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COMMENTARY

THE POST-COVID INDIA: MAKING SCIENCE AND TECHNOLOGY SOCIALLY AND ENVIRONMENTALLY RELEVANT

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1. INTRODUCTION

The ongoing global pandemic and its health and economic effects have aggravated multiple existing systemic vulnerabilities linked to human and environmental systems, both in India and around the globe. Science and technology offer evidence- and data-driven strategies to address these challenges, but they ought to be grounded in an overall value framework that applies evidence and data to strengthen human, social, and ecological resilience. Critical to identifying successful solutions is an interdisciplinary approach.

2. DIALOGUE ACROSS DISCIPLINES

In May 2020, steered by the echo network,[1] the authors of this commentary—a group of economists, public health professionals, lawyers, environmental scholars, policymakers, activists, journalists, and CEOs—assembled over three online discussions to identify the urgent problems created, revealed, or exacerbated by the current crisis; clarify priorities for rejuvenating India; and establish immediate starting points. Our goal was to stimulate further discussions on the role of science and technology as India readies itself to address and move beyond COVID-19.

The online dialogue started with a survey to identify pressing COVID-19 related concerns. At the first online meeting, participants identified a series of priority challenges that were later categorized into broader concepts. A second discussion streamlined these constructs into the "compass points" that we outline below. The final conversation led to the drawing up of recommendations to which science, including social science and local knowledge systems, and technology can contribute. These are meant to serve as triggers for deeper dialogue across sectors on knowledge gaps and methods for targeted interdisciplinary research. This process, through a progressive funnelling of ideas from challenges to concepts to recommendations, allowed diverse viewpoints to be recognized and synthesized (echo network 2020).

[1] Please see https://www.echonetwork.in/.

3. PREVENTIVE AND RESPONSIVE PUBLIC HEALTH SYSTEMS

While life expectancy has steadily increased in India, morbidity and mortality risks vary significantly across the country based on location and socio-economic status (Ravindran and Gaitonde 2018; ISDBIC 2017). Thus, the current pandemic calls for a careful diagnostic assessment of disease and accident risk across Indian states and the environmental, agricultural, and livelihood sources of risk. Further, the decentralized and intersectoral management of interactions among people, livestock, wildlife, forests, and water is essential to prevent and respond to infectious diseases. Science and technology have a role to play in facilitating OneHealth[2] approaches that recognize the interconnections among people, animals, and plants and their shared environment (Chatterjee *et al.* 2016; Vanak and Paul 2020).

In addition, we need a system-wide overhaul of primary healthcare, with investments in infrastructure and provisions, disease surveillance based on OneHealth principles, and local health governance supported by trained public health professionals rather than specialist doctors, who currently dominate public health and infectious disease management. For instance, providing essential public health workers, such as the million women ASHAs (accredited social health activists) at the forefront of the Government of India's COVID response, with training, equipment, and strategies to cope with any negative societal responses to their work, is critical. There are serious capacity gaps at the district level in primary and secondary healthcare and educational programmes on nutrition, safety, and hygiene. These gaps need to be filled with the support of nodal public health research and training centres. Earlier efforts, including the High-Level Expert Group on Universal Health Coverage, can offer guidance on such investments (Planning Commission of India, 2011, Takhur 2011, Patel *et al.* 2015). The National Mission on Biodiversity and Human Well Being, the United Nations Sustainable Development Goals (SDGs), and the Global Health Security Agenda provide specific targets and indicators.[3]

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[2] OneHealth is defined by the Centers for Disease Control (CDC) as "a collaborative, multisectoral, and transdisciplinary approach—working at the local, regional, national, and global levels—with the goal of achieving optimal health outcomes recognizing the interconnection between people, animals, plants, and their shared environment" (see the CDC website for more information: https://www.cdc.gov/onehealth/index.html.)

[3] Please see http://psa.gov.in/pmstiac-mssions/national-biodiversity-mission for National Biodiversity Mission, Office of the Principal Scientific Advisor to the Government of India. Please see https://www.un.org/sustainabledevelopment/sustainable-development-goals/ for the 17 interconnected SDGs. The Global Health Security Agenda (GHSA) is a group of

4. COMMUNITIES WITH DIGNITY AND EQUITY

The current crisis has aggravated as well as focused attention on the glaring inequities within India's population, with some staying at home without the ability to practise physical distancing and others returning home under extremely difficult circumstances. It has also brought into stark relief the invisible work undertaken by two demographic groups—migrants and women caregivers. The mass migration of Indians as a result of COVID-19, in particular, has put a spotlight on two critical issues: a) the need for mandatory registration of employees at the lowest administrative levels of businesses (to enable assessment and communication); and b) decentralized data-driven public service delivery (to meet basic needs). A series of recommendations are available in the 2017 Working Group on Migration (MHUPA 2017). Importantly, significant progress is possible by enforcing existing laws such as the Interstate Migrant Workmen's Act of 1979 (Chief Labour Commissioner 2020).

