project. *IHS Markit*, Online news story. Available: https://cleanenergynews.ihsmarkit.com/research-analysis/global-co2-emissions-to-rise-by-49-in-2021-global-carbon-proje.html [Accessed: April 2022].

ALLEN, T., MURRAY, K.A., ZAMBRANA-TORRELIO, C., MORSE, S.S., RONDININI, C., DI MARCO, M., BREIT, N., OLIVAL, K.J., & DASZAK, P. 2017. Global hotspots and correlates of emerging zoonotic diseases. *Nature Communications*, 8(1).

ANKIT, KUMAR, A., JAIN, V., DEOVANSHI, A., LEPCHA, A., DAS, C., BAUDDH, K., & SRIVASTAVA, S. 2021. Environmental impact of COVID-19 pandemic: more negatives than positives. *Environmental Sustainability*, 4(3), 447–454

ASAYAMA, S., EMORI, S., SUGIYAMA, M., KASUGA, F., & WATANABE, C. 2021. Are we ignoring a black elephant in the Anthropocene? Climate change and global pandemic as the crisis in health and equality. *Sustainability Science*, 16(2), 695–701.

ATOLANI, O., BAKER, M. T., ADEYEMI, O. S., OLANREWAJU, I. R., HAMID, A. A., AMEEN, O. M., OGUNTOYE, S. O., & USMAN, L. A. 2020. Covid-19: Critical discussion on the applications and implications of chemicals in sanitizers and disinfectants. *EXCLI Journal*, 19, 785–799.

AZMY, N., GIRITHARAN, A., JAMEL, H., MANGUBHAI, S., & DE VOS, A. 2021. The impacts of COVID-19 lockdowns on coastal fisheries in Sri Lanka. *Oceanswell*, Publication. Available: https://oceanswell.b-cdn.net/wp-content/uploads/2021/07/The-impacts-of-COVID-19-lockdowns-on-coastal-fisheries-in-Sri-Lanka-1.pdf [Accessed April 2022].

BAR, H. 2021. COVID-19 lockdown: animal life, ecosystem and atmospheric environment. *Environment, Development and Sustainability*, 23, 8161–8178.

BATES, A.E., PRIMACK, R.B., BIGGAR, B.S., BIRD, T.J., CLINTON, M.E., COMMAND, R.J., RICHARDS, C., SHELLARD, M., GERALDI, N.R., VERGARA, V., ACEVEDO-CHARRY, O., COLÓN-PIÑEIRO, Z., OCAMPO, D., OCAMPO-PEÑUELA, N., SÁNCHEZ-CLAVIJO, L.M., ADAMESCU, C.M., CHEVAL, S., RACOVICEANU, T., ADAMS, M.D., … DUARTE, C.M. 2021. Global COVID-19 lockdown highlights humans as both threats and custodians of the environment. *Biological Conservation*, 263.

BENGALI, S. 2020. The COVID-19 pandemic is unleashing a tidal wave of plastic waste. *Los Angeles Times*, Online news story. Available: https://www.latimes.com/world-nation/story/2020-06-13/coronavirus-pandemic-plastic-waste-recycling [Accessed April 2022].

BENNETT, N.J., FINKBEINER, E.M., BAN, N.C., BELHABIB, D., JUPITER, S.D., & KITTINGER, J.N., 2020. The COVID-19 pandemic, small-scale fisheries and coastal fishing communities. *Coastal Management*, 48(4).

BENSON, N.U., BASSEY, D.E., & PALANISAMI, T. 2021a. COVID pollution: impact of COVID-19 pandemic on global plastic waste footprint. *Heliyon*, 7(2).

BENSON, N.U., FRED-AHMADU, O.H., BASSEY, D.E., & ATAYERO, A.A. 2021b. COVID-19 pandemic and emerging plastic-based personal protective equipment waste pollution and management in Africa. *Journal of Environmental Chemical Engineering*, 9(3).

BITTEL, J. 2020. Pandemic shutdowns saved thousands of animals from becoming roadkill, report suggests. *The Washington Post*, Online news story. Available: https://www.washingtonpost.com/science/2020/07/08/coronavirus-shutdowns-saved-thousands-animals-becoming-roadkill-report-suggests [Accessed April 2022].

BRANCALION, P.H.S., BROADBENT, E.N., DE-MIGUEL, S., CARDIL, A., ROSA, M.R., ALMEIDA, C.T., ALMEIDA, D.R.A., CHAKRAVARTY, S., ZHOU, M., GAMARRA, J.G.P., LIANG, J., CROUZEILLES, R., HÉRAULT, B., ARAGÃO, L.E.O C., SILVA, C. A., & ALMEYDA-ZAMBRANO, A.M. 2020. Emerging threats linking tropical deforestation and the COVID-19 pandemic. *Perspectives in Ecology and Conservation*, 18(4), 243–246.

