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### Impact Assessment of COVID-19 Severity on Environment, Economy and Society towards Affecting Sustainable Development Goals

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**Published in:**  
Sustainability (Switzerland)

**Published:** 01/12/2022

**Document Version:**  
Final Published version, also known as Publisher's PDF, Publisher's Final version or Version of Record

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**Publication record in CityU Scholars:**  
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**Published version (DOI):**  
[10.3390/su142315576](https://doi.org/10.3390/su142315576)

**Publication details:**  
Hannan, M. A., Abd Rahman, M. S., Al-Shetwi, A. Q., Begum, R. A., Ker, P. J., Mansor, M., Mia, M. S., Hossain, M. J., Dong, Z. Y., & Mahlia, T. M. I. (2022). Impact Assessment of COVID-19 Severity on Environment, Economy and Society towards Affecting Sustainable Development Goals. *Sustainability (Switzerland)*, 14(23), Article 15576. <https://doi.org/10.3390/su142315576>

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## Article

# Impact Assessment of COVID-19 Severity on Environment, Economy and Society towards Affecting Sustainable Development Goals

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**Citation:** Hannan, M.A.; Abd Rahman, M.S.; Al-Shetwi, A.Q.; Begum, R.A.; Ker, P.J.; Mansor, M.; Mia, M.S.; Hossain, M.J.; Dong, Z.Y.; Mahlia, T.M.I. Impact Assessment of COVID-19 Severity on Environment, Economy and Society towards Affecting Sustainable Development Goals. *Sustainability* **2022**, *14*, 15576. <https://doi.org/10.3390/su142315576>

Academic Editor: Antonio Boggia

Received: 24 August 2022

Accepted: 24 September 2022

Published: 23 November 2022

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**Abstract:** The COVID-19 pandemic has affected every sector in the world, ranging from the education sector to the health sector, administration sector, economic sector and others in different ways. Multiple kinds of research have been performed by research centres, education institutions and research groups to determine the extent of how huge of a threat the COVID-19 pandemic poses to each sector. However, detailed analysis and assessment of its impact on every single target within the 17 Sustainable Development Goals (SDGs) have not been discussed so far. We report an assessment of the impact of COVID-19 effect towards achieving the United Nations SDGs. In assessing the pandemic effects, an expert elicitation model is used to show how the COVID-19 severity affects the positive and negative impact on the 169 targets of 17 SDGs under environment, society and economy groups. We found that the COVID-19 pandemic has a low positive impact in achieving only 34 (20.12%) targets across the available SDGs and a high negative impact of 54 targets (31.95%) in which the most affected group is the economy and society. The environmental group is affected less; rather it helps to achieve a few targets within this group. Our elicitation model indicates that the assessment process effectively measures the mapping of the COVID-19 pandemic impact on achieving the SDGs. This assessment identifies that the COVID-19 pandemic acts mostly as a threat in enabling the targets of the SDGs.

**Keywords:** impact assessment; COVID-19 pandemic; UN sustainable development goals; economic; social; environmental impact of COVID-19

## 1. Introduction

A severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) was first found in December 2019 in Wuhan, China, causing severe acute respiratory disease syndrome in the person infected with the virus, and on February 2020, the disease was then named by World Health Organization (WHO) as COVID-19 [1,2]. By March 2020, the number of infected countries was 114, with more than 4000 deaths, leading to WHO declaring COVID-19 a

health pandemic [2]. As of early 2021, the total number of reported COVID-19 cases are reported officially to WHO to be at 83,326,479 million cases, and more than 200 countries have officially confirmed their COVID-19 cases with WHO, which clearly indicates the increasing rate of the cases globally [3,4]. The COVID-19 pandemic has posed threats and challenges to the world not only as a health crisis but also majorly creating economic and social crises at their core [5]. Countries are facing difficulties in handling the outbreak and stopping the transmission of the virus through multiple policies such as partial/full lockdown, quarantining patients and testing and treating patients; all of the policies taken are severely affecting each country's growth [3]. According to research on the current world's situation in combatting the pandemic, the COVID-19 pandemic is observed to threaten and halt countries achieving multiple development targets at an alarming rate, including the Sustainable Development Goals (SDGs).

The Sustainable Development Goals (SDGs), also known as the Global Goals, were adopted by the United Nations (UN) in 2015 as a universal call to action to end poverty, protect the planet, and ensure that by 2030 all people enjoy peace and prosperity [6]. The 17 SDGs are integrated—they recognize that action in one area will affect outcomes in others, and that development must balance social, economic and environmental sustainability [7]. The SDGs are set to emphasize policies involving social, environmental, and economic aspects to end poverty, protect the planet and ensure everyone can enjoy peace and prosperity by 2030 [8]. Countries have committed to prioritizing progress for those who are furthest behind. The SDGs are designed to end poverty, hunger, AIDS, and discrimination against women and girls. The creativity, knowledge, technology and financial resources from all of society is necessary to achieve the SDGs in every context [6]. However, ever since the policy has been introduced, many nations are seen to be falling behind in meeting their targets which shows a lack of commitment in nations of the world [9]. With 10 years left to achieve the objectives, the world was observed to be already not on track to achieving most of the target goals by 2030 [10,11]. Before the pandemic, goals such as eliminating food insecurity, poverty, and environmental targets were not even on track to be completed. This situation has become worse since the COVID-19 pandemic hit.

