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Special Section:

The COVID-19 pandemic: linking health, society and environment

Key Points:

- The COVID-19 pandemic has negative impacts on most Sustainable Development Goals, which may subside in the medium and long terms
- Key impeding factors causing the negative impacts include lockdowns, unemployment, and diluted focus on non-COVID-19-related issues
- The COVID-19 pandemic has also opened a short-lived and narrow window of opportunity for sustainable transformation

Supporting Information:

Supporting Information may be found in the online version of this article.

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The COVID-19 Pandemic Not Only Poses Challenges, but Also Opens Opportunities for Sustainable Transformation

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Abstract The COVID-19 pandemic has impacted social, economic, and environmental systems worldwide, slowing down and reversing the progress made in achieving the Sustainable Development Goals (SDGs). SDGs belong to the 2030 Agenda to transform our world by tackling humankind's challenges to ensure well-being, economic prosperity, and environmental protection. We explore the potential impacts of the pandemic on SDGs for Nepal. We followed a knowledge co-creation process with experts from various professional backgrounds, involving five steps: online survey, online workshop, assessment of expert's opinions, review and validation, and revision and synthesis. The pandemic has negatively impacted most SDGs in the short term. Particularly, the targets of SDG 1, 4, 5, 8, 9, 10, 11, and 13 have and will continue to have weakly to moderately restricting impacts. However, a few targets of

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SDG 2, 3, 6, and 11 could also have weakly promoting impacts. The negative impacts have resulted from impeding factors linked to the pandemic. Many of the negative impacts may subside in the medium and long terms. The key five impeding factors are lockdowns, underemployment and unemployment, closure of institutions and facilities, diluted focus and funds for non-COVID-19-related issues, and anticipated reduction in support from development partners. The pandemic has also opened a window of opportunity for sustainable transformation, which is short-lived and narrow. These opportunities are lessons learned for planning and action, socio-economic recovery plan, use of information and communication technologies and the digital economy, reverse migration and “brain gain,” and local governments’ exercising authorities.

Plain Language Summary The current pandemic has impacts on social, economic, and environmental systems, including Sustainable Development Goals (SDGs). SDGs consist of 17 interlinked goals that aim to achieve a better and more sustainable future for all. We studied the pandemic’s impacts on SDGs for Nepal by following a knowledge co-creation process. For this, we conducted online surveys and workshops with experts from various professional backgrounds and assessed expert’s opinions articulated in the surveys and workshops. The experts reviewed and validated our assessment. Then, we revised and synthesized the assessment. Our study highlights that the pandemic has negatively impacted most SDGs, particularly the targets of SDG 1, 4, 5, 8, 9, 10, 11, and 13. These negative impacts may subside in the medium and long terms. The key factors behind the negative impacts are: lockdowns, underemployment and unemployment, closure of facilities, diluted focus and funds for non-pandemic issues, and anticipated reduction in development support. The pandemic has also opened a short-lived and narrow window of opportunity for sustainable transformation. The transformative opportunities consist of lessons learned for planning and actions, socio-economic recovery plan, use of information and communication technologies and the digital economy, reverse migration and “brain gain,” and local governments’ exercising authorities.

1. Introduction

In 2015, the United Nations Member States adopted the 2030 Agenda for Sustainable Development that consists of 17 Sustainable Development Goals (SDGs) with 169 targets, to be achieved by 2030, for transforming our world (see Table S1 for the list of all goals and targets). Despite progress made during the last five years, achieving SDGs remains a challenge in many countries under current trends (Editorials, 2020; Sachs et al., 2019). Hence, the SDG summit in 2019 called for a Decade of Action, pledging to mobilize resources and enhance national implementation to achieve SDGs in a stipulated time.

At the beginning of this Decade of Action, the COVID-19 pandemic (from now on referred to as pandemic) hit the world, affecting all three sustainability pillars—society, economy, and environment (Difffenbaugh et al., 2020). Measures taken to control the pandemic have, for example, impacted existing workforces, closed schools, affected healthcare systems, and decreased manufacturing activities. These impacts led to various negative socio-economic repercussions (Nicola et al., 2020). However, these measures have also brought a few positive impacts on the environment, for example, reduced air pollutants and greenhouse gas emissions (Chen et al., 2020; Le Quéré et al., 2020). Most past studies have investigated the pandemic’s social, economic, and environmental impacts separately or have only focused on a few SDGs (Adhikari et al., 2021; Fleetwood, 2020; Filho et al., 2020; UN, 2020). Comprehensive studies on the pandemic’s impacts (both restricting and promoting) are still lacking, especially in the context of developing countries.

For achieving the 2030 Agenda, there is a need to understand the pandemic’s impacts on SDGs thoroughly so that policymakers can develop interventions to address the negative impacts. This holistic understanding is crucial because SDGs are considered a system of interacting components rather than a collection of goals, indicators, and targets (Pradhan, 2019). However, as the global pandemic is still unfolding into the second year, its intricate impacts, including on the potential structural transformation, are yet to be understood. Especially for developing countries, inadequate—and often the complete lack of information—makes assessment of the multifaceted impacts even more difficult.

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Based on a participatory approach to the knowledge co-creation process, this first-of-its-kind study investigates the pandemic's potential impacts on achieving SDGs, with Nepal as a case study. We expect that our research will enhance the understanding of the underlying challenges and help formulate policy interventions to curtail the negative impacts of the pandemic on SDGs in Nepal and other developing countries.