BURANYI, S. 2018. The plastic backlash: what's behind our sudden rage – and will it make a difference? The Guardian, Online news story. Available: https://www.theguardian.com/environment/2018/nov/13/the-plastic-backlash-whats-behind-our-sudden-rage-and-will-it-make-a-difference#:~:text=The%20case%20against%20plastic%20had,and%20in%20harbours%20was%20increasing. [Accessed April 2022].

CLIMATE CHAMPIONS. 2021. Latin America and Caribbean "Zero Emissions Mobility" pact launches. *United Nations Framework Convention on Climate Change*, Climate Champions, Online news story. Available: https://climatechampions.unfccc.int/latin-america-and-caribbean-zero-emissions-mobility-pact-launches [Accessed April 2022].

CONSERVATION INTERNATIONAL. 2020. Conservation International reports increase in poaching and tropical deforestation due to COVID-19 restrictions. *Conservation Internationa*l, Online news story. Available: https://www.conservation.org/press-releases/2020/04/21/conservation-international-reports-increase-in-poaching-and-tropical-deforestation-due-to-covid-19-restrictions [Accessed April 2022].

DASGUPTA, S., 2020. Will fish boom amid pandemic-driven fishing bust? Mongabay, Available: https://news.mongabay.com/2020/05/will-fish-boom-amid-pandemic-driven-fishing-bust [Accessed: April 2022].

DEPARTMENT OF FISHERIES BANGLADESH. 2020. Yearbook of fisheries statistics of Bangladesh 2018–19. Ministry of Fisheries and Livestock, Government of the People's Republic of Bangladesh, Publication. Available: https://fisheries.portal.gov.bd/sites/default/files/files/fisheries.portal.gov.bd/page/4cfbb3cc_c0c4_4f25_be21_b91f84bdc45c/2020-10-20-11-57-8df0b0e26d7d0134ea2c92ac6129702b.pdf [Accessed April 2022].

FRIEDLINGSTEIN, P., JONES, M.W., O'SULLIVAN, M., ANDREW, R.M., BAKKER, D.C.E., HAUCK, J., LE QUÉRÉ, C., PETERS, G.P., PETERS, W., PONGRATZ, J., SITCH, S., CANADELL, J.G., CIAIS, P., JACKSON, R.B., ALIN, S.R., ANTHONI, P., BATES, N.R., BECKER, M., BELLOUIN, N., BOPP, L., CHAU, T.T.T., CHEVALLIER, F., CHINI, L.P., CRONIN, M., CURRIE, K.I., … ZENG, J. 2021. *The global carbon budget 2021*. Earth System Science Data, 14, 1917–2005.

FINER, B.M., NOVOA, S., WEISSE, M.J., PETERSEN, R., MASCARO, J., SOUTO, T., STEARNS, F., & MARTINEZ, R.G. 2018. Combating deforestation: From satellite to intervention. *Science*, 360(6395), 1303–1305.

GARDNER, C. 2020. Nature's comeback? No, the coronavirus pandemic threatens the world's wildlife. *The Conversation*, Online news story. Available: https://theconversation.com/natures-comeback-no-the-coronavirus-pandemic-threatens-the-worlds-wildlife-136209 [Accessed April 2022].

HIGGS, N.D. 2021. Impact of the COVID-19 pandemic on a queen conch (Aliger gigas) fishery in the Bahamas. *PeerJ*, 9.

IEA. 2020. Changes in transport behaviour during the Covid-19 crisis. *International Energy Agency*, Online article. Available: https://www.iea.org/articles/changes-in-transport-behaviour-during-the-covid-19-crisis [Accessed April 2022].

KHAN, I., SHAH, D., & SHAH, S.S. 2021. COVID-19 pandemic and its positive impacts on environment: An updated review. *International Journal of Environmental Science and Technology*, 18(2), 521–530.

KLEMEŠ, J.J., FAN, Y. VAN TAN, R.R., & JIANG, P. 2020. Minimising the present and future plastic waste, energy and environmental footprints related to COVID-19. *Renewable and Sustainable Energy Reviews*, 127.

LANGFORD, Z., SALEH, H., WALDRON, S., & SULFAHRI. 2021. One Indonesian industry has boomed during the pandemic: Seaweed farming. The Conversation, Online news story. Available: https://theconversation.com/one-indonesian-industry-has-boomed-during-the-pandemic-seaweed-farming-156211 [Accessed April 2022].