In the literature, different studies assessed the impacts of different sectors on achieving the SDGs across the globe. For instance, the authors in [12] analyzed the 2030 sustainable development goal for health. The results of this study concluded that, although the three health-related goals are unlikely to be met, there has been substantial progress towards their achievement, particularly for infectious diseases. The impacts of renewable energy utilization and artificial intelligence in achieving SDGs are assessed in [13]. This study found that renewable energy positively impacts achieving 75 targets across all SDGs and may negatively affect the accomplishment of the 27 targets. Additionally, the impact assessment of battery energy storage systems (BESS) towards achieving SDG is assessed in [14]. The outcomes of this study conclude that the BESS positively impacts the achievement of 60 targets (35.5%) of all SDGs, but it may negatively impact the accomplishment of 22 targets (13%). Moreover, the effects of different sectors on achieving the SDGs are assessed, such as municipal solid waste management [15], water perspective [16], energy policy [17], efficiency of universities [18], behavioral entrepreneurship [19], public health and trade [20], sanitation and socio-economy [21], food supply chain [22], mechanical engineers [22], and so on. The studies mentioned above conclude that each sector can affect positively for some SDG targets and may affect negatively for others.

In terms of the COVID-19 impacts on SDGs, different studies have been conducted. For instance, the authors in [23] highlighted the associations between coronavirus disease and poverty (SDG 1). The results of this study proved that the pandemic has a significant impact on low-income societies. In addition, the study conducted by [24] assessed the effects of COVID-19 on achieving some of the 17 SDGs and found that SDG5 and SDG10 are critically affected by the pandemic. The impacts of COVID-19 on the 17 SDGs from a health perspective have been investigated by [25]. The study shows that due to its wide scope and

areas of influence, COVID-19 may also jeopardize the process of the implementation of the SDGs.

Although huge numbers of papers have been recently published about the impact of the COVID-19 pandemic in different areas, detailed analysis and assessment of its impact on every single target within the 17 SDG goals has not been discussed so far. Moreover, the impacts of the pandemic are seen to be more intense on the halting progress of achieving SDGs [26] and even reversing the hard-earned achievement of previous SDGs goals. This observation leads to the main idea of this research study which is to display, discuss and analyze how the COVID-19 pandemic actually affects the achievement of all 169 targets within the 17 SDGs whether in a positive impact or a negative impact based on the literature studies using expert elicitation method. Processes taken in finding out the connections between the COVID-19 pandemic and the targets are discussed in more details in the Methodology section of this research study. The method used can be considered through the process of a method-based consensus that is discussed earlier on the mapping of SDGs interlinkages [27,28]. The research study was performed based on identifying the impact of the COVID-19 pandemic to be an enabler or disabler for the 169 targets inside the 17 SDGs.

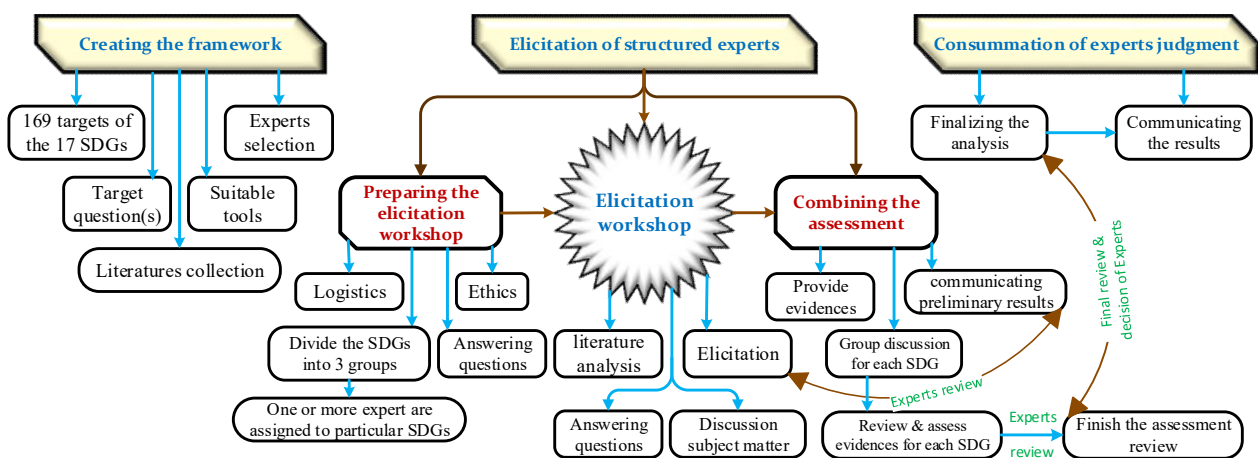
This study is divided into seven sections. Section 2 outlines the methods of the study. An assessment of how COVID-19 can impact achieving the 17 SDGs is presented in Section 3. Next, COVID-19 and economic outcomes have been discussed in Section 3.1. Further, Sections 3.2 and 3.3 reviews the impact of COVID-19 on the environment and society. Finally, Section 4 presents the conclusions and summary of the study.

