Environmental Resilience and Transformation in Times of COVID-19: Climate change effects on environmental functionality

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ENVIRONMENTAL RESILIENCE AND
TRANSFORMATION IN TIMES OF COVID-19
Climate Change Effects on Environmental Functionality

AL. Ramanathan
S. Chidambaram
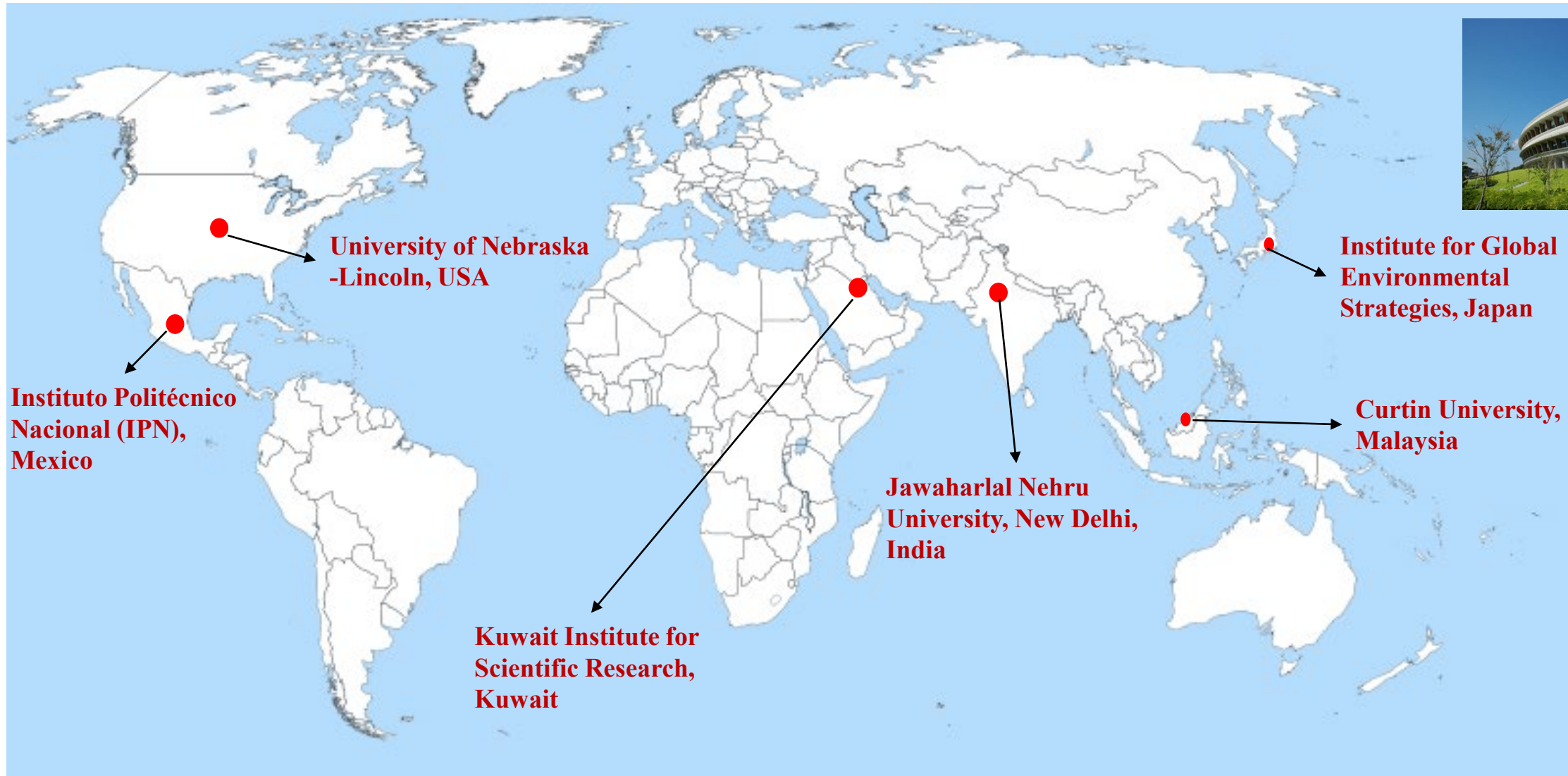M.P. Jonathan
M.V. Prasanna
Pankaj Kumar
Francisco Muñoz Arriola

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- **Peer reviewed book**

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- **Available from : elsevier.com/shop ; Amazon and other online book store**

- **https://www.amazon.co.jp/-/en/L-Ramanathan/dp/0323855121**

Why this book? (Motivational background)

- Very few or no study providing enough scientific information on effect of COVID19 on different socio-environmental factors at global scale at a single platform/window
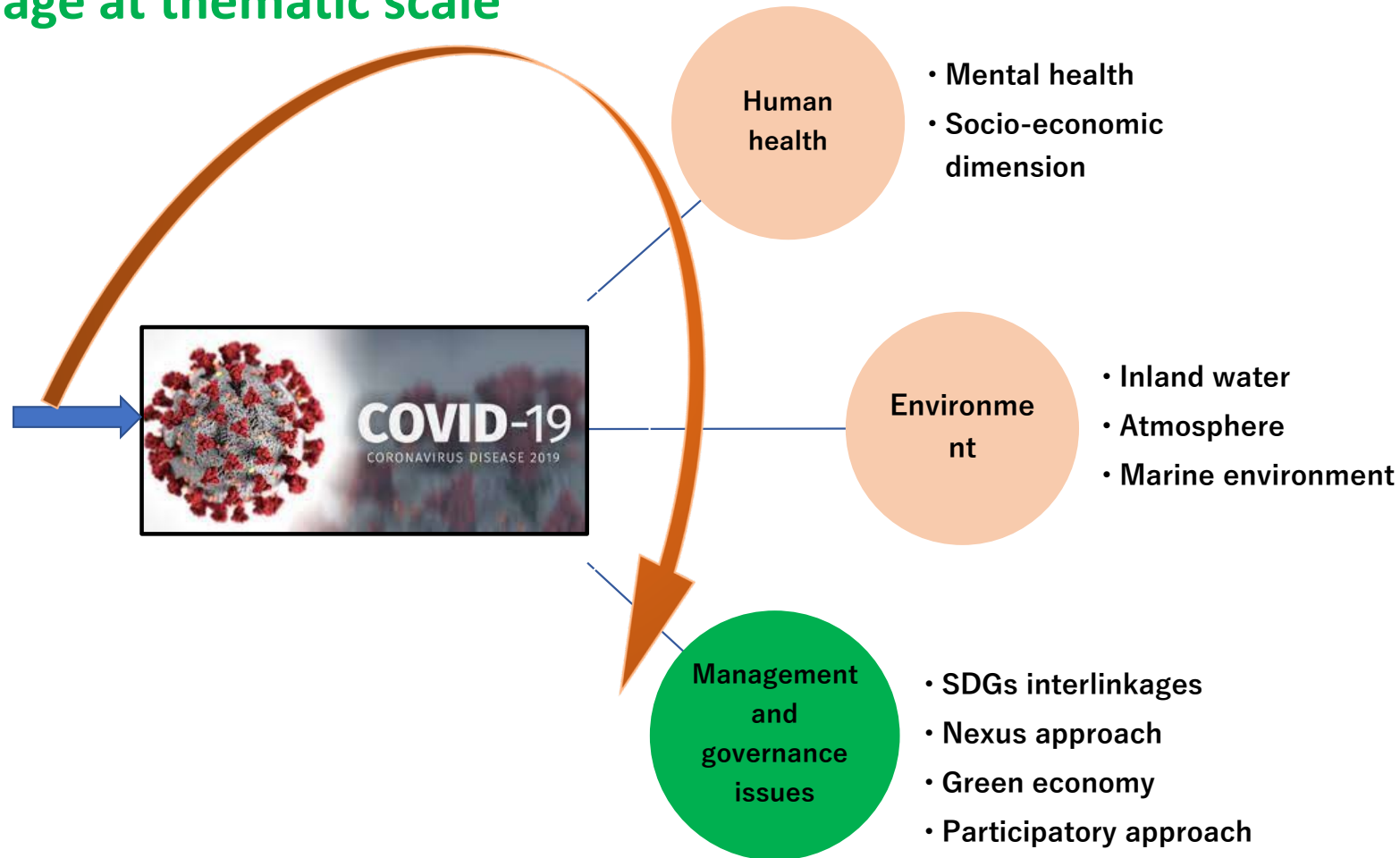
→ **Large coverage at spatial scale**

University of Nebraska -Lincoln, USA

Institute for Global Environmental Strategies, Japan

Instituto Politécnico Nacional (IPN), Mexico

Curtin University, Malaysia

Jawaharlal Nehru University, New Delhi, India

Kuwait Institute for Scientific Research, Kuwait

Why this book? (Motivational background)