LELE, N., NIGAM, R., & BHATTACHARYA, B.K. 2021. New findings on impact of COVID lockdown over terrestrial ecosystems from LEO-GEO satellites. Remote Sensing Applications: *Society and Environment*, 22.

MAJOR, T. 2021. Recreational fishing is booming in Queensland, so should fishers pay a licence fee? *ABC News*, Online news story. Available: https://www.abc.net.au/news/rural/2021-02-24/recreational-fishing-conservation-seafood-regulations-qld-fish/13180176 [Accessed May 2022].

MOORE, J.W. 2017. The Capitalocene, Part I: on the nature and origins of our ecological crisis. *Journal of Peasant Studies*, 44(3), 594–630.

MOUSAZADEH, M., PAITAL, B., NAGHDALI, Z., MORTEZANIA, Z., HASHEMI, M., KARAMATI NIARAGH, E., AGHABABAEI, M., GHORBANKHANI, M., LICHTFOUSE, E., SILLANPÄÄ, M., HASHIM, K.S., & EMAMJOMEH, M.M. 2021. *Positive environmental effects of the coronavirus 2020* episode: A review. Environment, Development and Sustainability, 23(9), 12738–12760.

MUCHE, M., YEMATA, G., MOLLA, E., MUASYA, A.M., & TSEGAY, B.A. 2022. COVID-19 lockdown and natural resources: a global assessment on the challenges, opportunities, and the way forward. *Bulletin of the National Research Centre*, 46(1).

NEUPANE, D. 2020. How conservation will be impacted in the COVID-19 pandemic. *Wildlife Biology*, 2020(2).

NOWLIN, M., DIANA, Z., PICKLE, A., & VIRDIN, J. 2020. Policy in the Pandemic: Are Governments Pushing the Pause Button on Responses to Plastic Pollution? *Duke Nicholas Institute for Environmental Policy Solutions*, Online news story. Available: https://nicholasinstitute.duke.edu/articles/policy-pandemic-are-governments-pushing-pause-button-responses-plastic-pollution [Accessed April 2022].

PITA, P., AINSWORTH, G. B., ALBA, B., ANDERSON, A. B., ANTELO, M., ALÓS, J., … ZARAUZ, L. 2021. First assessment of the impacts of COVID-19 pandemic on global marine recreational fisheries. F*rontiers in Marine Science*, 1533.

RITCHIE. 2020. Cars, planes, trains: Where do CO_2 emissions from transport come from? *Our World in Data*, Online database. Available: https://ourworldindata.org/co2-emissions-from-transport [Accessed April 2022].

RUME, T., & ISLAM, S.M.D.U. 2020. Environmental effects of COVID-19 pandemic and potential strategies of sustainability. *Heliyon*, 6, 9.

RUTZ, C., LORETTO, M.C., BATES, A.E., DAVIDSON, S.C., DUARTE, C.M., JETZ, W., JOHNSON, M., KATO, A., KAYS, R., MUELLER, T., PRIMACK, R.B., ROPERT-COUDERT, Y., TUCKER, M.A., WIKELSKI, M., & CAGNACCI, F. 2020. COVID-19 lockdown allows researchers to quantify the effects of human activity on wildlife. *Nature Ecology and Evolution*, 4(9), 1156–1159.

STATE OF THE TROPICS. 2014. *State of the Tropics 2014 Report*. James Cook University, Report. Available: https://www.jcu.edu.au/state-of-the-tropics/publications/2014-state-of-the-tropics-report [Accessed: April 2022].

SULTANA, R., IRFANULLAH, H.M., SELIM, S.A., RAIHAN, S.T., BHOWMIK, J., & AHMED, S.G. 2021. Multilevel resilience of fishing communities of coastal Bangladesh against COVID-19 pandemic and 65-day fishing ban. *Frontiers in Marine Science*, 1419.

SUNNY, A.R., SAZZAD, S.A., PRODHAN, S.H., ASHRAFUZZAMAN, M., DATTA, G.C., SARKER, A.K.,... MITHUN, M. H. 2021. Assessing impacts of COVID-19 on aquatic food system and small-scale fisheries in Bangladesh. *Marine Policy*, 126, 104422.

TILMAN, D. 1999. Global environmental impacts of agricultural expansion: The need for sustainable and efficient practices. *PNAS*, 96.

UNEP. 2022. Our planet is choking on plastic. UN Environment Program, Online article. Available: https://www.unep.org/interactives/beat-plastic-pollution [Accessed April 2022].