## 2. Methods of the Study

This section describes the procedure used to achieve the findings reported in this study. The main aims of this study were to discuss and explore how the COVID-19 pandemic can either affect the achievement of the adopted 2030 agenda positively or negatively for sustainable development that includes 17 SDGs with their 169 targets. Focusing on this goal, an expert elicitation procedure is focused on consensus, guided by previous research on the interlinkage mapping of SDGs. Writers participating in this research study are part of an assortment of academic fields, especially regarding energy, environment, engineering, and natural sciences, which function as experts within the elicitation technique. This method can be explained as a research method and process for identifying and critically appraising relevant research and collecting and analyzing data from said research. The elicitation of scientific and technical expert judgments, in the form of subjective probability distributions, can be a valuable addition to other forms of evidence supporting public policy decision-making. The writers conducted an expert-driven academic research search to support the established linkage between the COVID-19 pandemic, development, and application with the 169 targets. In this search, the following sources of knowledge were deemed to be appropriate evidence: (a) research published on actual-international applications provided that the analyzed publications have adequate quality; (b) research published on laboratory/controlled eventualities provided that the publications taken into consideration within the evaluation have been of adequate quality; (c) published data, statistics, reports, and other forms of published evidence that come solely from organizations that have been authorized or accredited, such as government bodies and the UN; and (d) applications recorded on the commercial level. The following resources of knowledge were not deemed to be sufficient proof: (a) actual-international applications with a lack of peer-reviewed study; (b) media; (c) public beliefs; (d) educated assumptions; and (e) other means of knowledge. Finally, it is essential to note that the period of this analysis is based on published evidence from the beginning of the pandemic until the day this research study is being conducted. Based on the published evidence worldwide, a comprehensive list of all SDGs along with each of their constituent targets and the detailed findings and evidence are analyzed in detail. To support the established linkage between COVID-19 impacts and the 169 targets, the authors conducted an expert-driven academic publication, which will be described in Section 2.1 below.

### 2.1. Expert Elicitation Process for SDG Impact Analysis

This process involves assigning one or more key contributors to respective SDGs. Nevertheless, the same SDG can be assigned to more than one contributor in certain cases. With this in mind, the first search will be carried out by the decided contributor and the additional contributor will add more analysis. In certain cases, the first contributor adds analysis along with the additional ones. The authors have made an effort to search and provide sufficient evidence for each target with adequate quality. When the assessment is completed for each SDG, reviewer/s will evaluate the contact and causes. The reviewer's main contribution would be assessing the study objectively and providing alternate points of view. The final step would be to carry out a broad discussion and analysis of the outcomes of every single goal between the contributors and reviewers until the assessment for all goals is fairly perfect. The detail expert elicitation assessment is performed based on the creation of the framework, elicitation of expert structure and consumption of experts' judgement, as illustrated in Figure 1.



**Figure 1.** Expert elicitation method for the impacts assessments in achieving all SDGs.

This elicitation model is based on multiple experts that assume  $\beta$  regression coefficients are a mixture of three distributions reflecting positive impact, the negative impact and no impact as follows,

$$\beta_j \sim \sum_{m=-1,0,+1} \omega_{jm} N(\mu_{jm}, \sigma_{jm}^2) \quad (1)$$

where  $\beta_j$  is the regression coefficient of the  $j$ th variable of experts;  $m$  is the components which indicate +1 is the positive impact,  $-1$  is the negative impact, and  $0$  is the no impact;  $\omega_{jm}$  is the confident score of  $j$ th variables of  $m$ th mixture components;  $N$  is the normal distribution;  $\mu$  is the coefficient of hyperparameters and  $\sigma$  is the elicitor approximation of standard deviation.

### 2.2. Analysis of SDG Goals and Targets

In this part, after finding consensus on the assessment of each goal, as illustrated in Table 1, analysis of the final results has been done by categorizing which targets have been impacted positively, negatively or no evidence can be found related to the COVID-19 pandemic, as shown in Table 2. The findings will then be evaluated and measured (in percentage %) as positive and negative impacts for each of the 169 targets within the 17 SDGs. A summary of the analysis obtained from the research is shown in Figure 2. The 17 SDGs are also categorized into three main groups in reference to the three key pillars of sustainable development: Economy, Environment and Society.