Nepal is a land-locked country in South Asia, bordering China and India. In 2019, its estimated population was around 28.6 million, with 29.6% of population under age 15, 22.3% of population aged 15–24, 42.3% of population aged 25–64, and 5.8% its population aged above 65 (UN-DESA, 2019). Nepal has an average life expectancy at birth of 70.78 years, the infant mortality rate of 26 per 1,000 live births, and the total fertility of 1.88 in 2019 (UN-DESA, 2019). Nepal is one of the few developing countries to have made remarkable progress in achieving many Millennium Development Goals (UN, 2015), thus putting a similar expectation for Nepal's achievement of the SDGs. Although the country has made some progress during the first five years (NPC, 2020), it faces challenges in achieving most of SDGs. Particularly, the Sustainable Development Report 2020 highlights that Nepal is on track or maintaining achievement of SDG 6, 8, 13, and 17, stagnant in making process in SDG 7, 11, 15, and 16, and moderately improving in achieving SDG 1–5, and 9 (Sachs et al., 2020).

2. Methods

We based this study on the co-creation of knowledge involving experts with various professional backgrounds based on their workplaces. We broadly categorized these workplaces into government (e.g., ministries and departments of federal and provincial governments, and urban and rural municipalities), academia and research (e.g., educational and research institutes), (international) non-governmental organizations (e.g., non-profit organizations providing various services and functions), business (e.g., companies, and micro, small, and medium enterprises), freelancers (e.g., independent consultant and retired experts without affiliation), policy makers (e.g., member of parliament and politicians), international organizations (e.g., United Nations Organizations), and others (mainly civil society advocates and media). We identified key experts in each SDG through our networks and snowball sampling. To facilitate mutual learning and evidence-based reasoning, we took a participatory approach to the knowledge co-creating process, encouraging the experts to participate as equal partners (Chambers, 1994). This study did not include SDG 14 (Life below water), which the Government of Nepal (GoN) has excluded as Nepal is a land-locked country. While most experts participated in only one SDG, some contributed to multiple SDGs based on their primary expertise. The process involved the following five steps (Figure 1).

First, we conducted an online survey among the selected experts to familiarize them with our approach and collect their initial perceptions of the pandemic's impacts. The survey included questionnaires on each SDG target where experts would evaluate impacts of the pandemic in the short term (current year), medium term (within five years), and long term (by 2030) using a mandatory seven-point scale: –3 (strongly restricting), –2 (moderately restricting), –1 (weakly restricting), 0 (no influence), +1 (weakly promoting), +2 (moderately promoting), and +3 (strongly promoting). We adapted the seven-point scale framework developed by Nilsson et al. (2016) to understand SDG interactions. Other studies have also applied this framework for a similar purpose, for example, to investigate the impact of food systems innovation on SDGs (Herrero et al., 2020). Besides providing scores on the seven-point scale, experts could also optionally describe in the survey the rationale and mechanisms behind the impacts. We received a total of 410 responses from 364 experts with an average of 23 and a minimum of 10 responses per SDG (see Figure S1). Around 70% of the responses consist of a brief description of the rationale and mechanism.

Second, we organized 20 online workshops, with at least one workshop for each SDG (more than one for SDG 4 and SDG 17), to offer the experts a platform for a multilateral discussion on the impacts. For SDG 4, we conducted four workshops to discuss the pandemic's impacts on four education domains: primary education, secondary education and training, higher education, and policy. Similarly, we organized two workshops for SDG 17 due to its large number of targets. Altogether, 302 experts participated in these workshops (some experts joined more than one workshop). Each workshop had an average of 19 (minimum 11) expert participants (see Figure S1). In the workshops, we shared the survey results. We encouraged partic-

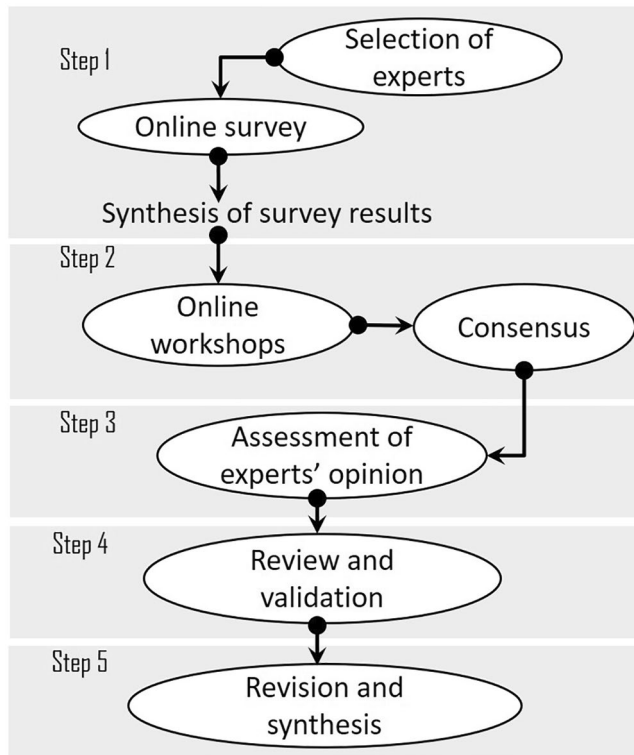


Figure 1. The methodological framework of the study consisting of five steps: (i) online survey, (ii) online workshop, (iii) assessment of expert's opinions, (iv) review and validation, and (v) revision and synthesis.

Participants to explain the discrepancies among the scores they had provided. This process helped to build a consensus on mechanisms and scores of the impacts.

We conducted the workshops between July 17th and August 30th, 2020. The GoN has imposed strict regulations and policies to control the pandemic after March 22nd by stopping all international flights, closure of educational institutions and religious places, and restricting gatherings of more than 25 people. Within the country, the GoN restricted vehicular movement on long routes from March 23rd and started the first lockdown on March 24th, 2020. This lockdown ended on July 21st, 2020. The second lockdown came into effect on August 18th, 2020 and lasted for 5 weeks. During our study period, international borders were closed. Similarly, educational institutions including schools, colleges, and universities were only having online teaching and learning activities. People were also asked to stay home and advised to come out as per the necessity but had to strictly follow the principle of social distancing and compulsory wear a mask. Moreover, it had been strictly advised to adopt work from home where possible.