WILDLIFE CONSERVATION SOCIETY. 2022. Why Pangolins? *Wildlife Conservation Society*. Online article. Available: https://www.wcs.org/wildcards/posts/why-pangolins [Accessed: April 2022].

ZHANG, T., WU, Q., & ZHANG, Z. 2020. Probable Pangolin Origin of SARS-CoV-2 Associated with the COVID-19 Outbreak. *Current Biology*, 30(7), 1346-1351.e2.

ZHU, Y. G., GILLINGS, M., & PENUELAS, J. 2020. Integrating Biomedical, Ecological, and Sustainability Sciences to Manage Emerging Infectious Diseases. *One Earth*, 3(1), 23–26.

PHOTO: MARTINE PERRET, UN

4

THE IMPACT OF COVID-19 ON KENYAN COMMUNITIES AND THE FISHERIES SECTOR

VICTORIA MULAMA, CHIEF FISHERIES OFFICER, KENYA

PHOTO: PETER KAPUSCINSKI, WORLD BANK

GENERAL OVERVIEW

COVID-19 was declared a pandemic on 11th March 2020 by the World Health Organization (WHO, 2022). The highly infectious disease spread rapidly, disrupting world economies and causing panic, fear, hospitalisation crises and a large number of deaths within a short period. Kenya, like many nations in the world, was not spared. There had been rumours and reports from other parts of the world until March 10th 2020, when Kenya confirmed its first case of COVID-19 (Ministry of Health Portal, 2022).

In sequence, preventive measures were defined, declared and constructively put in place as a general practice to shield the masses from exposure to the virus. The new measures included the cessation of movement both locally and internationally, lockdowns, mandatory mask mandates, mandatory vaccine mandates, social distancing and strict hygiene regimes.

In many ways, these measures inevitably led to slow-downs and uncertainty in Kenya's economy, eventually leading to large-scale redundancies. Employers that did not want to release employees instead imposed pay cuts and unpaid leave in both the formal and informal employment sectors. Increasing disruptions were reported locally and internationally as well as the closure of open markets and mandatory testing at border points in most parts of the country. The worst-hit sectors of the economy included the tourism, hospitality, and aviation sectors, which were forced to close down completely.

COMMUNITY IMPACTS AND RESPONSES

There was widespread fear and shock among Kenyans, especially because the virus had no known treatment or vaccine. A majority of people lost their jobs, and many others were rendered inactive. It was this economic uncertainty that fuelled the mass exodus from urban areas to the rural areas with the belief that the villages were safer. This, of course, represented a culture shock; suddenly, people had to stay in their own homes. There was no shaking of hands even with neighbours and friends, no hugging people except members of the same household, the churches had closed down and realigned themselves to online platforms and other media, and there were no gatherings at all, whether it be for funerals or for weddings. We were in complete isolation.

However, Kenya reported few cases compared to the world numbers, which helped to keep hope alive. According to the Ministry of Health, the rate of infection was about 21% at the peak period, with infected people hospitalised or kept in isolation (Ministry of Health Portal, 2022). The constant threat of exposure meant that communities had to be vigilant on their own and report any newcomers for the purpose of quarantine. For this reason, nobody accepted visitors from other locations, even if they were family or friends. Anyone new in the community who did not self-isolate could send all members of the host family into designated isolation centres.

VACCINATIONS

Despite massive awareness campaigns, vaccine uptake in Kenya is low. According to the Ministry of Health, only 29.9% of the adult population had been fully vaccinated as of 2nd April 2022 (Ministry of Health Portal, 2022). An initial delay in the vaccine distribution across the country has since been rectified. Vaccines are now available at every local health centre to which every Kenyan has access. Still, the Kenyan population has been reluctant to take vaccines due to various misconceptions.

THE IMPACT ON PERSONAL LIFE AND FAMILY

Kenyan families quickly adapted to more responsibilities imposed by the pandemic coupled with constantly changing scenarios that were critical to survival. There was the need to rise above the socio-economic dynamics that were at play and to ensure family safety. Most families in my community saw peaceful cohesion among members. However, there were reports of families that were severely affected due to the inability to withstand the pressure exerted by outside factors. These factors included job loss, lack of markets for local produce, closure of entertainment facilities and social distancing, which impacted mental health. People became more irritable, fuelling an increase in suicide cases. Reports of increases in domestic violence were noted, and there were indications of increases in crime in the community.