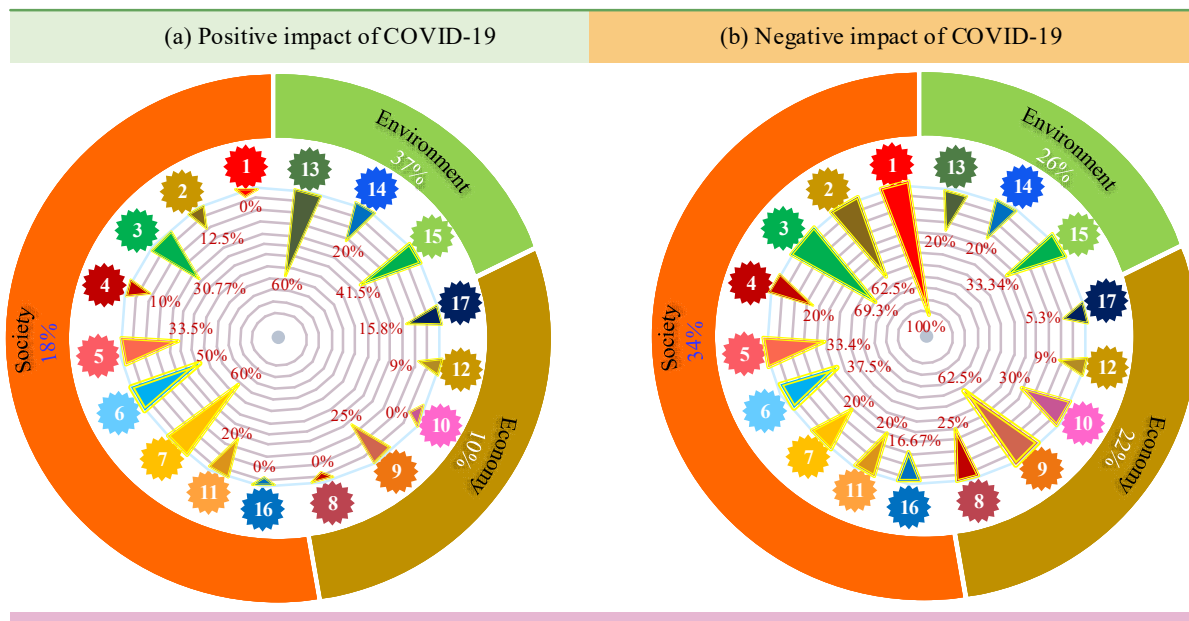
**Table 1.** Evidence of COVID-19 impacts on the achievement of all 169 targets within the 17 goals.

Target	Impact	Ref.	Target	Impact	Ref.	Target	Impact	Ref.	Target	Impact	Ref.
SDG 1.1	N	[29,30]	SDG 5.6	N/A	-	SDG 10.7	N/A	-	SDG 15.4	N/A	-
SDG 1.2	N	[31,32]	SDG 5.7	N/A	-	SDG 10.8	N/A	-	SDG 15.5	N/A	-
SDG 1.3	N	[33]	SDG 5.8	N/A	-	SDG 10.9	N/A	-	SDG 15.6	N/A	-
SDG 1.4	N	[34–36]	SDG 5.9	N/A	-	SDG 10.10	N/A	-	SDG 15.7	P	[37,38]
SDG 1.5	N	[39]	SDG 6.1	N	[40,41]	SDG 11.1	P & N	[42–44]	SDG 15.8	P & N	[45]
SDG 1.6	N	[46,47]	SDG 6.2	P	[48,49]	SDG 11.2	P	[50,51]	SDG 15.9	N/A	-
SDG 1.7	N	[34,52,53]	SDG 6.3	P & N	[54–57]	SDG 11.3	N/A	-	SDG 15.10	N/A	-
SDG 2.1	N	[58–60]	SDG 6.4	N/A	-	SDG 11.4	N/A	-	SDG 15.11	N/A	-
SDG 2.2	N	[61,62]	SDG 6.5	N/A	-	SDG 11.5	N	[63,64]	SDG 15.12	N/A	-
SDG 2.3	N	[65]	SDG 6.6	P & N	As 6.3	SDG 11.6	N/A	-	SDG 16.1	N	[66–68]
SDG 2.4	N	As 2.3	SDG 6.7	N/A	-	SDG 11.7	N/A	-	SDG 16.2	N	[71–73]
SDG 2.5	P & N	[69,70]	SDG 6.8	N/A	-	SDG 11.8	N/A	-	SDG 16.3	N/A	-
SDG 2.6	N/A	-	SDG 7.1	P	[74]	SDG 11.9	N/A	-	SDG 16.4	N/A	-
SDG 2.7	N/A	-	SDG 7.2	P & N	[75,76]	SDG 12.1	N/A	-	SDG 16.5	N/A	-
SDG 2.8	N/A	-	SDG 7.3	P	[75,77]	SDG 12.2	N/A	-	SDG 16.6	N/A	-
SDG 3.1	N	[78,79]	SDG 7.4	C	-	SDG 12.3	N/A	-	SDG 16.7	N/A	-
SDG 3.2	N	As 3.1	SDG 7.5	N/A	-	SDG 12.4	N	[86,87]	SDG 16.8	N/A	-
SDG 3.3	P & N	[80–82]	SDG 8.1	N	[83–85]	SDG 12.5	N/A	-	SDG 16.9	N/A	-
SDG 3.4	N	[88]	SDG 8.2	N/A	-	SDG 12.6	N/A	-	SDG 16.10	N/A	-
SDG 3.5	N	[89,90]	SDG 8.3	N	[91,92]	SDG 12.7	N/A	-	SDG 16.11	N/A	-
SDG 3.6	P & N	[93–95]	SDG 8.4	N/A	-	SDG 12.8	N/A	-	SDG 16.12	N/A	-
SDG 3.7	P & N	[96,97]	SDG 8.5	N/A	-	SDG 12.9	P	[101,102]	SDG 17.1	P	[52,103]
SDG 3.8	P	[98]	SDG 8.6	N	[99,100]	SDG 12.10	N/A	-	SDG 17.2	N/A	-
SDG 3.9	N/A	-	SDG 8.7	N/A	-	SDG 12.11	N/A	-	SDG 17.3	N/A	-
SDG 3.10	N/A	-	SDG 8.8	N/A	-	SDG 13.1	P & N	[104,105]	SDG 17.4	N/A	-
SDG 3.11	N/A	-	SDG 8.9	N/A	-	SDG 13.2	P	[106–108]	SDG 17.5	N/A	-
SDG 3.12	N	[78,79,98]	SDG 8.10	N/A	-	SDG 13.3	P	As 13.2	SDG 17.6	N/A	-
SDG 3.13	N	As 3.12	SDG 8.11	N/A	-	SDG 13.4	N/A	-	SDG 17.7	N/A	-
SDG 4.1	N	[109,110]	SDG 8.12	N/A	-	SDG 13.5	N/A	-	SDG 17.8	P & N	[121–123]
SDG 4.2	N/A	-	SDG 9.1	N	[111,112]	SDG 14.1	P & N	[118–120]	SDG 17.9	N/A	-
SDG 4.3	P & N	[113–115]	SDG 9.2	N	[116,117]	SDG 14.2	P & N	[120,125]	SDG 17.10	N/A	-
SDG 4.4	N/A	-	SDG 9.3	N	[124]	SDG 14.3	N/A	-	SDG 17.11	N/A	-
SDG 4.5	N/A	-	SDG 9.4	N/A	-	SDG 14.4	N/A	-	SDG 17.12	N/A	-
SDG 4.6	N/A	-	SDG 9.5	P	[126,127]	SDG 14.5	N/A	-	SDG 17.13	N/A	-
SDG 4.7	N/A	-	SDG 9.6	N	[52,128]	SDG 14.6	N/A	-	SDG 17.14	P	[130–132]
SDG 4.8	N/A	-	SDG 9.7	N/A	-	SDG 14.7	N/A	-	SDG 17.15	N/A	-
SDG 4.9	N/A	-	SDG 9.8	P & N	[114,129]	SDG 14.8	N/A	-	SDG 17.16	N/A	-
SDG 4.10	N/A	-	SDG 10.1	N	[128,133,134]	SDG 14.9	N/A	-	SDG 17.17	N/A	-
SDG 5.1	N	[135,136]	SDG 10.2	N/A	-	SDG 15.1	P & N	[3,145,146]	SDG 17.18	N/A	-
SDG 5.2	N	[137–140]	SDG 10.3	N	[141–143]	SDG 15.2	P & N	[145,149,150]	SDG 17.19	N/A	-
SDG 5.3	N	[97,144]	SDG 10.4	N/A	-	SDG 15.3	P & N	[151]			