Third, we assessed the experts' scores and opinions collected through the survey and workshops. The authors were tasked with individual SDGs and supplemented the assessment based on their expertise to fill any information gaps. This supplement was mainly instrumental in a few cases where the pandemic's arguments were not well-captured either due to time constraints or deviations from the workshop's core discussion. We drafted a report for each SDG based on this assessment, tabulating the impact scores for short, medium, and long terms at the target level and corresponding descriptive reasoning.

Fourth, we offered a final opportunity to the respective experts to review and validate our assessment reports. The experts either agreed to the reports or provided additional suggestions on the impact scores and mechanisms behind the impacts.

Finally, we prepared the final reports by incorporating, when available, experts' feedback collected in step four of the review and validation process. We then analyzed the revised and finalized reports to identify key impeding factors of the pandemic on SDGs and the transformative opportunities it offers to achieve them. We also visualized the scores in the final reports at the target and SDG levels. Based on the scores provided for each target belonging to an SDG, we derived the shares of impact scores at the SDG level.

3. Results

The pandemic has and may have weakly to moderately restricting impacts on most SDGs in the short term (Figure 2 and Table S1), particularly on the targets of SDG 1, 4, 5, 8, 9, 10, 11, 13, and 16, bringing new challenges in achieving those SDGs by 2030. In the short term, the pandemic could have weakly promoting impacts on a few targets, mainly of SDG 2, 3, 6, and 11, largely due to an increased focus on health care systems, information and communication technologies (ICTs), and digital economy (Figure S2). In the medium and long terms, many of the negative impacts may subside, resulting in no influence or even up to moderately promoting impacts on most SDG targets. Nevertheless, restricting impacts would persist on a few targets, such as SDG 3, 5, 8, and 10, in the medium and long terms, reflecting a massive time needed to fully recover from the pandemic. The experts expected positive impacts in the medium and long terms, mainly based on two reasons. First, Nepal is expected to catch up with ongoing progress in achieving the SDGs once the pandemic is under control. Second, the GoN is expected to utilize the generated transformative opportunities for sustainable development based on lessons learned from the pandemic. This is because the pandemic has opened a window of opportunity for sustainable transformation, that is, to make progress