IGES — Institute for Global Environmental Strategies

→ **Large coverage at thematic scale**

Zoonotic diseases and other background information about the origin of this pandemic

Human health
- Mental health
- Socio-economic dimension

Environment
- Inland water
- Atmosphere
- Marine environment

Management and governance issues
- SDGs interlinkages
- Nexus approach
- Green economy
- Participatory approach

➤ **These themes provide an insight ranging from cause of COVID19 to the impact of COVID-19 on the socio-environment processes and various environmental management, planning and governance options necessary for designing policy processes and help to build resilient society.**

➤ Featuring **many case studies from around the globe**, this book offers a crucial examination of the intersectionality between climate, sustainability, the environment, and public health for **researchers, practitioners, and policymakers** in environmental science.
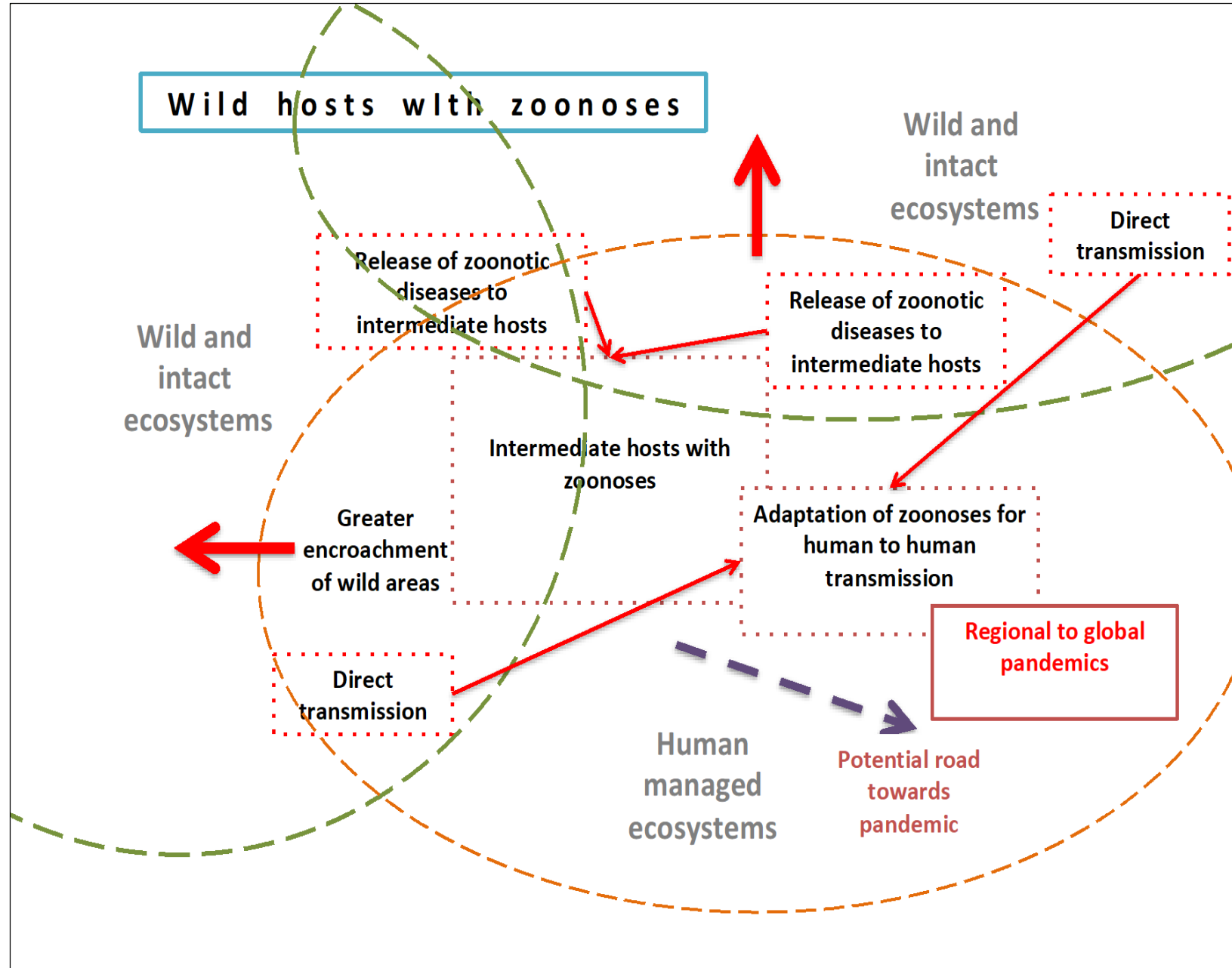
Thematic highlights and summary

1) Causes of COVID 19 pandemic and its impact on human health

2) Impact of COVID 19 on water resources (planning, management, and governance)

3) Impact of COVID 19 on air quality (monitoring, fate, transport, and drivers of socioenvironmental change)

4) Impact of COVID 19 on marine and lacustrine environment

5) Management perspectives (Governance, SDGs and environmental justice)

Theme 1 - Environmental modifications, degradation, and human health risks

- Total number of chapters -**6**

- This theme set the platform by describing the COVID19 as a wakeup call. Highlighting importance of research on **planetary health** for a better understanding on human health and its relation with ecosystem health.

- It also highlights zoonotic diseases in the face of rapidly changing human-nature interactions in the Anthropocene and the case of COVID-19.

- Later part highlights the effect of this pandemic on human health like mental health, socio-economic issues, transboundary issues etc.

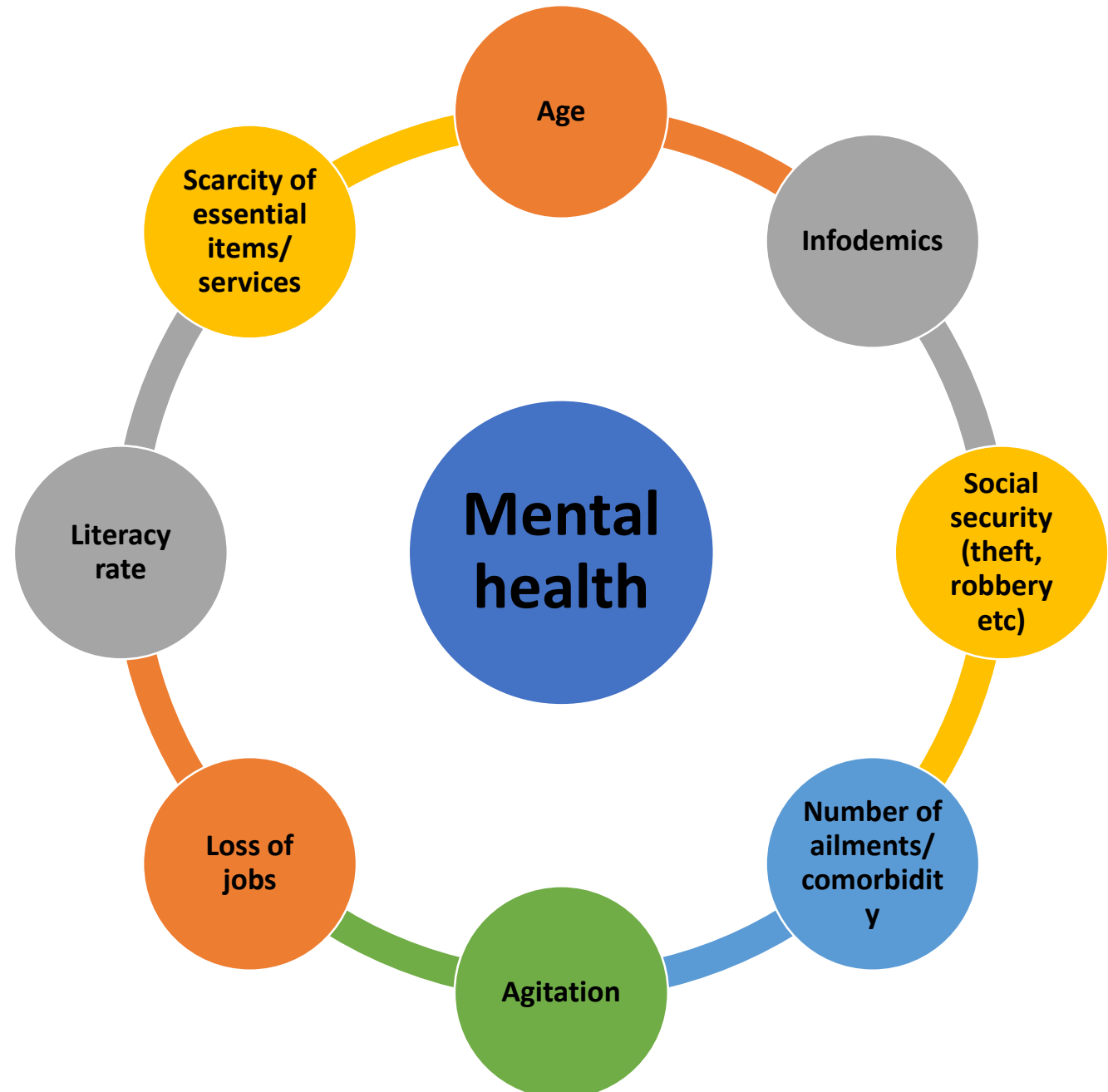# Schematic diagram showing possible pathways of transfer of zoonotic diseases

It shows how the landscape of zoonotic diseases may look like under declining biodiversity with increasing encroachment of wild and intact ecosystems (including how they are transferred to humans and can grow to pandemic proportions).