P = Positive Impact, N = Negative impact, N/A = The authors have not found any articles/academic writings that relate COVID-19 with this target goal.

**Table 2.** Results of SDGs target analysis with percentage (%).

No.	The SDG Goal	No. of Targets	Positive Impact	%	Negative Impact	%	No. Evidence	%
1	No poverty	7	0	0%	7	100%	0	0%
2	Zero Hunger	8	1	12.5%	5	62.5%	3	37.5%
3	Good Health and Well-being	13	4	30.77%	9	69.23%	3	23.07%
4	Quality Education	10	1	10%	2	20%	8	80%
5	Gender Equality	9	3	33.34%	3	33.34%	6	66.67%
6	Clean Water and Sanitation	8	4	50%	3	37.5%	4	50%
7	Affordable and Clean Energy	5	3	60%	1	20%	2	40%
8	Decent Work and Economic Growth	12	0	0%	3	25%	9	75%
9	Industry, Innovation and Infrastructure	8	2	25%	5	62.5%	2	25%
10	Reducing Inequality	10	0	0%	3	30%	7	70%
11	Sustainable Cities and Communities	10	2	20%	2	20%	7	70%
12	Responsible Consumption & Production	11	1	9.091%	1	9.091%	9	81.81%
13	Climate Action	5	3	60%	1	20%	2	40%
14	Life Below Water	10	2	20%	2	20%	8	80%
15	Life On Land	12	5	41.67%	4	33.34%	7	58.34%
16	Peace, Justice, and Strong Institutions	12	0	0%	2	16.67%	10	83.34%
17	Partnerships for the Goals	19	3	15.79%	1	5.263%	16	84.21%
•	Total	169	34	20.12%	54	31.95%	103	60.94%



**Figure 2.** Assessment outline of the negative and positive impact of the COVID-19 pandemic on each SDG. Collected evidence on the impact of the pandemic on the 17 SDGs as (a) positive impact and (b) negative impact.