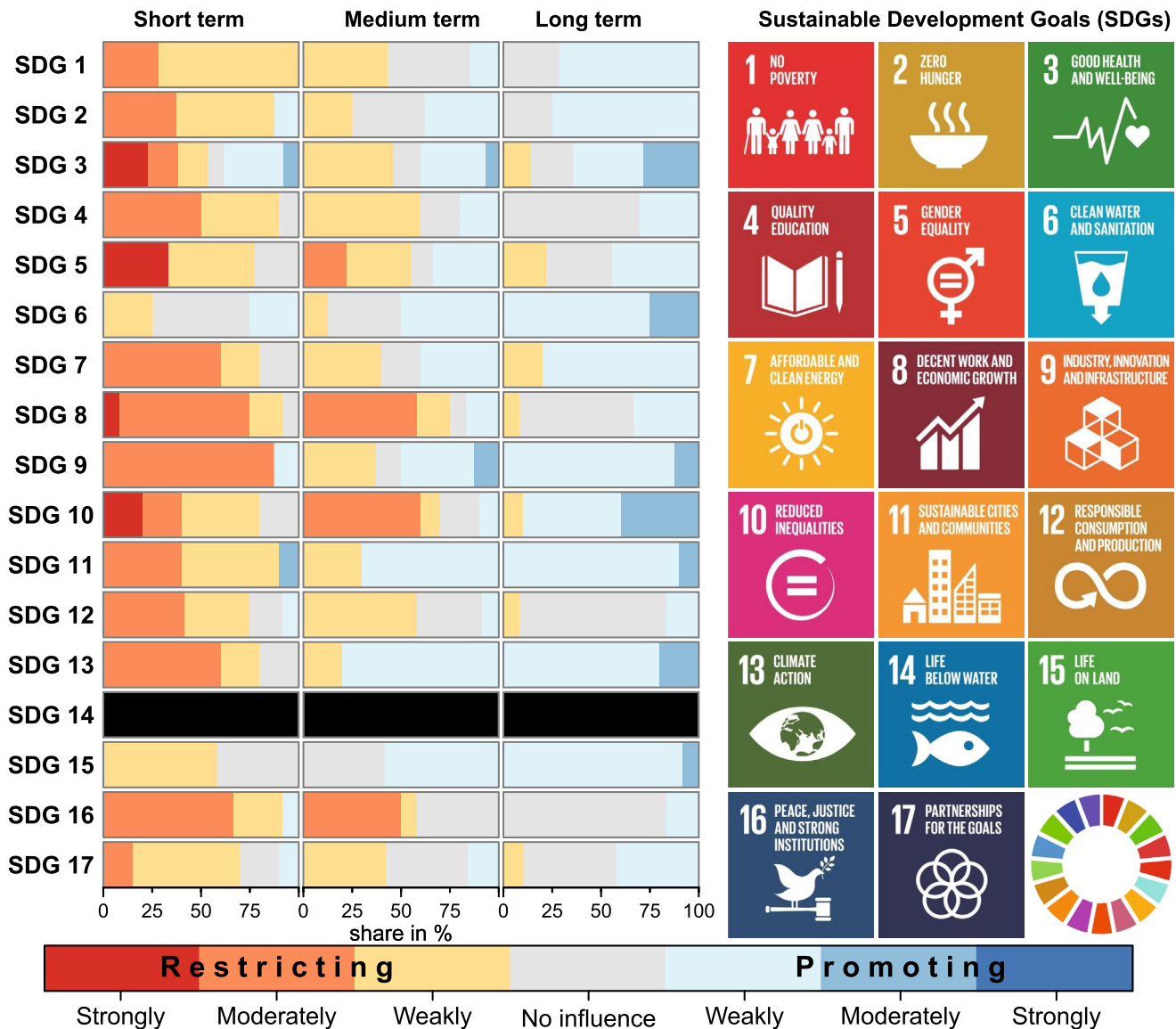


Figure 2. Impact of the COVID-19 pandemic on Sustainable Development Goals (SDGs) in Nepal for short term (within a year), medium term (within next five years), and long term (by 2030). The pandemic will have restricting impacts on most SDGs in the short term. These restricting impacts may subside in the medium and long terms, and may even result in some promoting impacts. These promoting impacts are expected because Nepal would catch up with ongoing progress in achieving the SDGs and utilize the generated transformative opportunities, once the pandemic is under control. The color bars represent the shares of impacts from strongly promoting to strongly restricting at the goal level. We derived the shares from the impact scores at the target level (see Figure S2). The impact scores are co-created, involving up to 364 experts with various professional backgrounds (see Figure S1) based on surveys and workshops. The black bar depicts no data because our study does not include SDG 14.

in achieving SDGs. However, we expect it to narrow over time, before rebounds occur following past trajectories. We have distilled and described below the key impeding factors and the transformative opportunities offered by the pandemic for achieving the SDGs based on the described rationale and mechanisms behind the impacts by the experts. Table S1 consists of the detailed rationale and mechanisms of the impacts and respective impact scores.

3.1. Key Impeding Factors

The pandemic's negative impacts arise from various factors that are either directly or indirectly linked to it, or from repercussions of the government's measures to control it. Most of these impeding factors would

only exist for a short term, and might subside after controlling the pandemic, as reflected in Figure 2. However, several factors that may challenge the achievement of the SDGs, could persist in the medium or long terms. Here, we present the five key impeding factors, together with their cascading impacts.

3.1.1. Lockdowns

The GoN imposed lockdowns and restrictions on movements in two phases to contain the pandemic: the first phase from March 24th, 2020 for 17 weeks, and the second phase from August 18th, 2020 for 5 weeks. This measure negatively impacted many SDGs. Below, we highlight two significant repercussions (under-employment and unemployment, and closure of various institutions) as key impeding factors. Our discussion here mainly focuses on other restricting impacts led by this measure.

The lockdowns have disrupted supply chains, manufacturing, production, and markets, impacting many SDGs negatively, mostly in the short term. For example, disrupted food and agriculture supply chains exacerbated food insecurity and decreased agricultural productivity (SDG 2), and increased food losses (SDG 12) (Adhikari et al., 2021). A survey conducted by WFP (2020) highlighted that increased food price and shortage of food were major concerns for most respondents during the lockdowns, that is, around 20% and 16%, respectively. Disrupted material supply chains have hindered activities associated with clean water and sanitation (SDG 6), construction of energy infrastructures (SDG 7), and industrial production and infrastructural development (SDG 9). Overall, Nepal's economy (SDG 8), including government revenue (SDG 17), has slowed down because of disrupted supply chains and exports/imports. Nepal's projected economic growth rate was reduced from 7.3% to 2.7% for the fiscal year 2020 due to the pandemic (ADB, 2020).

At least for the short term, the movement restrictions postponed several plans and programs, which include the National Vaccination Program, Vitamin A Program (SDG 2), Visit Nepal 2020 tourism promotion campaign (SDG 8 and 12), and the first *Sagarmatha Sambaad*—a global dialogue forum focusing on climate change and sustainability (SDG 13 and 17). It also hindered existing services, for example, maternal health (SDG 3) and judicial (SDG 16) services. For example, by the end of the lockdowns, safe childbirths at medical facilities were reduced by 52.4% compared to the preceding year (KC et al., 2020). The negative impacts on SDG 3 were also related to anxiety, isolation, fear, and stigma associated with the pandemic both at the service receiver and provider sides. Additionally, movement restrictions increased mental health problems both in adults and children, resulting in negative impacts on SDG 3, 4, and 16. For example, more people lost their lives due to suicide during the lockdown period than the previous year, that is, an average 16.5 people per day within 74 days of the first lockdown compared to 15.8 person per day in 2019 (Singh et al., 2020). During the lockdowns, domestic violence incidences, mainly against children and women, also increased (SDG 5 and 16). For example, the number of reported cases of violence against women doubled during the lockdowns (Sharma, 2020). Although such violence may subside after the lifting of lockdowns, its subsequent impacts would remain in the medium or long terms. Similarly, women and girls are also more engaged in household and unpaid care work than male members, resulting in increased gender inequalities (SDG 5). National and international movement restrictions also go against the SDG 10 target on responsible and well-managed migration policies. The lockdowns have also disrupted cultural activities, including various festivals (e.g., *Rato Machhindranath Jatra*—the longest chariot festival in Nepal), public transport systems, and rural-urban linkages (SDG 11). Weakened law enforcement due to the restricted mobility of staff, as well as unemployment, also led to increased illegal extractions of forest products and wildlife poaching (SDG 15).

Temporarily, the lockdowns have positively impacted several SDG targets. Reduced traffic and industrial activities led to decreased air and water pollution (SDG 6 and 11). For example, the Kathmandu Valley's air quality, which suffers from severe air pollution almost throughout the year, improved visibly and substantially. The monthly PM_{2.5} concentration decreased from around 150 $\mu\text{g}/\text{m}^3$ a month before the first lockdown to around 100 $\mu\text{g}/\text{m}^3$ a month into the first lockdown (Shrestha et al., 2020). For the first time in decades, there were clear blue skies and unprecedented views of Mt. Everest from the Kathmandu Valley and elsewhere in Nepal as a result of improved air quality and visibility. This improvement in air quality could also be linked to the 4.54% decrease in the number of human-induced forest fires due to the lockdowns (Paudel, 2021). This restriction also limited human trafficking (SDG 5 and 16), illegal wildlife trade (SDG 15), and illicit financial flows (SDG 16) temporarily. For example, Nepal observed an increase in remittance despite many Nepali

migrants losing their jobs in countries where they were employed (NRB, 2020). A reason for this increased remittance is a decline in illicit financial flows, commonly known as *hundi*, which is widely practiced by the majority of Nepali migrants to remit money back home at a cheaper fee (Seddon et al., 2002).