Supporting vulnerable mobile populations will require decentralized action by smart, inclusive, and sustainable communities. Thus, local governments (urban and rural) need to be empowered to deliver quality public services—and particularly health and safety information and services—while simultaneously enabling residents to access information and data at their source. Medium-term strategies may include establishing central- and state-level commissions (with public representation) to examine current inequities in service access and district-level citizen-focused public emergency funds. Some immediate actions, supported by evidence-based research on impacts on nature and the livelihoods of both men and women, can help with long-term sustainable development. Public works programmes such as the Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) [4] and Pradhan Manthri Krishi Sinchayee Yojana can be used to restore ecosystems, build agricultural infrastructure, and conserve water resources, especially in rural districts with high tribal, returning migrant, or daily wage worker populations.

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67 countries, international organizations, non-government organizations, and private-sector companies that have come together to address threats posed by infectious diseases. https://ghsagenda.org/.

[4] Please see Narayan (2020) on MGNREGA's potential to address economic crisis-related challenges.

5. SUSTAINABLE LIVELIHOODS

With the economy in crisis, the pandemic has brought attention to India's persistently large informal sector (Ghani *et al.* 2013), which provides over 90% of jobs (Mehrotra and Parida 2019), and the dominant role of micro, small, and medium enterprises (MSMEs). Urgent action to support MSMEs would include payment of public-sector outstanding dues and a time-bound government credit guarantee on incremental loans to induce lending to MSMEs. Further, a recovery package that includes low-interest credit to promote climate- and biodiversity-friendly business practices and investments in clean R&D, waste management, energy generation, grid development, and regenerative agriculture would nudge India onto a climate-smart and nature-positive pathway.

Successful examples of distributed market linkages point to how we may be able to move the economy forward with a united focus on jobs, growth, and sustainability. New scientific and technological innovations in distributed and decentralized energy, water, and sanitation infrastructure, sustainable cooling, regenerative agriculture, and rural value chains can support both rural and urban economies (Ghosh *et al.* 2020). Human, livestock, and agri-residue waste offer additional potential resources for conversion to energy or farm nutrients. These new sources of growth would require research, capital, and public education to bolster rural entrepreneurship. Collaborations between industry, education, and the government can provide pedagogical and technical training for the production, use, and repair of new technologies and services. With the active participation of Indian youth, both men and women, this interdisciplinary space where science, technology, social science, and policy intersect can generate innovation. Women's labour force participation in India was already on the decline (32% in 2005 to 21% in 2018 [ILO 2020]) and any job rebound from COVID-19 is likely to be far easier for men than women. Hence, technical training would need to pay attention to drawing Indian women into the labour force.

6. SECURE HUMAN AND ENVIRONMENTAL ECOSYSTEMS

Modern scientific knowledge, traditional ecological knowledge, and SDG targets can be combined into a roadmap that prevents environmental degradation and strengthens ecosystem protection and restoration. This roadmap would need to be guided by careful research and analyses of biodiversity and ecosystem service losses and predictions regarding disease emergence, climate change impacts, and economic and health implications. Rigorous environmental, social, and economic assessments, combined with

stakeholder participation, and lifecycle analyses of infrastructure and industry planning can help incorporate the benefits of ecological goods and services into decision-making. To be effective, research would need to be coupled with local monitoring. The National Mission on Biodiversity and Human Well Being can assist in this process (Krishnan 2020).

Closely entwined with the loss in biodiversity and ecosystem services is agriculture, which is fundamental to India's food security and for securing livelihoods. Making agriculture both more competitive and increasingly nature-positive and climate-responsive is a critical challenge. Research to foster integrated watershed development and regenerative agricultural practices would need to go hand-in-hand with investments in upgrading rural skills, technology adoption across value chains, and efficient post-harvest activities.

7. CONCLUSIONS

The pandemic has brought to the forefront systemic issues that require an interdisciplinary focus to generate effective solutions. Innovations in science and technology have the potential to drive positive social, economic, and environmental change, but they need to be explicitly leveraged for this purpose. Interdisciplinary research can facilitate reforms that are more sustainable and equitable. We hope that our efforts will stimulate new science and additional conversations across sectors and geographic boundaries to identify ways to better embed scientific discourse into society.

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