Impact of COVID on marine plastic/solid waste

- Two chapters also reviewed about <u>increased use of plastic materials in terms of (PPE kits, medical equipment, medicinal packaging etc.) and highlighted that a many fold increase in marine plastic was found during this COVID-19 period.</u>

- This causing additional environmental burden especially for the countries with inadequate management options/facilities.

- One chapter specially focussed on the issues of plastic pollutions in coastal zones, which is severely affecting biodiversity hotspot of mangrove ecosystem in India.

- Study investigated the role of socio-environmental factors on mental health of people during COVID-19 using **Composite COVID Stress Index (CCSI) and COVID Anxiety Scale (CAS) through web-based survey**.

- Empirical results from **Explanatory Factor Analysis (EFA) and Weighted Least Square (WLS)** suggest that respondents are highly worried **(anxiety, stress, anger etc.)** about following things shown in the diagram:

- Thus, findings propose the need of both physical and psychological healthcare services, online-based healthcare programs and spread of authentic COVID-19 information and basic amenities sufficiency.

Mental health

Age

Infodemics

Social security (theft, robbery etc)

Number of ailments/ comorbidity

Agitation

Loss of jobs

Literacy rate

Scarcity of essential items/ services

Theme 2- Impact of COVID 19 on water resources (planning, management, and governance)
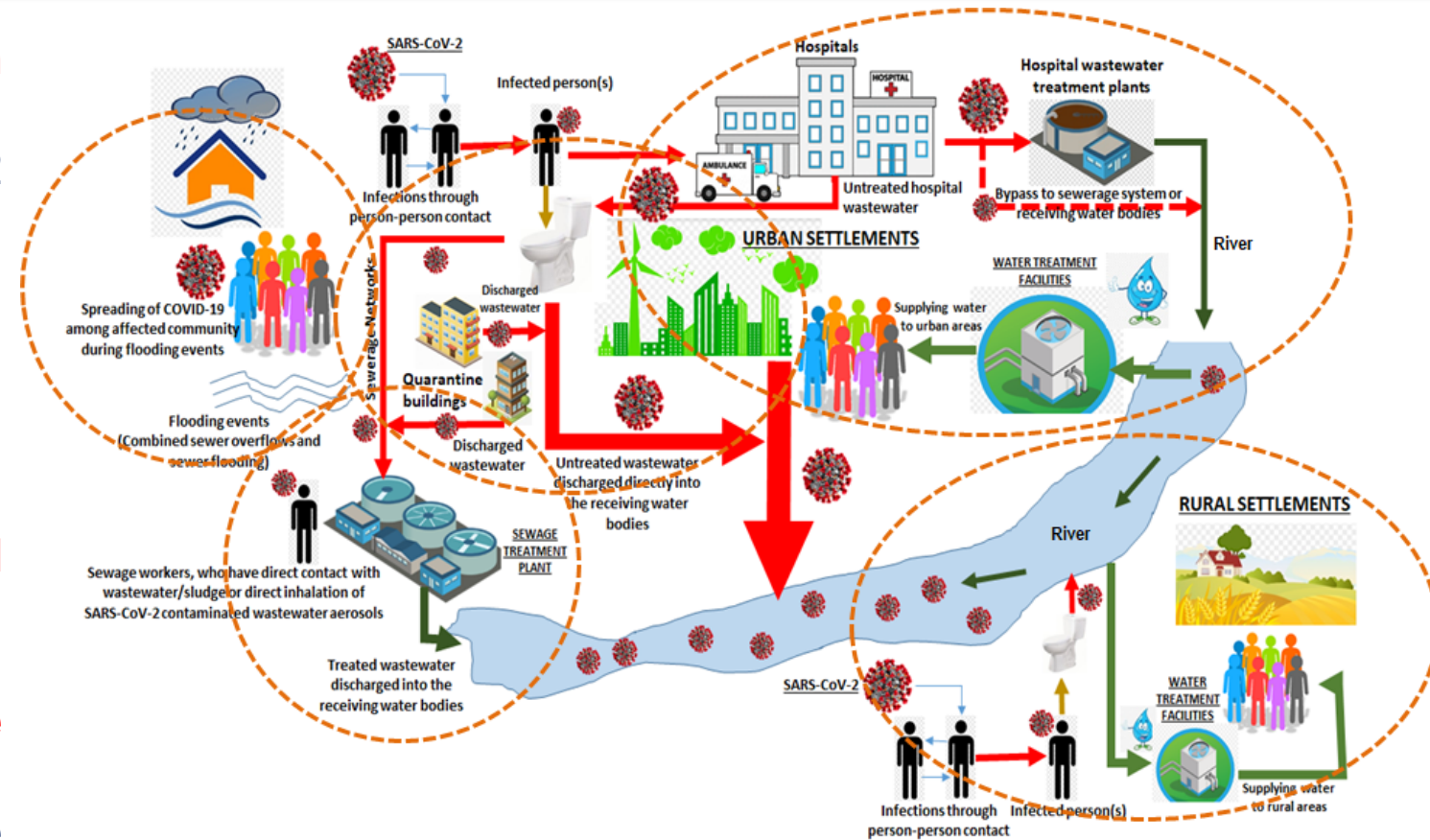
- Total number of chapters -**8**

- First part in this section, provides a glance of methodologies to track COVID-19 and evaluate environmental states (water quality in terms of hydrochemical parameters, heavy metals etc.) during the lockdown imposed by COVID19.

- Later part of this theme highlights about the fate of water and wastewater contamination of COVID RNA in various countries.

- It stresses the framework for epidemiological management and proper surveillance of wastewater to avoid fecal/ urinal shedding of infected individuals.

- In most of countries studied, effective monitoring in infected communities at an early-stage through wastewater-based epidemiology, together with clinical diagnostic testing or clinical surveillance is poor.

- Effective interventions and preparedness actions can be taken as early as possible to restrict the movements of the infected population, as well as to minimize the pathogen spread and a threat to public health.

- To get an insight into the existing challenges and bottlenecks, cases across the Asia-Pacific was carried out in this section.

Addressing associated risks of COVID-19 infections across water and wastewater service chain in Asia

✓ SARS-CoV-2 was **detected and spreading through human feces; and gradually ended up in sewage/wastewater treatment plants**. SARS-CoV-2 could **maintain their viability** (e.g., in raw sewage, hospital wastewater, raw wastewater discharges from quarantine buildings/spots, SARS-CoV-2 contaminated floodwater, and water bodies that was originated from fecal discharge of infected patients) for several days in vitro after leaving the feces; thus **posing a potential risk to public health, if it is not properly handled and treated.**

✓ Therefore, **precautionary measures, effective interventions and control strategies should be taken** to stop the spread of SARS-CoV-2 infections from these possible routes, especially from aerosol transmission in above mentioned hotspot areas.


Possible routes of SARS-CoV-2 infections and contamination in water and wastewater services sector

✓ Regular virus surveillance in wastewater has a long history of use and a proven concept in public health, which can be utilized as **an early warning tool for the occurrence of COVID-19 in communities**, monitoring the status of COVID-19 infection in local communities, evaluating the trends and tracking hotspots, **revealing true scale of the coronavirus outbreak.**

Governance of wastewater surveillance systems to minimize the impact of COVID-19: Cases across Asia-Pacific

- Wastewater Surveillance was found to be an effective tool to support clinical testing for monitoring COVID-19