3.1.2. Underemployment and Unemployment

As a result of shrinking domestic and international labor markets due to the pandemic, many workers (i.e., three out of five) in formal and informal economies lost their jobs (UNDP, 2020). Informal sectors mostly suffered from unemployment, while underemployment is an issue in the formal sectors. Around two-thirds of Nepal's workforce is employed in informal sectors (MOLE, 2018). Nepal has also issued over 4 million labor permits to migrant workers in the last decade, mainly for the Gulf countries and Malaysia (MOLESS, 2020). Additionally, remittance contributes to 25.4% of Nepal's gross domestic product (NRB, 2019).

Increased underemployment and unemployment are a setback to Nepal's progress in poverty reduction (SDG 1) and economic growth (SDG 8). Subsequently, underemployment and unemployment could also have cascading impacts on other SDGs. With reduced income, households have limited access to various essential goods and services, for example, nutritious food (SDG 2), health care (SDG 3), and education (SDG 4) in the short and medium terms. Additionally, poverty and reduced incomes could lead to unsustainable agricultural practices on marginal lands (SDG 2), abuse of drugs and alcohol (SDG 3), and an increase in school dropout rates (SDG 4), mainly for girls (SDG 5). Even before the pandemic, 3.0%–4.8% of students were already leaving primary schools every year in Nepal, with a higher dropout rate for girls than boys (DOE, 2018). The pandemic has also exacerbated gender discrimination in terms of unemployment (SDG 5). Around 90% of employed women work in the informal sectors in Nepal (CBS, 2019). Self-employed workers, domestic workers, female-headed households, and casual or temporary agency employees are at particular risk of losing their jobs (UNICEF, 2020). A survey from UNDP (2020) reported that 41% of females lost their jobs during the first lockdown, compared to 28% of males. In addition to jobs lost, female household members are also subjected to increased gender-based violence (SDG 5), resulting from stresses at home due to underemployment and unemployment. In the absence of recovery plans to support the poor and vulnerable population, underemployment and unemployment could increase modern slavery and child labor, restrict labor rights (SDG 8), widen the gaps between rich and poor (SDG 10), and push more people into informal settlements (SDG 11). Increased poverty would put additional pressure on natural resources, mainly on forests for timber and non-timber products (SDG 15), as a traditional livelihood alternative. Reduced livelihood options will also put women and children at risk of trafficking (SDG 5 and 16) in the short and medium terms. A similar risk of human trafficking was evident after the 2015 Nepal Earthquake (Gyawali et al., 2017). Unemployment would also increase illicit arms flow due to a growth in criminal activities in the medium and long terms (SDG 16).

3.1.3. Closure of Institutions and Facilities

The GoN closed or limited the opening of various institutions and facilities, including schools, universities, public transportation, government offices, international borders, and industries. The closure of educational institutions has negative impacts on various aspects of students' growth and learning at different levels (primary, secondary, tertiary, and vocational education) due to hindrance in activities associated with education, teaching, training, and regular examinations (SDG 4). Although face-to-face education would resume post-pandemic, these hindrances in educational activities would limit the country's economic development in the medium and long terms (SDG 8). Additionally, confinement at home could raise the risk of violence against children and disruptions in their social networks (SDG 16). ICTs, mainly online and virtual classes, have been increasingly used as an alternative learning and teaching tool to overcome the impacts of educational institutions' closure. However, it has produced a digital divide between boys and girls within a household (SDG 5), between rich and poor (SDG 10), and between urban and rural areas (SDG 11). This means that this alternative approach has a negative impact on the overall SDG agenda to "leave no one behind." In contrast, SDGs' achievements can be leveraged by prioritizing women, younger, and rural populations, that is, leaving no one behind (Warchold et al., 2020).

The limited opening of various institutions also reduced training, skill enhancement, and internship possibilities for students (SDG 4). Similarly, the limited opening of judicial facilities has discouraged the reporting of cases, for example, on violence against women (SDG 5 and 16). Additionally, the closure of major

industries and markets resulted in unemployment and underemployment, with negative impacts on SDG 9 and an increase in inequalities (SDG 10). The closure of many temples, including the famous and sacred Hindu temple *Pashupatinath*, has hindered cultural activities (SDG 11). Moreover, the limited opening of government offices has also resulted in weak law enforcement, illicit extraction of natural resources (e.g., deforestation [SDG 15]), and a delay in services (e.g., provision of vital registration [SDG 16]). Closure of international borders and travel limitations have restricted international collaboration, capacity building activities, and trade (SDG 17).

Conversely, the closure or limited opening of institutions and facilities has also produced a few positive impacts. Some of these impacts could facilitate the achievement of a number of SDGs in the long term. For example, enhanced ICTs in education could promote virtual teacher-training programs and encourage internationally qualified teachers and professors to conduct online classes and interact with students from developing countries virtually, contributing to the achievement of SDG 4. Similarly, an increased use of ICTs due to the limited opening of institutions and facilities has already pushed the GoN to digitalize vital registration, contributing to the achievement of SDG 16, which includes the target of providing legal identity for all by 2030. However, other impacts would only be temporary, for example, reduced food waste from restaurants and businesses (SDG 12) and improved water and air quality (SDG 6 and 11).