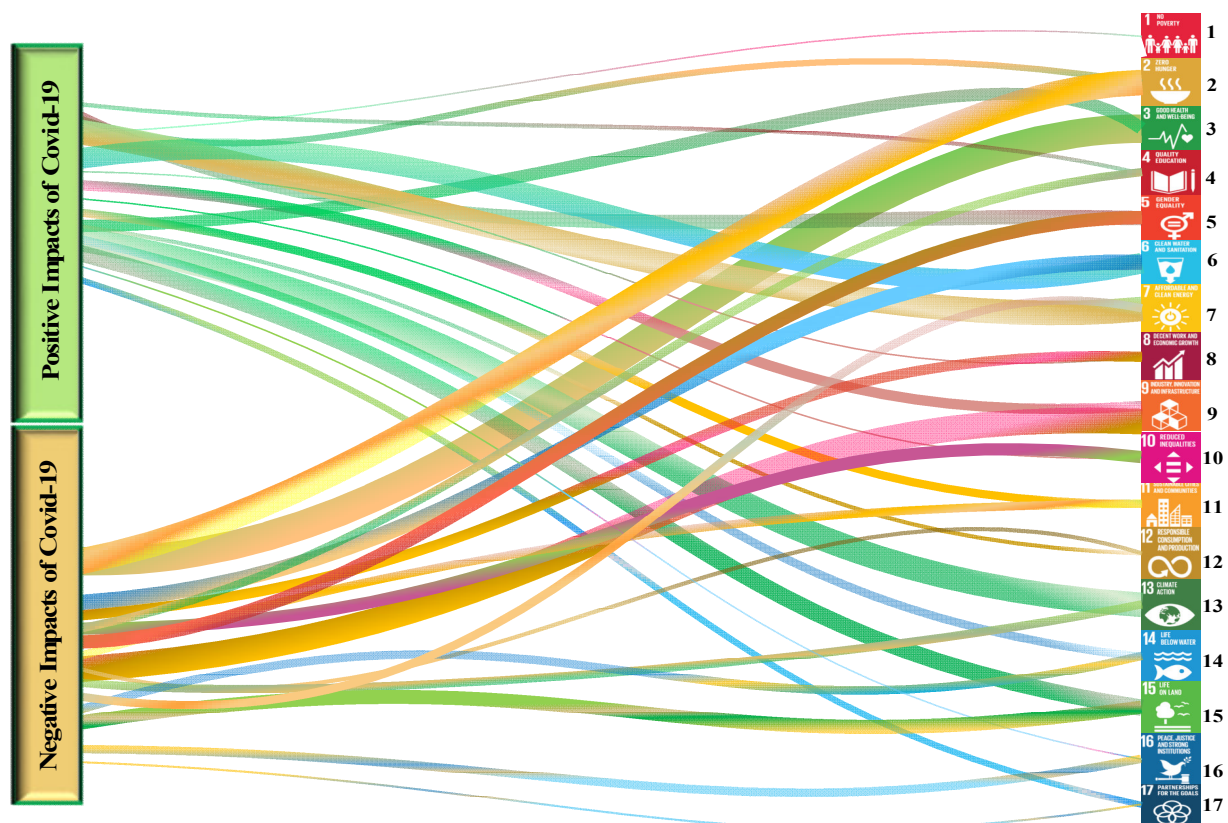
**2.3. Limitations of the Research**

The presented analysis represents the perspective of the authors. Some literature on how COVID-19 might affect certain SDGs could have been missed by the authors, or there might not be published evidence yet on such interlinkage. Nevertheless, the employed methods tried to minimize the subjectivity of the assessment. How COVID-19 might affect the delivery of each SDG was assessed and reviewed by several authors and a number of studies were reviewed for each interlinkage. Furthermore, as discussed above, each interlinkage was discussed among a subset of authors until consensus was reached on its nature. In addition, as this study depends on the published evidence all over the world, the territorial situations that are being addressed are quite distinct from one another and

impossible to compare. Finally, this research study is based on SDG analysis which offers a strong view on globally defined objectives on sustainable development and creating a guideline in reflecting all aspects of sustainability outcomes. The SDGs, nevertheless, are a political settlement set by an organization and could be limited in describing dynamic complexities and cross-interactions between targets.

### 3. COVID-19 Impacts on Achieving SDGs

A method was designed in this research study which is to tabulate any evidence of the COVID-19 pandemic impacting the 169 targets inside the 17 SDGs either positively or negatively on each specific target. As shown in Figure 3, the analysis shows that the pandemic has a low positive impact on only 34 targets, a high negative impact with 54 targets being affected and 103 targets with no evidence to show any impact caused by the pandemic. However, this assessment is only up to the day this research study is being done as more studies are being carried out every second, which may cover more targets in the future. To better analyse the results of the study, the SDGs are categorized into three main groups similar to the three main pillars of sustainable development, which are Economy, Society and Environment [152–154]. By categorizing the 17 SDGs into three main groups, a simpler yet accurate overview of the COVID-19 impact on the SDGs is provided. Another analysis that presents the weight of appropriateness of evidence supporting the pandemic impacts on each goal is presented below in Figure 3. The thick lines indicate high impact, and the thin lines indicate a low impact. This can provide an understanding of the interlinking between the evidence found with respect to its target assessed, which will be explained in more detail in the Methods section of the study. A detailed discussion of the COVID-19 pandemic impacts on the three main groups (Economy, Society and Environment) will be explained in the following sections:



**Figure 3.** Impacts of the COVID-19 pandemic on each SDG towards achieving the 17 SDGs using Sankey diagram. Thicker line linkage indicates higher impact, with thinner line linkage indicates lower impacts towards respective SDG.