School closures through 2020 lasted until January 2021. During this period of lockdowns, parents had to take on the responsibility of schooling their children at home. Those who had access to technology enrolled in online schooling under parental supervision. However, children from low-income families did not have this privilege and resorted to community-based initiatives of learning. There were also reports of increased rates of pregnancy in teenage girls, increased drug abuse and increases in school dropouts hampering the government's efforts to achieve universal education for the country. According to the World Bank report, poverty increased in Kenya by seven points, hampering efforts to achieve sustainable development goals (Pape & Delius, 2021).

Due to the forced lockdowns, COVID-19 did provide an opportunity for families to increase their bonds with their children. The children were happy to explore several aspects of their parents' lives that they were previously unaware of. Parents, conversely, also discovered the previously hidden strengths in their children, strengthening their bonds. This period was an eye-opener and an opportunity for children to expand their horizons beyond the textbook and school syllabus.

THE IMPACT ON THE FISHERIES INDUSTRY

During the pandemic, the government prioritised only essential services while the other functions were accessed on online platforms. This brought about a disruption in the fisheries management systems as well as processes that implement and monitor fisheries activities and projects. As a consequence, the majority of fisherfolk were unable to access timely technical guidance unless through scheduled virtual meetings. The situation exposed the vulnerability of Kenyan fisheries to various unprecedented external factors powerful enough to render them unsustainable. During this period, the fish supply chain received an enormous amount of pressure from the demand caused by panic buying. Several links in the supply chain were unable to function due to the COVID-19 restrictions. These effects cascaded to other parts of the supply chain.

The closure of markets, indefinite lockdowns and 8 pm to dawn curfews impacted both the fishermen and small-scale fish traders. Suddenly, fishing hours were reduced, and transport to other areas became a challenge. Traders were cut off from big markets in the cities limiting steady daily incomes.

Employment in the fishery sector was affected too, as the number of those engaging in the fish trade declined on a daily basis for fear of being exposed to the virus. Those who remained employed in the industry demanded more pay. As the lockdowns continued, surveillance became a challenge, and as a result, scarcity ensued that may have led to illegal, unreported and unregulated fishing.

Those engaged in aquaculture were particularly hard hit. They had to retain their fish stock for longer periods than planned. The longer retention periods translated to higher production costs, increased risks (of death or theft) and disrupted production cycles. Ornamental fish markets stalled due to the closure of international transport and enterprises that supply feeds and inputs. In particular,

fishing gear suffered economic losses. This led to a decrease in revenue from fish and fish products both for the government and stakeholders in the industry. Additionally, it was increasingly challenging to access funds, as lending institutions employed strict requirements due to the fear of increases in non-performing loans and outright loan defaults.

The inflation of food commodities increased during this period, and fish became expensive. The price increase was likely due to storage fees that traders had to pay for the perishable commodity. Restrictions on transport and the increase in wages also contributed to the increase in prices. Although the price of fish increased, buyers were more than willing to pay more for it. The COVID-19 pandemic improved the demand for healthy meat, easing the competition of fish with other meats in the market. Food processing factories also struggled to stay afloat as the supply of raw materials and fresh catch decreased compared to daily output.

On the upside, the closure of markets and restrictions on in-person engagements helped in the digitisation of the fishery industry, from technical advice to vibrant online fish markets. It is important to note that traders were able to receive payments and transact online without handling cash, helping to curb the spread of the virus. Additionally, the exemption of transaction fees between the banks and the mobile wallet encouraged mobile transactions adding to a favourable trading environment.

The fishery waters in Kenya also enjoyed the reprieve from aggressive fishing activities during the period under restriction; both lockdowns and curfew hours limited the time spent fishing and reduced some illegal fishing activities. This was a very positive outcome for the ecosystem. There was also less bycatch, and it gave overfished species time to increase their population. Pollution-related human activities were also greatly reduced during this period.

There has been a more focussed investment in the fisheries infrastructure in the aftermath of the pandemic. This is a factor that could help close loopholes in the supply chain of fish and fishery products. New people have joined the fishery industry in response to the demand witnessed during the pandemic. Efforts to increase productivity, especially aquaculture ventures (cage fish farming in the lakes, dams and rivers), have also increased. These efforts are likely to positively impact the fishery industry in the long term through food security initiatives. Increased fish production and consumption will also reduce malnutrition and help alleviate abject poverty. Other efforts seek to aggregate fish from collection points and supply them directly to processing factories to ease bottlenecks in the aquaculture industry. This is a good strategy to empower the commercialisation of fish products and contribute immensely to livelihoods. Local fish markets have also been upgraded to increase customers and ensure a viable price, reducing the reliance on city markets that offer cheaper prices.