3.1.4. Diluted Focus and Funds on Non-COVID-19-Related Issues

The GoN is currently mobilizing its resources to control the pandemic, as concentrated efforts are a prerequisite to deal with the pandemic effectively. However, they would also dilute the government's focus and funds on other issues, mainly on implementing SDGs, in the short term. Consequently, all SDGs could be negatively impacted due to diluted focus and funds. For example, the GoN diverted Nepali Rupee (NPR) 136 billion from its annual budget of the fiscal year 2076/2077 *Bikram Sambat* (or 2019/2020 AD) to fund efforts to combat the pandemic (UNDP, 2020). Additionally, most sectoral budgets for the fiscal year 2077/2078 (2020/2021 AD) have been reduced compared to last year's budget to manage the pandemic, with the exception of the healthcare sector, which is set to obtain an increased budget of NPR 90.69 billion (MoF, 2020). Despite this increase in budget, other health issues within the healthcare sector (e.g., maternal and child health, sexual and reproductive health, and non-communicable diseases) have been side-lined.

3.1.5. Anticipated Reduction in Support From Development Partners

As a developing country, Nepal relies heavily on development partners' support for various development agendas, including implementing SDGs. The main development partners include Australia, China, Denmark, Finland, Germany, India, Japan, Republic of Korea, Kuwait, Netherlands, Norway, Switzerland, Saudi Arabia, United Kingdom, United States of America, and other multilateral agencies (MoF, 2019). As the pandemic has hit most countries globally, including Nepal's development partners, there are concerns if ongoing official development assistance and capacity building activities would continue in the medium and long terms. While these partners have been and will continue supporting efforts to control the pandemic, there are questions on whether and to what extent they will continue to support implementing and financing SDGs. This concern is due to the shrinkage of their economies and additional funds required to revitalize their own economies. Most support provided by the development partners have recently been in the form of loans, which is likely to increase the indebtedness of a developing country like Nepal.

3.2. Transformative Opportunities

The pandemic has also opened a window of opportunities for sustainable development. Although the impacts of these opportunities would be visible in the medium and long terms, the window to grasp these opportunities is short and would become narrower over time. In the absence of a drive towards more sustainable pathways, rebounds would occur, following the past business-as-usual trajectories. The achievement of SDGs would depend on the successful utilization of these opportunities. We present five key transformative opportunities together with their promoting impacts on various SDGs.

3.2.1. Lessons Learned

The pandemic has laid bare the strengths and weaknesses in governance, socio-economic systems, and leadership worldwide. Its bright side is that various lessons have been learned (e.g., from improvements in

planning and actions on SDGs to preparations for future crises). These lessons could positively impact many SDGs in the medium and long terms. We highlight lessons in the four main categories (socio-economy recovery plan, information and communication technologies and digital economy, reverse migration and “brain gain,” and exercising authorities by local government) as separate key transformative opportunities in the later sections. Our discussion here mainly focuses on other lessons that have promoting impacts on SDGs.

The pandemic has highlighted the crucial role of proper nutrition to have a healthy population, that is, to end all forms of malnutrition, and the importance of maintaining plant genetic diversity, promoting rural infrastructure and agricultural research, and enhancing food self-sufficiency (SDG 2). Activities that could positively impact SDG 2, for example, cultivation of fallow land, development of urban rooftop gardens, and use of local seeds, have increased during the lockdowns. Nepal observed the highest area of paddy cultivation in 2020 (MOALD, 2020). The pandemic provided lessons and raised awareness on sanitation and hygiene (SDG 6) as well as various aspects of healthcare systems, all of which helped to promote public health, well-being, and healthcare funding (SDG 3). Another lesson that was learned mainly due to job loss is a need for an education policy with an entrepreneurial- and skill-oriented focus on self-employment (SDG 4). Being an agro-based country with remittance contributing a substantial share of gross domestic product, such self-employment could focus on agro-based entrepreneurship and vocational trainings, including craftsmanship. Similarly, the pandemic has largely impacted poor and vulnerable populations regarding access to health care facilities and social security programs. This impact provides an essential lesson on the need to reduce inequalities (SDG 10), including the promotion of gender equality (SDG 5).

The pandemic has also emphasized the need for regularization and upgrading of low-income settlements, inadequate housing, and public transport systems for overall urban transformations (SDG 11). There is a limited possibility of maintaining physical distances in low-income settlements and public transport systems required to control the spread of COVID-19. The pandemic also revealed a lack of holistic disaster risk management plans at different governance levels, which is also crucial for crisis management. As an example, following the 2015 Nepal Earthquake, the GoN updated its National Building Codes (NBCs, e.g., NBC 105, 203, and 204) and enforced their implementation strictly (Khadka, 2020). Similar efforts are required to utilize lesson learned from the pandemic on disaster risk management and urban planning.

Public awareness on responsible consumption and production (SDG 12) has also increased during the pandemic, for example, food waste reduction due to limited food availability and waste management for maintaining hygiene. This increase in awareness also holds for climate action (SDG 13), mainly on nature conservation for resilience and adaptive capacity, and on environmentally friendly development through pollution and emission reduction in sectors such as transportation and industries. Since the degradation of nature is the source of the pandemic and other zoonotic diseases, public planners and policy makers have become more aware of the importance of healthy ecosystems for ensuring public health (SDG 15). Furthermore, the pandemic has shown that good air quality is essential for avoiding severe health outcomes from the pandemic. The current health emergency has also provided a glimpse of the potential climate emergency in the absence of climate action (Vinke et al., 2020). Another crucial lesson of the pandemic is to promote South-South cooperation, that is, more exchange of resources, technologies, and knowledge with other developing countries, together with North-South cooperation, that is, obtaining economic and other forms of support from developed countries (SDG 17). So far, Nepal has only received limited benefits from South-South cooperation.