### 3.1. COVID-19 and Economic Outcomes

Although COVID-19 is a worldwide pandemic and public health crisis, it poses a huge threat to the economic sector of the world. The outcome analysis obtained from this research study shows that there are huge negative impacts that can be found caused by the pandemic on the economic group of the SDGs. The SDGs categorized into the Economy group are SDGs 8, 9, 10, 12, and 17. SDGs are oriented toward providing sustainable economic development for the world in terms of job security, reducing inequality, providing better infrastructure and innovation and partnerships with others in pursuing sustainable development. Based on the analysis of this research study outcome, COVID-19 pandemic has impacted this group more on the negative side, with 13 (22%) out of 60 targets being affected negatively and six (10%) out of 60 targets being affected positively by the pandemic. The targets affected by the pandemic either positively or negatively within this group are illustrated in Figure 4. SDG 8 is analysed to only have three negative impacts on its targets, SDG 9 with five negative impacts and two positive impacts on its targets, SDG 10 has three targets with negative impacts, SDG 12 has one negative impact and one positive impact and SDG 17 has three positive impacts on its targets and one negative impacts in which all of the SDGs will be discussed in detail below.

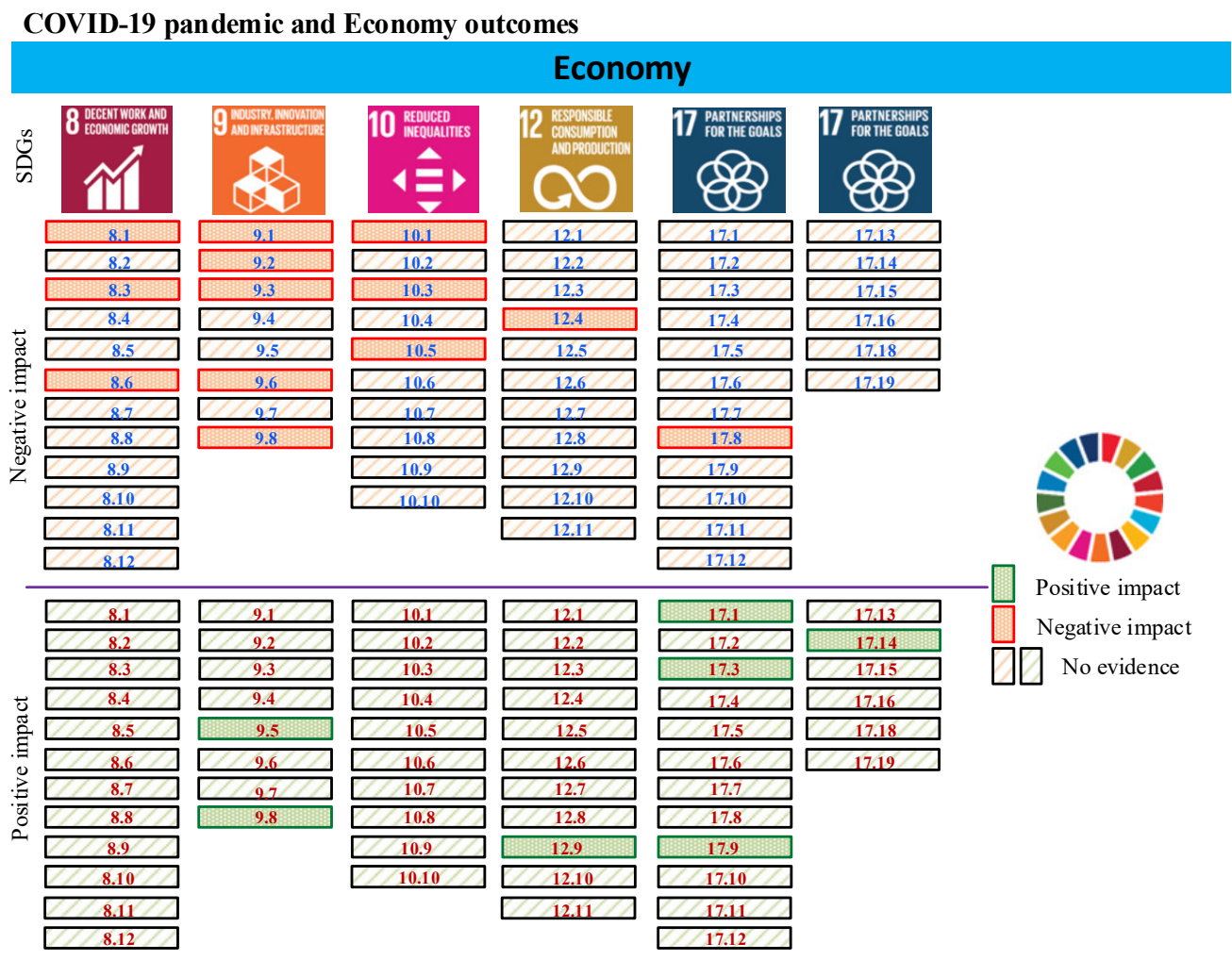


Figure 4. An analysis of the impact of COVID-19 pandemic on the SDGs within Economy group [SDGs (8,9,10,12,17)].