CONCLUSIONS

COVID-19 impacted several aspects of fisheries, including fishing activities, aquaculture production, local and international marketing, local and international transportation of inputs and products, distribution of fish and fishery products, and fish processing and value additions in various ways. The situation was a timely reminder of the prudent use of natural resources. This came as a wake-up call to Kenya and the world to sustainably use and manage the fisheries industry. These natural resources can be either depleted, sustained or rendered unavailable due to unforeseen circumstances such as the COVID-19 pandemic. There is a need for continuing analysis of industry progress following the pandemic to better inform strategic planning and fisheries policy.

REFERENCES

MINISTRY OF HEALTH PORTAL. 2022. Ministry of Health, Kenya. Available: https://www.health.go.ke [Accessed April 2022].

PAPE, U., & DELIUS, A. 2021. How COVID-19 continues to affect livelihoods in Kenya: Rapid response phone survey rounds 1 to 5. *World Bank Group*, Open Knowledge Repository, Publication. Available: https://openknowledge.worldbank.org/handle/10986/36650 [Accessed April 2022].

WHO. 2022. Coronavirus disease (COVID-19) pandemic. *World Health Organization*., Online factsheet Available: https://www.euro.who.int/en/health-topics/health-emergencies/coronavirus-covid-19/novel-coronavirus-2019-ncov [Accessed April 2022].

PHOTO: FLORE DE PRENEUF, WORLD BANK

STATE OF
THE TROPICS

APPENDIX A

REGION/Nation	Population 2020 (millions)	% of Population in the Tropics	% of Regional population in the Tropics
CENTRAL AND SOUTHERN AFRICA			
Angola	32.87	100.0%	3.6%
Benin	12.12	100.0%	1.3%
Botswana	2.35	51.5%	0.3%
Burkina Faso	20.90	100.0%	2.3%
Burundi	11.89	100.0%	1.3%
Cameroon	26.55	100.0%	2.9%
Cape Verde	0.56	100.0%	0.1%
Central African Republic	4.83	100.0%	0.5%
Comoros	0.87	100.0%	0.1%
Democratic Republic of the Congo	89.56	100.0%	9.8%
Congo	5.52	100.0%	0.6%
Cote d'Ivoire	26.38	100.0%	2.9%
Equatorial Guinea	1.40	100.0%	0.2%
Ethiopia	114.96	100.0%	12.5%
Gabon	2.23	100.0%	0.2%
Gambia	2.42	100.0%	0.3%
Ghana	31.07	100.0%	3.4%
Guinea	13.13	100.0%	1.4%
Guinea-Bissau	1.97	100.0%	0.2%
Kenya	53.77	100.0%	5.9%
Liberia	5.06	100.0%	0.6%
Madagascar	27.69	91.8%	3.0%
Malawi	19.13	100.0%	2.1%
Mauritius	1.27	100.0%	0.1%
Mozambique	31.26	80.3%	3.4%
Namibia	2.54	80.3%	0.3%
Nigeria	206.14	100.0%	22.5%
Rwanda	12.95	100.0%	1.4%
Sao Tome and Principe	0.22	100.0%	0.0%
Seychelles	0.10	100.0%	0.0%
Sierra Leone	7.98	100.0%	0.9%
Tanzania	59.73	100.0%	6.5%
Togo	8.28	100.0%	0.9%
Uganda	45.74	100.0%	5.0%
Zambia	18.38	100.0%	2.0%
Zimbabwe	14.86	100.0%	1.6%
NORTHERN AFRICAL AND MIDDLE EAST			
Djibouti	0.99	100.0%	0.5%
Chad	16.43	100.0%	8.1%
Eritrea	3.55	100.0%	1.8%
Mali	20.25	99.9%	10.0%
Mauritania	4.65	99.3%	2.3%
Niger	24.21	100.0%	12.0%
Saudi Arabia*	14.28	41.3%	7.1%
Senegal	16.74	100.0%	8.3%
Somalia	15.89	100.0%	7.9%