3.2.2. Socio-Economy Recovery Plan

A sound plan is required to recover from the pandemic's negative impacts. This plan provides a window of opportunity to steer socio-economic systems towards sustainable pathways instead of letting them rebound to past trajectories. The lessons learned from the pandemic can contribute to designing a recovery plan with positive impacts on SDGs. For example, the pandemic has highlighted a need for a more pro-poor, gender-sensitive, equitable, and inclusive policy framework (SDG 1, 5, 10), for example, on social security programs. Similarly, the pandemic has reversed many of the progress made in achieving SDGs related to the health and education sectors (SDG 3 and 4). Thus, the recovery plan should focus on reinstalling the activities and programs disrupted by the pandemic, and developing new ones to accelerate the progress on various SDGs based on past experiences. Self-reliance, resilience, and local resources should be at the forefront

of the recovery plan, focusing on low carbon and environmentally friendly development (SDG 13 and 15). This approach would lead to poverty eradication (SDG 1), employment generation (including green jobs), economic growth (SDG 8), and equitable development (SDG 5, 10), together with the promotion of clean and affordable energy (SDG 7). The pandemic has reinforced the importance of “build back better” and a greener economy with a low carbon strategy and development cooperation (SDG 17). During the pandemic, another lesson learned is that Nepal should no longer rely on tourism and international remittances to support its economy. External forces could easily affect these sectors, thus crippling the economy. Nepal has made a clear realization that the agriculture sector needs to be self-sufficient to avoid any future problems demonstrated by the pandemic. Hence, it has increased its agriculture budget in the fiscal year 2077/2078 (2020/2021 AD) compared to the previous year.

3.2.3. Information and Communication Technologies (ICTs) and Digital Economy

The use of ICTs and the digital economy played an essential role in coping with the pandemic's impacts across different sectors. In 2017, Nepal had 130 mobile cellular subscriptions per 100 people and 21 internet users per 100 people (WB, 2021). This use of ICTs would open a transformative opportunity to promote many SDGs in the medium and long terms. For example, online delivery and new online business, commercial and banking activities could contribute to equal rights to ownership, essential services, technology and economic resources (SDG 1), as well as decent work and economic growth (SDG 8). The pandemic has opened a new window of opportunity to leverage digital and distance learning across educational levels and disciplines despite the digital divide, while also promoting international cooperation (SDG 4). With adequate digital infrastructure and facilities, this new learning approach could also enhance many health workers' skills in remote areas (SDG 3). The increased use of ICTs and the digital economy could also empower women in the medium and long terms (SDG 5). For example, digital innovations have provided women entrepreneurs with an opportunity to strengthen their skills and expand their businesses during the pandemic. The pandemic's lessons and experiences of using ICTs to acquire vital registration and acquainting with social and digital media would help achieve targets on providing universal legal identity and ensuring public access to information (SDG 16). Overall, the awareness and experience of ICTs during the pandemic will be crucial for further developing sustainable development measures (SDG 17). Additionally, achieving universal and affordable access to ICTs is also a target of SDG 9.

3.2.4. Reverse Migration and “Brain Gain”

The pandemic has also triggered reverse migration in Nepal, that is, migration from abroad back to Nepal or from urban centers to rural areas, leading to “brain gain.” For example, the GoN facilitated rescue flights for around 63,000 overseas Nepalis to return home by September 15th, 2020 (IOM, 2020). Reverse migration, mainly of the youth population, provides an opportunity to utilize the skilled workforce and their experiences and knowledge gained from abroad to support sustainable development at home, which would not have been available otherwise. The lockdown period has provided some glimpses of these opportunities. The reverse migration has stimulated the cultivation of fallow land that was left uncultivated due to labor shortage, raising hopes for increasing food production (SDG 2) (MOALD, 2020). In the medium and long terms, self-reliance and a rural economic transformation due to reverse migration would strengthen regional development (SDG 11). The return of skilled and semi-skilled migrant workers would also provide the needed labor force and investment to increase agricultural and industrial production capabilities (SDG 9). These economic activities, driven by reverse migration, would also trickle down to the population's lower strata (SDG 10). For sustainable development, policies to utilize reverse migration and brain gain need to focus on creating green jobs based on conservation-friendly policies (SDG 15) instead of following past trajectories. Such policies and actions need to be swiftly and widely implemented to tap on the resources provided by reverse migration and brain gain. Otherwise, with a lack of livelihood opportunities, the returnees could start emigrating again.

3.2.5. Exercising Authorities by Local Government

Nepal's 2015 Constitution defined local governments as the third level of government division, distinct from a central government's unit. In addition, the Constitution has provided authority to local governments with different functional competencies. In this regard, the pandemic has generated an opportunity for local

governments to exercise their authority. During the pandemic, most local governments were and continue to be as responsive and active as provincial and federal governments in providing healthcare and other services, which was rarely the case before. Their positive performances in managing the pandemic could be an asset to improve the health sector (SDG 3) and sustainable development at the local level. For example, they could actively contribute to eradicating poverty (SDG 1), fostering sustainable urbanization (SDG 11), building a climate-resilient society (SDG 13), and conserving biodiversity (SDG 15).

4. Discussion

As our results show, the pandemic has posed additional challenges to achieving SDGs, but it has also opened a window of sustainable transformation opportunities. However, urgent actions are needed to utilize these opportunities before rebounds occur. Key insights and learnings from the Nepal case study may also be applicable in other parts of the world, particularly in developing countries. More specifically, the perception of the pandemic as a challenge and an opportunity to reset priorities, resources, capacities, and planning can be useful elsewhere in devising appropriate pathways for sustainable development. We bring several novel understandings to realize such sustainable transformation.

First, our study provided a holistic understanding of the pandemic's potential impacts on SDGs at the target level. Similar to the findings of existing studies at global (UN, 2020), we found that the pandemic has restricted most SDGs in the short term. However, this study also advanced the state-of-art understanding by estimating a number of promoting impacts in the medium and long terms. The pandemic's positive and negative impacts are similar to SDG interactions, consisting of synergies and trade-offs (Pradhan et al., 2017). The negative impacts on SDGs, that is, trade-offs, need to be tackled by understanding the impeding factors behind them. Simultaneously, transformative opportunities generating positive impacts or synergies need to be identified and leveraged for achieving the 2030 Agenda.