- Various governance challenges exist (in terms of infratsructure in the developing nations) before a robust sytem can be implemented in all countries studied
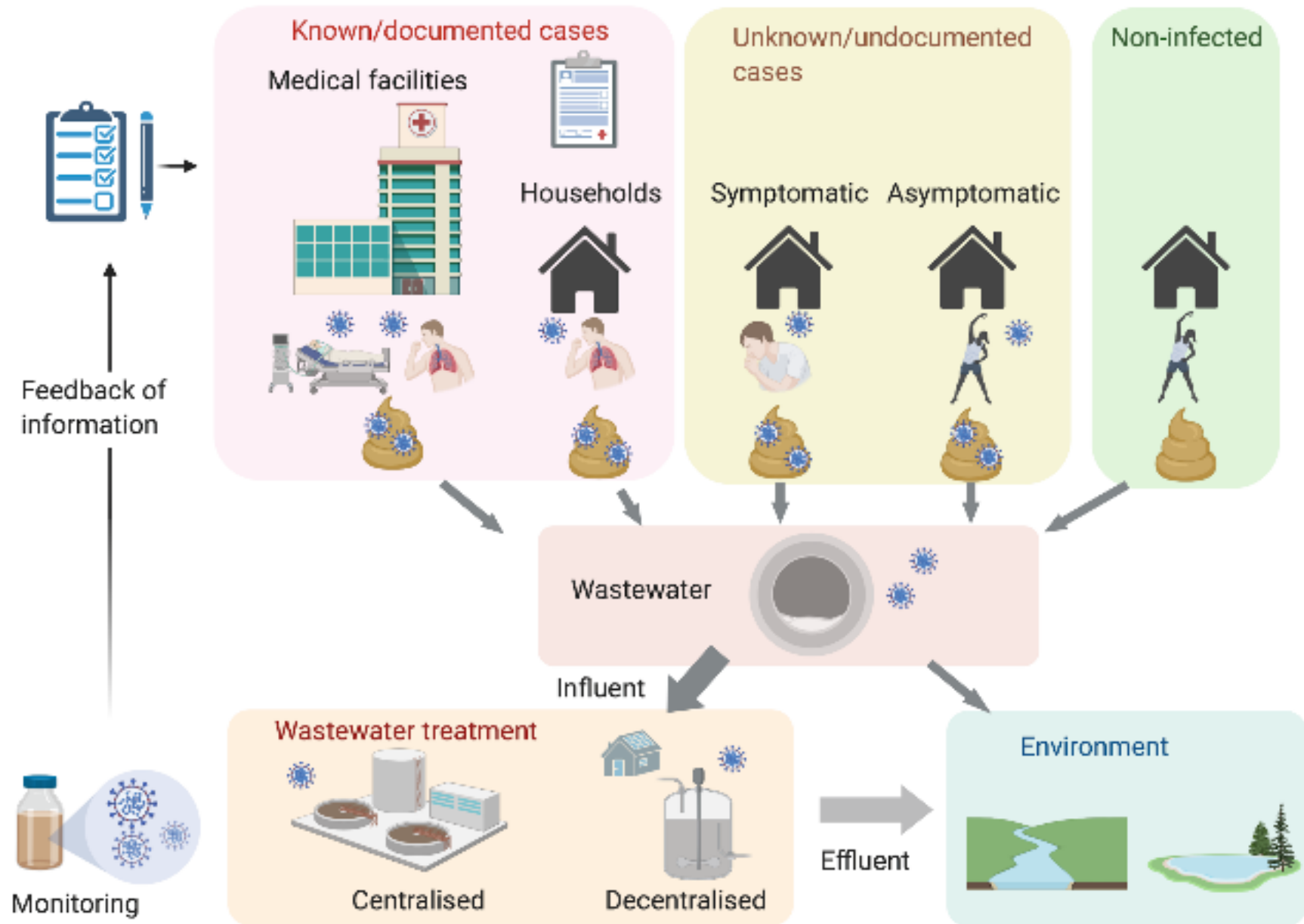
Effect of COVID19 on water quality

- **Less industrial activities, wastewater discharge in the surface water bodies results in the improvement of water quality**
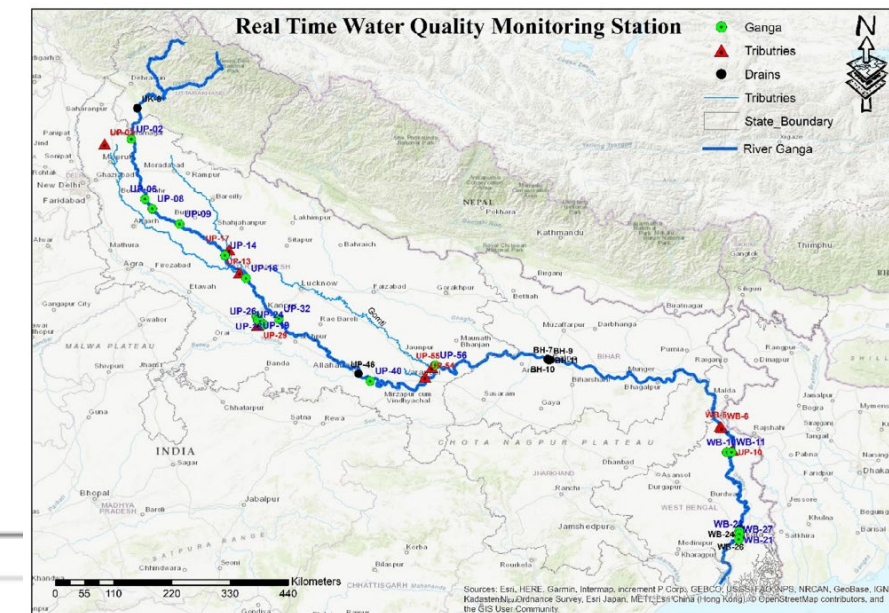
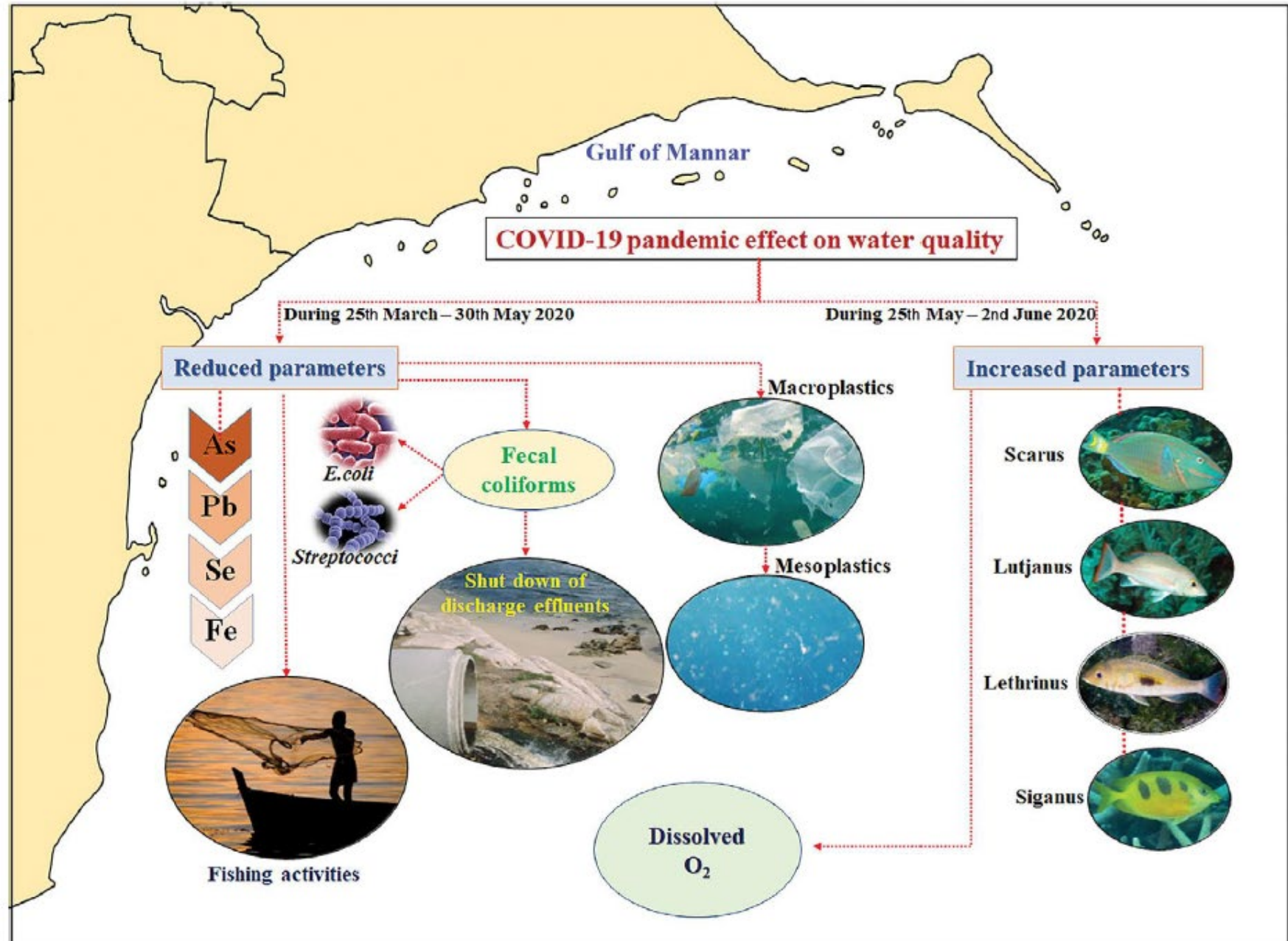FIG. 12.1 Location map of real-time monitoring stations.
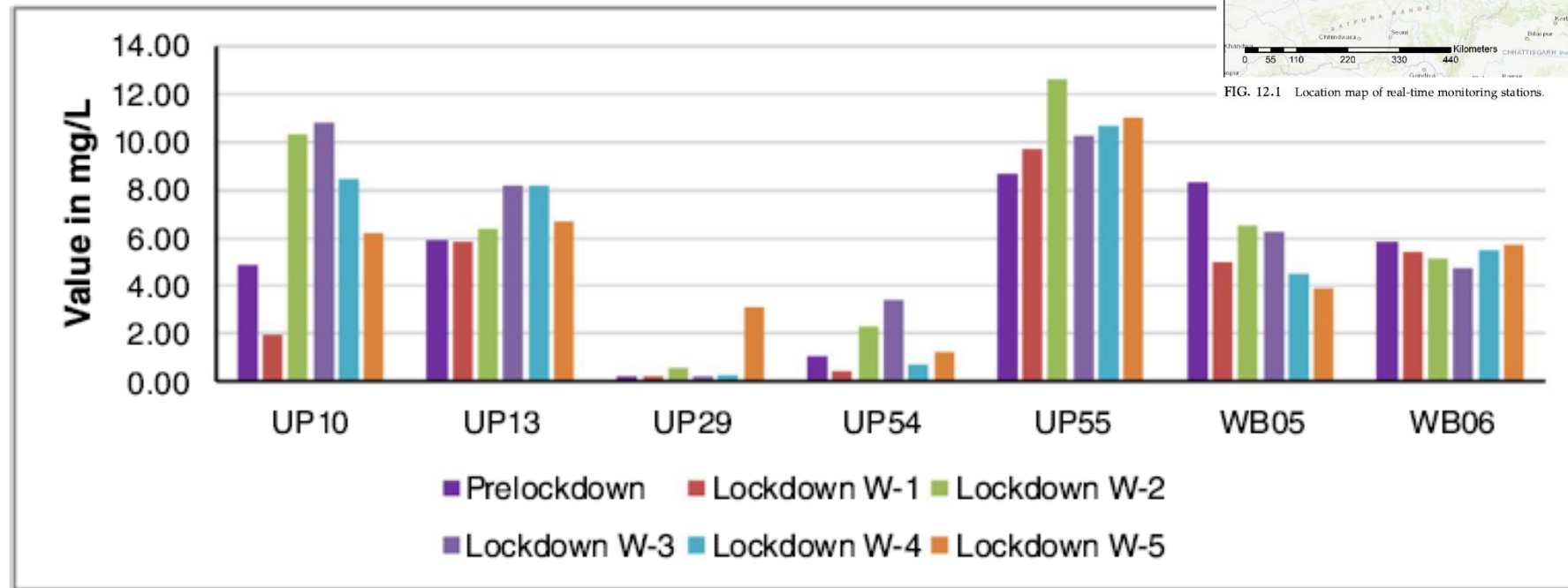
FIG. 12.6 Variation in DO before and after lockdown.