REGION/Nation	Population 2020 (millions)	% of Population in the Tropics	% of Regional population in the Tropics
South Sudan	11.19	100.0%	5.5%
Sudan	43.85	100.0%	21.7%
Yemen	29.83	100.0%	14.8%
SOUTH ASIA			
Bangladesh*	60.18	36.6%	6.9%
India*	792.00	54.0%	90.6%
Maldives	0.54	100.0%	0.1%
Sri Lanka	21.41	100.0%	2.4%
SOUTH EAST ASIA			
Brunei Darussalam	0.44	100.0%	0.1%
Cambodia	16.72	100.0%	2.0%
China*	169.52	7.9%	20.0%
China, Hong Kong SAR	7.50	100.0%	0.9%
China, Macao SAR	0.65	100.0%	0.1%
Indonesia	273.52	100.0%	32.3%
Lao People's Democratic Republic	7.28	100.0%	0.9%
Malaysia	32.37	100.0%	3.8%
Myanmar	54.41	90.8%	6.4%
Philippines	109.58	100.0%	12.9%
Singapore	5.85	100.0%	0.7%
Thailand	69.80	100.0%	8.2%
Timor-Leste	1.32	100.0%	0.2%
Vietnam	97.34	100.0%	11.5%
CARRIBBEAN			
Antigua and Barbuda	0.10	100.0%	0.2%
Barbados	0.29	100.0%	0.7%
Cuba	11.33	100.0%	27.2%
Dominica	0.07	100.0%	0.2%
Dominican Republic	10.85	100.0%	26.1%
Haiti	11.40	100.0%	27.4%
Jamaica	2.96	100.0%	7.1%
Puerto Rico	2.86	100.0%	6.9%
Saint Kitts and Nevis	0.05	100.0%	0.1%
Saint Lucia	0.18	100.0%	0.4%
Saint Vincent and the Grenadines	0.11	100.0%	0.3%
Trinidad and Tobago	1.40	100.0%	3.4%
CENTRAL AMERICA			
Belize	0.40	100.0%	0.3%
Costa Rica	5.09	100.0%	3.4%
El Salvador	6.49	100.0%	4.3%
Guatemala	17.92	100.0%	11.9%
Honduras	9.90	100.0%	6.6%
Mexico*	100.39	77.7%	66.4%
Nicaragua	6.62	100.0%	4.4%
Panama	4.31	100.0%	2.9%

REGION/Nation	Population 2020 (millions)	% of Population in the Tropics	% of Regional population in the Tropics
SOUTH AMERICA			
Bolivia	11.67	100.0%	3.6%
Brazil*	181.95	82.4%	56.0%
Colombia	50.88	100.0%	15.7%
Ecuador	17.64	100.0%	5.4%
Guyana	0.79	100.0%	0.2%
Peru	32.97	100.0%	10.1%
Suriname	0.59	100.0%	0.2%
Venezuela	28.44	100.0%	8.8%
OCEANIA			
Australia*	1.44	5.7%	9.7%
Fiji	0.90	100.0%	6.0%
French Polynesia	0.28	100.0%	1.9%
Kiribati	0.12	100.0%	0.8%
Marshall Islands	0.06	100.0%	0.4%
Micronesia (Fed. States of)	0.12	100.0%	0.8%
New Caledonia	0.29	100.0%	1.9%
Palau	0.02	100.0%	0.1%
Papua New Guinea	8.95	100.0%	59.9%
Samoa	0.20	100.0%	1.3%
Solomon Islands	0.69	100.0%	4.6%
Tonga	0.11	100.0%	0.7%
Tuvalu	0.01	100.0%	0.1%
United States of America*	1.45	0.4%	9.7%
Vanuatu	0.31	100.0%	2.1%

*Tropical population only. These nations have large populations and area and straddle the Tropics. Sub-national calculations were used and these nations divided into tropical and non-tropical regions for the analyses. See Appendix C.