Second, we identified key impeding factors directly or indirectly linked to the pandemic. Most of these key factors are associated with the repercussions of the measures taken to control the pandemic. The negative impacts of a few measures have also been reported by other existing studies in the context of developing countries. For example, Shammi et al. (2020) highlighted that a full lockdown to control the pandemic would severely hamper both the formal and informal economies as well as the education sector in Bangladesh, resulting in the loss of livelihoods and increased unemployment rate. Similarly, the lockdown has negatively impacted food production in India, for example, due to lack of migrant labor during the harvesting season (Kumar et al., 2021), while urban food insecurity has increased in Kenya, for example, due to the rise in cooking fuel and food prices (Shupler et al., 2021). Our Nepal case study advanced the findings of these existing studies by identifying the pandemic's impeding factors on SDGs as a whole, going beyond a single sector. Furthermore, our findings highlight how vulnerable Nepal's current social and economic systems are to unprecedented disasters like the pandemic. Therefore, there is a need for a more sustainable development of our social and economic systems, and to build resilience to unprecedented disasters, including climate emergencies.

Third, we highlighted key transformative opportunities generated by the pandemic for achieving SDGs, which are mostly associated with various lessons learned during the pandemic. Our findings on these opportunities also align with those of existing studies. For example, Bertram et al. (2021) highlighted that the pandemic has provided an opportunity to implement policies to accelerate the decline of global emissions from the energy sector due to a low electricity demand. Similarly, Mukherjee et al. (2020) argued that the pandemic has provided an unprecedented opportunity to re-think and re-orient the traditional development approach, which has historically caused negative consequences to both nature and human society, towards more sustainable pathways. The promoting impacts of these opportunities would be visible in the medium and long terms. However, the window to grasp these opportunities is small and shrinking, and if no swift action is taken, rebounds could soon occur following past trajectories. The pandemic has provided an opportunity to build back better, focusing on overall sustainability, including biodiversity conservation, climate resilience, and living in harmony with nature. Without urgent actions now, the opportunities for sustainable development would be missed. For example, some Nepali returnees have already started immigrating back to India as migrant workers due to the lack of livelihood opportunities in Nepal. Additionally,

the air quality in the Kathmandu Valley, which improved visibly and substantially during the lockdowns, worsened at alarming levels after the lifting of lockdowns, resulting in school closures for four days from March 30th to April 2nd, 2021. Similarly, global fossil fuel emissions, which saw a reduction in 2020, would increase in 2021 if measures to avoid a rebound in fossil fuel use are not taken (IEA, 2021).

Fourth, key insights and experiences gained from our study's methodological approach can also be useful in future studies. In particular, field research in the post-COVID world may require adapting existing research methods (for example, using our study's blended approach). Our experience has shown that online tools can effectively facilitate useful interactions among research team members and experts. They also help enhance the sharing of knowledge and experience and foster co-learning, capacity building, and co-generation of knowledge by involving experts from multiple disciplines. Our approach can also be applied to analyze other natural disasters as a tool for anticipating outcomes and decision support.

At the same time, we also acknowledge that our study has a few limitations. First, it is too early to quantitatively estimate the pandemic's full socio-economic and environmental impacts. Nevertheless, we provide a holistic qualitative understanding of the potential impacts on SDGs. Second, our study is based on expert judgment and perception of what is anticipated instead of quantification or simulation of potential impacts. While the latter is a generally preferred method, expert judgment is an accepted approach given the need for rapid assessment. However, the quality of obtained opinions can depend on the level of expertise of participants and their dynamics during workshops, for example, domination by a single or few participants. We attempted to minimize such bias in our study by inviting experts from various professional backgrounds, providing equal opportunities for all to express their opinions in workshops, and requesting experts to review our report at a later stage. Third, we did not focus on the impacts of SDGs on pandemics, which could be a question for future research. This is because the achievement of SDGs could help contain and combat pandemics and similar challenges in the future due to a number of specific interactions between SDGs and pandemics. For example, achieving SDG 3 and SDG 15 could help reduce the risks and spread of zoonotic diseases in the future. Fourth, our understanding of potential impacts, key impeding factors, and transformative opportunities are based on Nepal's case study. The transfer of this understanding to other countries needs to be taken cautiously. However, our approach of knowledge co-creation is nonetheless applicable in other countries.

Finally, there are several policy lessons and specific recommendations for Nepal to recover from the pandemic and achieve the SDGs simultaneously. Better coordination among federal, provincial, and local governments is needed to develop, implement, and monitor a transformative socio-economic recovery plan. This plan needs to consist of special packages for poor, vulnerable, and disadvantaged groups and returnees based on a gender-sensitive approach, with more support to sectors and societies that have been largely impacted. More systematic and coordinated efforts are also required to enhance awareness about the importance of nature conservation and nature-based solutions among politicians and the general public. Collaboration among all stakeholders is another important aspect of designing and implementing the plan. To implement SDGs, Nepal needs to mobilize national and international funds, knowledge and skills, including diaspora Nepalis, together with other enabling conditions (e.g., governance, transparency, and accountability). In light of the current political context, achievement of SDGs will largely depend on Nepal's political stability. At the very least, political agenda should not undermine the country's sustainable development agenda. Most importantly, sound interdisciplinary and transdisciplinary research is required to explore, investigate, identify, utilize, and facilitate the implementation of transformative opportunities. Evidence-based policy making is a crucial component of governance that enables sustainable development and, thus, for achieving the SDGs and the national aspiration of "Prosperous Nepal and Happy Nepali."

Data Availability Statement

We processed impact scores and mechanisms provided by experts during online survey, workshops, and review and validation processes. This processed data, that is, impact scores and mechanisms, are used for identifying key impeding factors and transformation opportunities. The processed data used in the study are available at the Supporting Information and the FIGSHARE via <https://doi.org/10.6084/m9.figshare.14822199.v2>.

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