Effect of COVID induced lockdown on water quality from Ganges river, India

Effect of COVID19 on water quality

- Water quality improvement also helps in improving aquatic ecosystem

14.1 Reduction coastal pollution in Gulf of Mannar coast.

water

MDPI

Did the COVID-19 Lockdown-Induced Hydrological Residence Time Intensify the Primary Productivity in Lakes? Observational Results Based on Satellite Remote Sensing

Ram Avtar [1,*], Pankaj Kumar [2], Hitesh Supe [1], Dou Jie [3], Netranada Sahu [4,5], Binaya Kumar Mishra [6] and Ali P. Yunus [7,8]

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[4] Department of Geography, Delhi School of Economics, University of Delhi, New Delhi 110007, India; nsahu@geography.du.ac.in

[5] Disaster Prevention Research Institute, Kyoto University, Kyoto 611-0011, Japan

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Abstract: The novel coronavirus pandemic (COVID-19) has brought countries around the world to a standstill in the early part of 2020. Several nations and territories around the world insisted their population stay indoors for practicing social distance in order to avoid infecting the disease. Consequently, industrial activities, businesses, and all modes of traveling have halted. On the other hand, the pollution level decreased 'temporarily' in our living environment. As fewer pollutants are supplied in to the hydrosphere, and human recreational activities are stopped completely during the lockdown period, we hypothesize that the hydrological residence time (HRT) has increased in the semi-enclosed or closed lake bodies, which can in turn increase the primary productivity. To validate our hypothesis, and to understand the effect of lockdown on primary productivity in aquatic systems, we quantitatively estimated the chlorophyll-a (Chl-a) concentrations in different lake bodies using established Chl-a retrieval algorithm. The Chl-a monitored using Landsat-8 and Sentinel-2 sensor in the lake bodies of Wuhan, China, showed an elevated concentration of Chl-a. In contrast, no significant changes in Chl-a are observed for Vembanad Lake in India. Further analysis of different geo-environments is necessary to validate the hypothesis.

Keywords: hydrological residence time (HRT); lake; COVID; waterbodies

1. Introduction

The residence time is a fundamental descriptor in hydrology that provides information on the timescales of a molecule of water spend in a specific system. Hydrological residence time (HRT) is estimated as the amount of time the water spent in any section of the connected network [1].

Theme 3- Air quality: Monitoring, fate, transport, and drivers of socio-environmental change

- Total number of chapters -**6**

- Here most of the chapters are focusing on impacts of COVID19 induced standstill on the atmospheric environment with reductions in major air pollutants (e.g. CO, NO_x, SO_2, Pb, O_3 and $PM_{2.5}$) particularly coming out from the industrial and transportation sectors from **India, Russia, Mexico and other part of the world**.

- One section also demonstrated a **safe way to collect airborne samples of COVID-19 virus through high precaution**.

- At last, this section highlights various lessons learned and possible adaptation strategies to cope up with it.

- Less industrial activities, vehicular emission results in the improvement of ambient air quality
- Relation between meteorological parameters and its relation with COVID19 related death rate in Russia
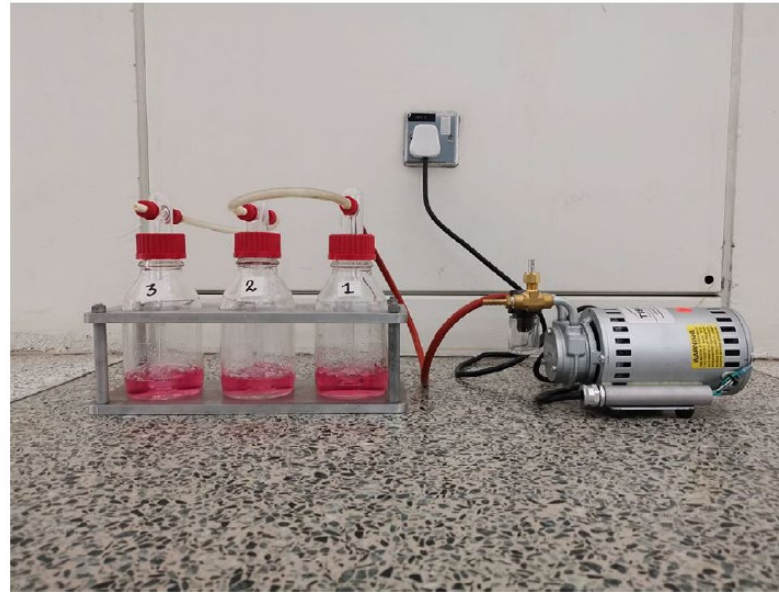- Shows how to do the safe air sampling to detect COVID19 transmission