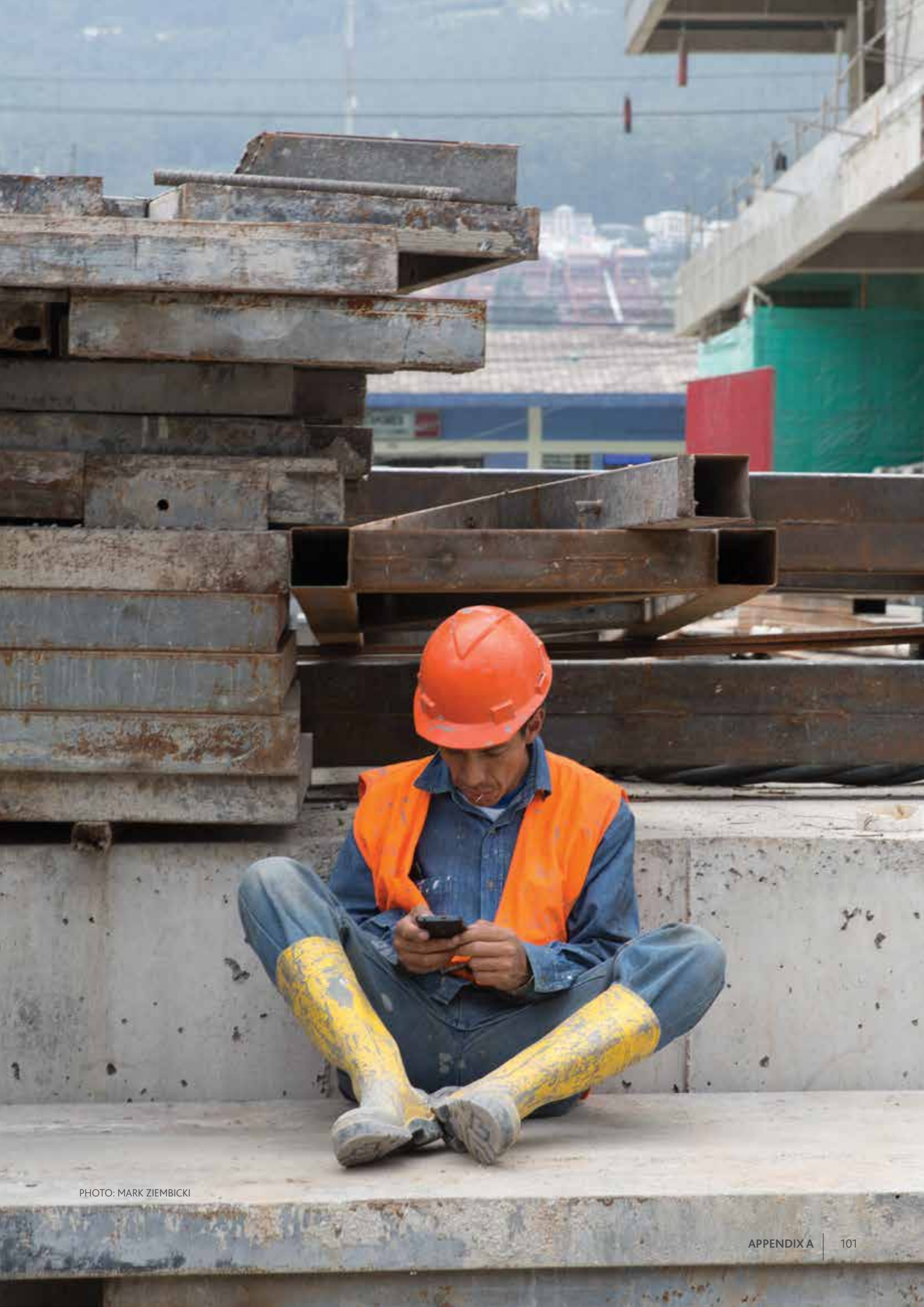

PHOTO: MARK ZIEMBICKI

STATE OF
THE TROPICS

APPENDIX B

SUB-NATIONAL REGIONS/STATES/PROVINCES USED FOR LARGE NATIONS THAT STRADDLE THE TROPICS

AUSTRALIA		
Queensland	**Western Australia**	**Northern Territory**
• Central West	• Kimberley	
• Far North	• Pilbara	
• Fitzroy		
• Mackay		
• Northern		
• North West		
BANGLADESH		
Barisal	Chittagong	Kulna
BRAZIL		
Acre	Goias	Pernambuco
Alagoas	Maranhoa	Rio de Janeiro
Amapa	Mato Grosso	Rio Grande di Norte
Amazonas	Mato Grosso do Sul	Rondonia
Bahia	Minas Gerais	Roraima
Ceara	Para	Sao Paulo
Distrito Federal	Paraiba	Sergipe
Espirito Santo	Piaui	Tocantins
CHINA		
Guangdong	Guangxi	Hainan
INDIA		
Andaman & Nicobar Islands	Gujarat	Mizoram
Andhra Pradesh	Jharkhand	Orrisa
Chhattisgarh	Karnataka	Pondicherry
Dadra & Nagar Haveli	Kerala	Tamil Nadu
Damon	Lakshadweep	West Bengal
Dui	Madhya Pradesh	
Goa	Maharashtra	
MEXICO		
Aguascalientes	Jalisco	Quintana Roo
Campeche	Mexico	San Luis Potosi
Chiapas	Michoacan	Tabasco
Colima	Morelos	Tlazcala
Federal District	Nayarit	Veracruz
Guanajuato	Oaxaca	Yucatan
Guerrero (Warrior)	Puebla	Zacatecas
Hidalgo (Noble)	Queretaro	
SAUDI ARABIA		
Asir	Jizan	Najran
Baha	Makkah	
UNITED STATES		
Hawaii		

stateofthetropics.org

STATE OF
THE TROPICS