FIG. 17.1 **The novel aerosol sampling setup.** The three gas wash bottles filled with 100 mL of Trizol.
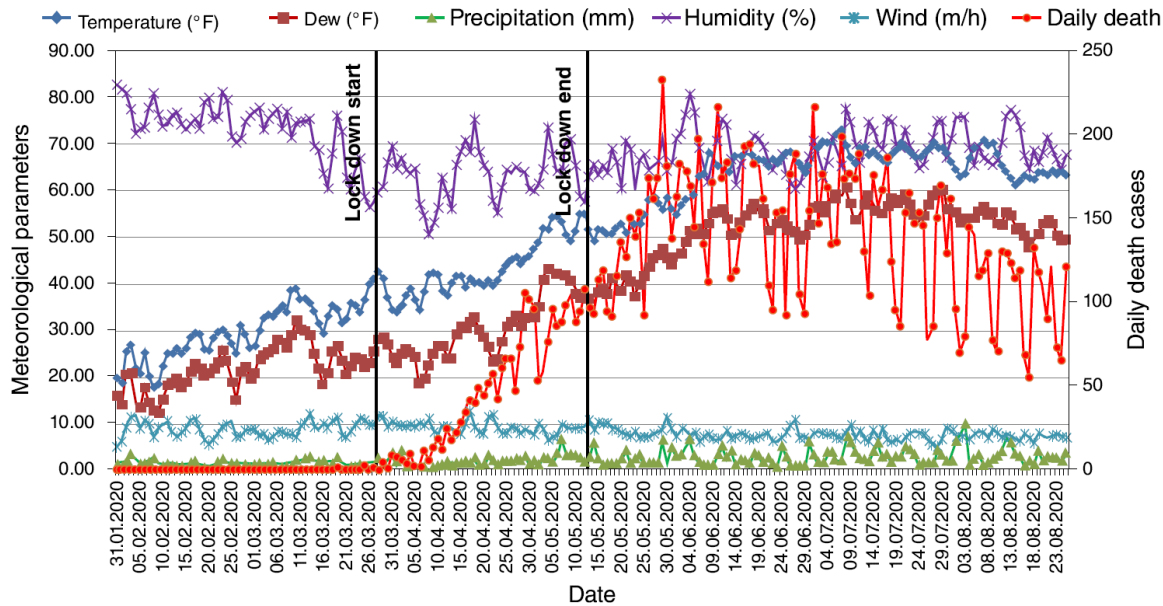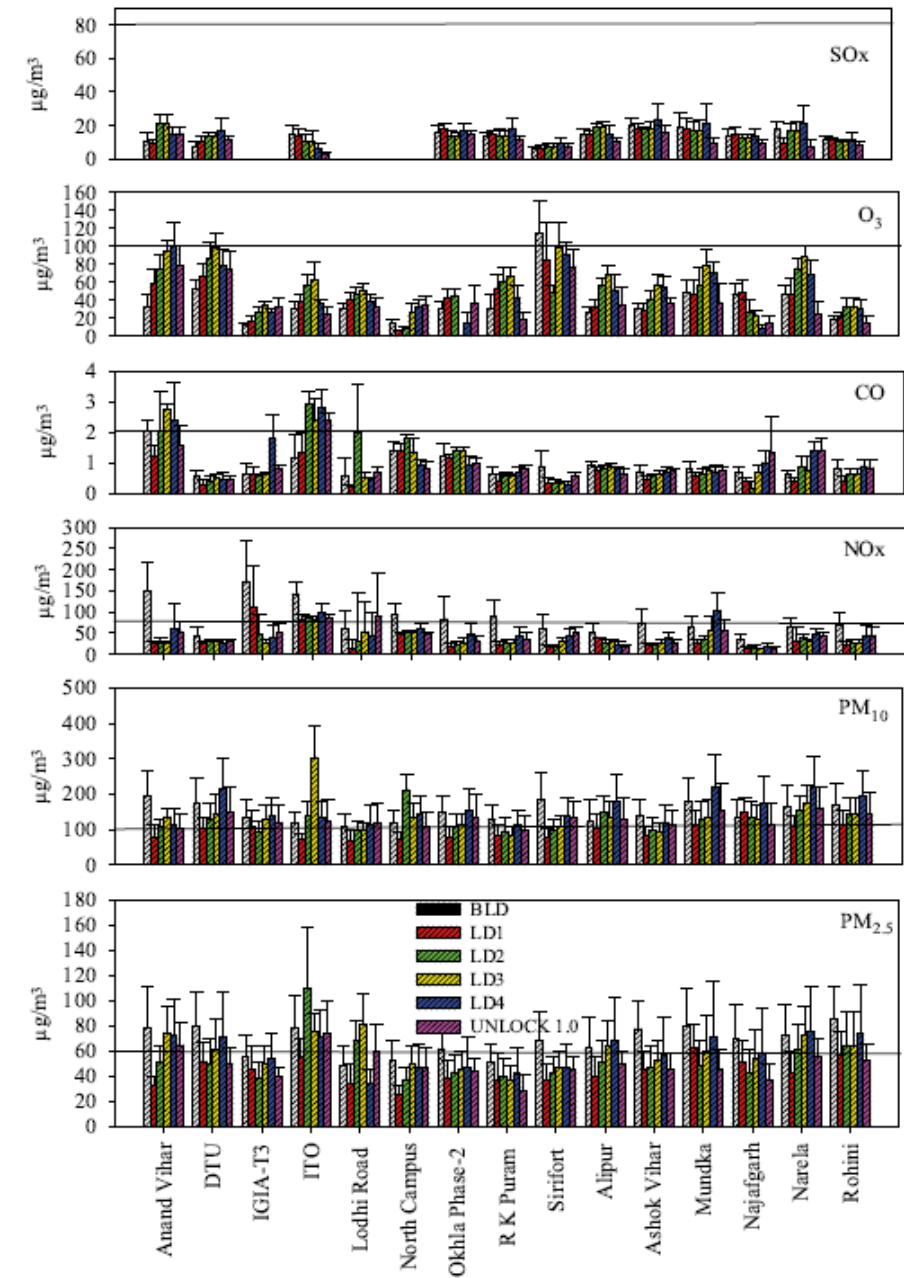

FIG. 18.3 Variation of meteorological parameters in relation with daily death rates during the study period.

Effect of COVID19 on air quality

Article

Geospatial Technology-Based Analysis of Air Quality in India during the COVID-19 Pandemic

Ajay Kumar Taloor [1], Anil Kumar Singh [2], Pankaj Kumar [3,*], Amit Kumar [4], Jayant Nath Tripathi [2,5], Maya Kumari [6], Bahadur Singh Kotlia [7], Girish Ch Kothyari [8], Surya Prakash Tiwari [9] and Brian Alan Johnson [3]

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Abstract: The study evaluates the impacts of India's COVID-19 lockdown and unlocking periods on the country's ambient air quality. India experienced three strictly enforced lockdowns followed by unlocking periods where economic and social restrictions were gradually lifted. We have examined the in situ and satellite data of NO_2 emissions for several Indian cities to assess the impacts of the lockdowns in India. Additionally, we analyzed NO_2 data acquired from the Sentinel-5P TROPOMI sensor over a few districts of the Punjab state, as well as the National Capital Region. The comparisons between the in situ and satellite NO_2 emissions were performed for the years 2019, 2020 and up to July 2021. Further analysis was conducted on the satellite data to map the NO_2 emissions over India during March to July for the years of 2019, 2020 and 2021. Based on the in situ and satellite observations, we observed that the NO_2 emissions significantly decreased by 45–55% in the first wave and 30% in the second wave, especially over the Northern Indian cities during the lockdown periods. The improved air quality over India is indicative of reduced pollution in the atmosphere due to the lockdown process, which slowed down the industrial and commercial activities, including the migration of humans from one place to another. Overall, the present study contributes to the understanding of the trends of the ambient air quality over large geographical areas using the Sentinel-5P satellite data and provides valuable information for regulatory bodies to design a better decision support system to improve air quality.

Keywords: COVID-19; Sentinel-5P; TROPOMI; air quality; North India

1. Introduction

In the last week of December 2019, an unusual type of pneumonia spreading quickly was reported in Wuhan city in the People's Republic of China [1]. During the early period, it was treated as a new form of pneumonia. After a group of infections was reported by Wuhan Municipal Health Commission to the World Health Organization (WHO) on 31 December 2019, the WHO published the first news of the outbreak of this virus on 5 January 2020 by identifying it as Coronavirus Disease 2019 (COVID-19), a sequel of pneumonia [2]. The patients with this disease showed similar symptoms as of Severe Acute Respiratory Syndrome (SARS) and Middle East Respiratory Syndrome

Theme 4- Marine and lacustrine environment

- Total number of chapters -**3**

- This theme focuses on the impact of the pandemic on the marine, lagoonal and lacustrine environment.

- The Marine environment (coastal, lagoon zones), has served as the key for the survival of corals, dependent biota and plays a significant role in the food chain.

- It shows an incipient evidence of trophic recovery in the lagoonal environment and hence biodiversity enrichment (case studies from Mexico, Philippines, India).

- It is emphasized that the interconnectivity of the marine ecosystems should be considered for deriving the management policies to protect the ecological health of these coastal habitats.

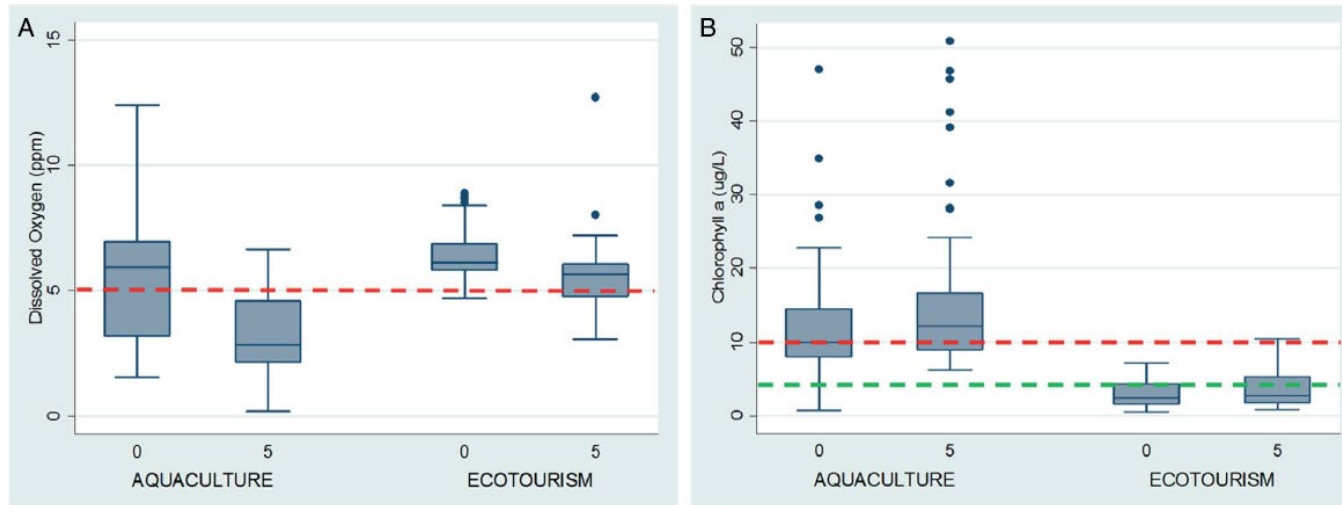# Effect of COVID19 on marine environment

FIG. 23.5 (A) Average dissolved oxygen (DO) and (B) chlorophyll-a concentration of aquaculture and ecotourism lakes of San Pablo.

Increase in the population of native as well as non-native fish species in seven lakes of Philippines
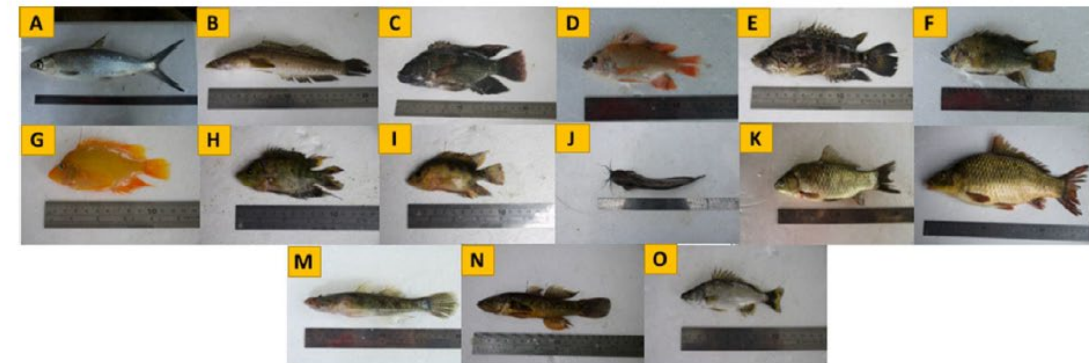

FIG. 23.6 Photographs of fish species present in Seven Lakes of San Pablo City, Laguna from 2001-2020. (A) *Chanos chanos*, (B) *Channa striata*, (C) *Oreochromis niloticus*, (D) *Oreochromis sp.*, (E) *Parachromis managuensis*, (F) *Tilapia sp.* (G) *Vieja sp.* (red devil), (H) *Vieja sp.* (green flowerhorn), (I) *Vieja sp.* (mixed red and green flowerhorn), (J) *Clarias batrachus*, (K) *Barbonymus gonionotus*, (L) *Carassius carassius*, (M) *Glossogobius aureus*, (N) *Giuris margaritacea*, and (O) *Leiopotherapon plumbeus*.

Theme 5- Management perspectives (Environmental justice and governance)

- Total number of chapters -**11**

- This section highlights the impacts of COVID19 on the slowing down the progress for achieving different global goals especially those in the world's developing economies

- Also, it highlights, what are the additional challenges and opportunities imposed by COVID-19 pandemic to achieve them in a timely manner.

- The area of thrust of all eleven chapters within this theme ranges from sectors like energy, natural resources and food security.

- Different approaches are highlighted to redesign our system to revive the economy as well as socio-environmental system. Main ideas discussed here are :

- **Green economy (Decarbonized society or net zero society)**

- **Transdisciplinary approach**

- **SDGs interlinkages**

- **Gender inclusiveness**

- **Nexus (food-energy- water) approach**

- **Transboundary application**

- **Planetary health**

SDGs interlinkage approach

- The existing gaps in SDG progress in Asia was worsened by the emergence of the COVID-19 pandemic and the subsequent global crisis reversing the decades of progress in many development areas.
- Due to the intrinsic interactions among the SDGs, understanding the impacts of COVID-19 and its recovery on achieving the SDGs from an interlinkage perspective is important to help grasp a wider picture of COVID-19 impact and inform about the synergies and trade-offs of the COVID-19 measures.
- In this study, a methodology based on an SDG interlinkage analysis was proposed for analyzing the impacts of COVID-19 and its recovery.
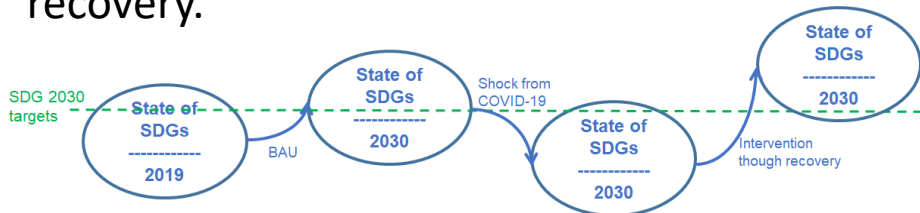
Figure 1 Trajectories of achieving the SDGs in the pre-and-post-COVID-19 eras
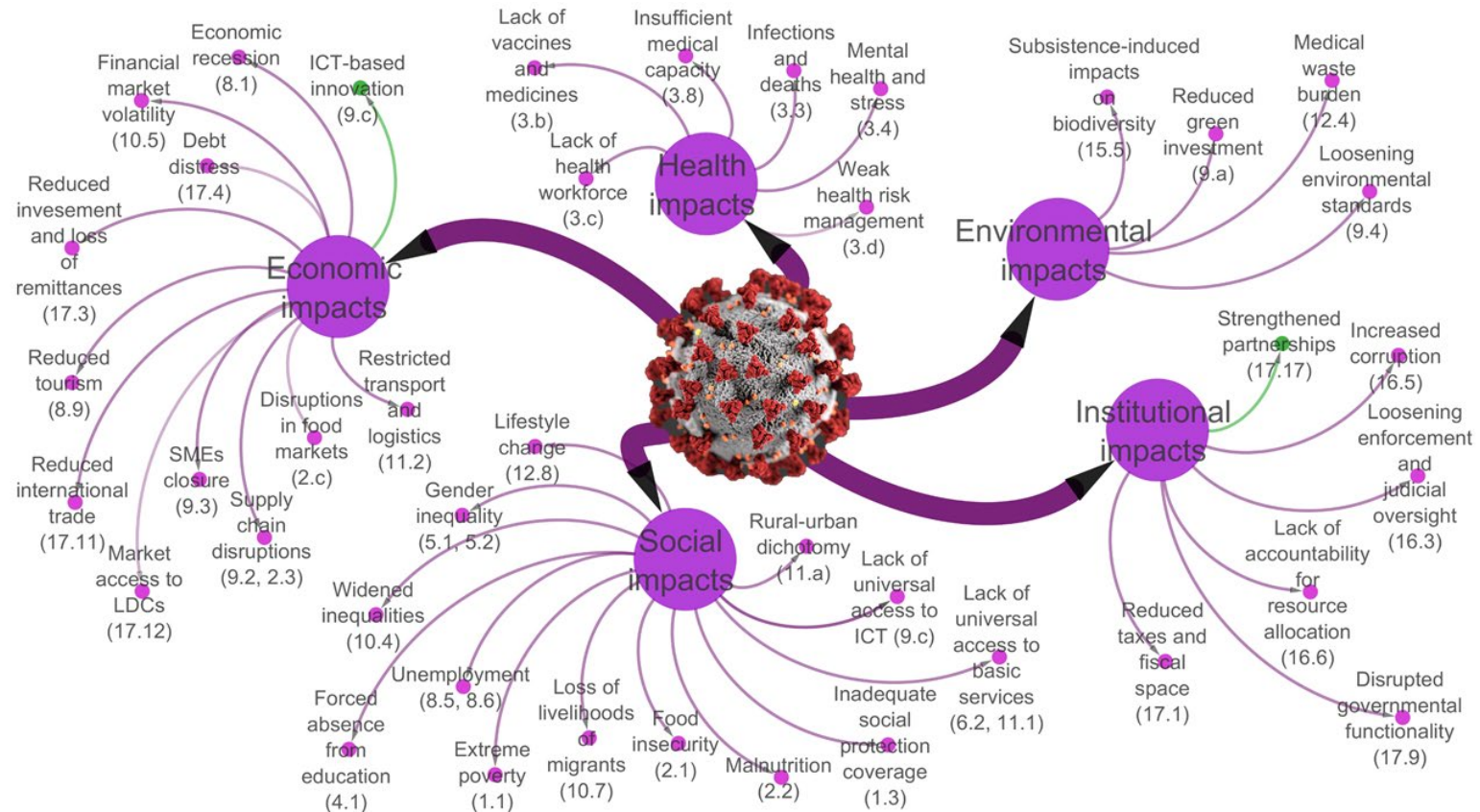

Figure 3 Impacts of COVID-19 and mapped SDG targets
Note: Codes in bracket are the mapped SDG targets. Purple-Negative impacts; Green-Positive impacts.

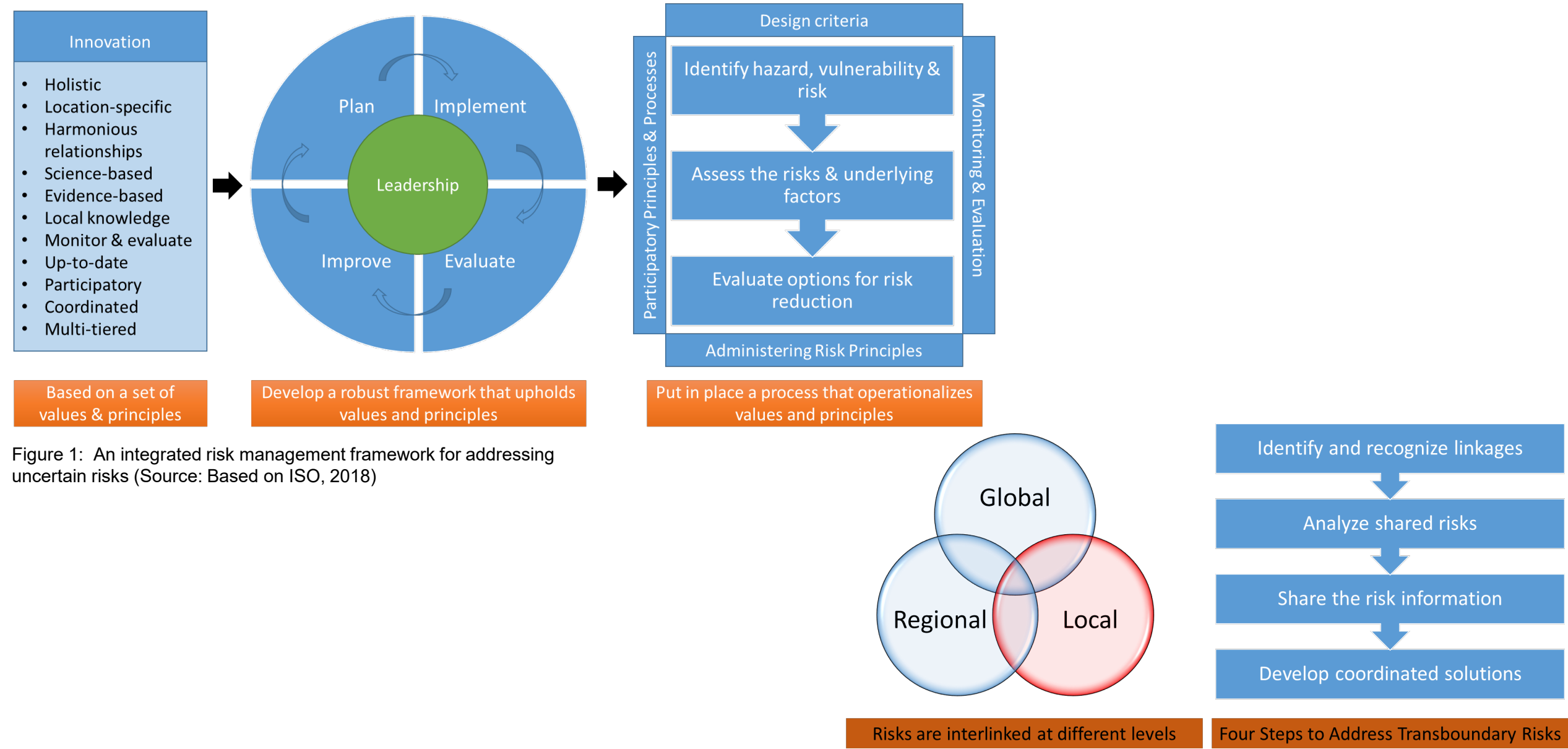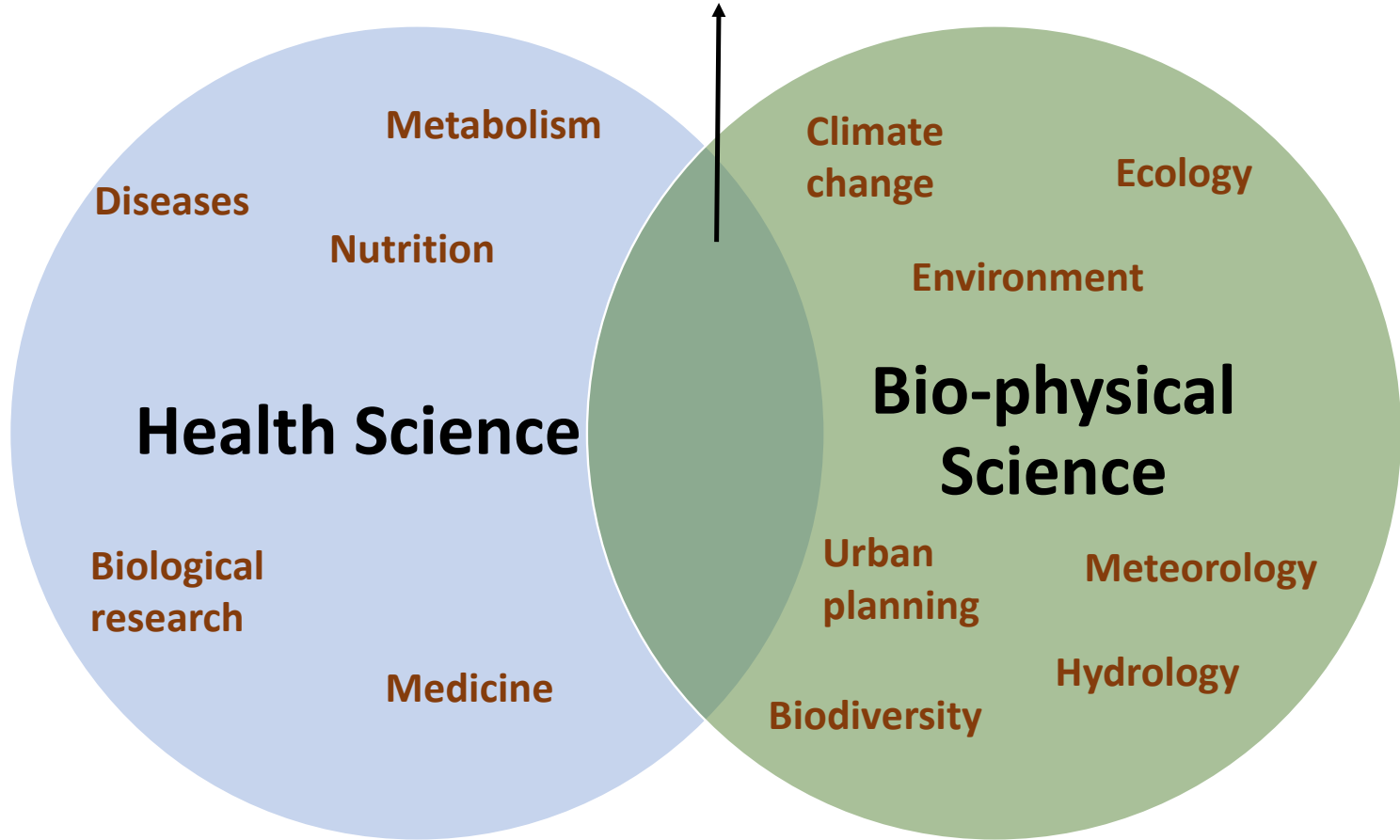# Strengthening Risk Management Frameworks to Mitigate Transboundary Risks

Figure 1: An integrated risk management framework for addressing uncertain risks (Source: Based on ISO, 2018)

Figure 2. Four steps to manage transboundary risks

Way forward

- Finally it highlights the importance of research on **planetary health**, which examines the health of human being along with the state of the natural systems or global environmental changes/challenges on which it depends.

Thank you for your valuable time