Focusing on SDG 8, which discusses “Decent Work and Economic Growth”, only negative impacts are observed caused by the pandemic leading to halted economic growth in the world as a whole. This can be seen in the declining rate of Gross Domestic Product (GDP) of the world’s countries, especially the least developed countries, on the year the pandemic started to hit with experts predicting that the COVID-19 pandemic would lower global GDP value by a significant amount [155]. In the first quarter of 2020, when the pandemic started to spread around the world, the world’s GDP shrank from 0.02% to 0.12% and at the end of the year 2020, the losses were observed to be as high as 1.41–1.67% which shows major losses and consequences caused by the pandemic in the economic sector [84,85]. The lower GDP values are most likely because of the unstable economic state caused by the pandemic. Significant income reduction, increase in job unemployment and disruption in manufacturing industries are the major key factors causing the unstable economy state in countries impacted by the COVID-19 pandemic [91]. Government policies such as partial/full lockdowns and social distancing restrictions are expected to close many small businesses and even some huge corporations.

Looking at SDG 9, which focuses on “Industry, Innovation and Infrastructure”, the pandemic is acting mostly as a disabler for this goal with few positive impacts. One of the major negative consequences is that countries are facing global economic depression that disrupts the development of better infrastructure and industrial sector, especially in slow-developing and emerging economy countries [111]. For example, countries such as India that heavily utilise the service industry face the intensive pandemic effect due to social policies that disrupt the service industry, leading to severe effects on their economy [156]. The agricultural industry also faces a similar negative impact with food processing and supply chain being disrupted [117], which subsequently leads to the food industry having negative impacts as well. Aids for infrastructure in developing countries are at a disadvantage with COVID-19 possibly leading to donor countries becoming concerned about their financial situations, which reduces foreign aid spending and supports aid cuts [52]. However, the pandemic has also brought a few positive impacts on these SDG targets such as having to push and improve the limit of technology in healthcare services. Healthcare technology such as Telehealth is becoming an integral part of the healthcare delivery during the pandemic as a measure to mitigate the risk of contracting the disease, making it more accessible for everyone compared to pre-COVID pandemic [129].

For SDG 10, the targets revolve around the concept of “reducing economic inequalities”. Based on the study’s analysis, the pandemic is a huge disabler in achieving this SDG. Evidence shows that the income growth of the bottom 40% of the population will decrease, causing more inequality discrepancy between the bottom 40% of the population and the national average. Research shows that the lack of work during the pandemic might cost up to one-third of the working population their job [128], with small business having mass layoffs and closures that severely disrupt the people’s income level [134], leading to economic inequalities in the population. In terms of economic opportunity, evidence gathered also proves that more unequal opportunities occur for people depending on their race or gender due to the pandemic. For example, research shows that during the pandemic in the UK, white men had a higher probability of being furloughed or dismissed from work in middle-income jobs as a result of structural gender earnings inequalities within occupation opportunities with more opportunities being given to women and racial-ethnic minorities causing white men lower opportunity in maintaining their job [142]. All of the evidence stated before indicates that the economic inequalities will only become larger due to the pandemic if no corrective measures are being taken.

Based on SDG 12, the main target of this SDG is to promote “Responsible Consumption and Production” for the people in the world. Based on the evidence gathered, the pandemic has both positive and negative impacts on achieving this SDG. One piece of evidence that indicates that the pandemic has become a disabler for this target goal is due to the huge amount of medical and healthcare waste being produced in the world’s effort to contain the spread of the pandemic [86,157]. Plastic consumption due to the PPE and the increase in

online shopping packaging has become an environmental and public health crisis where the safe and sustainable waste management is scarce and has not been adequately regulated. This shows irresponsible consumption and production behaviour [86]. However, this also leads to the positive impact of the pandemic, which exposes the irresponsible behaviour of authorities in product consumption and management. Scholars and policy makers are now becoming more aware and seeking better sustainable methods for short-term and long-term benefits in the form of a “sustainable consumption transition” [101]. The positive impact of the pandemic continues to show in SDG 17, which focuses on “Partnerships to achieve the SDGs” with NGOs such as the World Bank Group working together to support 100 developing countries in combatting the pandemic through financial support [158], and the International Monetary Fund (IMF) are urging developed countries to help and support the developing countries such as Vietnam and Cambodia in fighting the pandemic because of huge investment being made previously in the developing countries [159].

### 3.2. COVID-19 and Environmental Outcomes

This group is the smallest key group among the other two with only three SDGs, which are SDG 13, 14 and 15. Nevertheless, it is as important as the other key pillars, or some might say even more important as it involves discussing the sustainability of the world’s environment for the people to keep living in this world. There are a total of 27 targets for this key group, and based on this research study, it is found that 10 (37%) out of 27 targets are impacted positively and 10 (37%) out of 27 targets are impacted negatively with the remaining targets are not found to be related with the pandemic. The targets affected by the pandemic either positively or negatively within this group are seen in Figure 5. SDG 13 is found to have three positive impacts and only one negative impact due to the pandemic, SDG 14 has an equal number of positive and negative impacts to 2 and SDG 15 is found to have five positive impacts and four negative impacts which will be discussed in detail below. Based on the statement discussed earlier, it is observed that the pandemic has more positive impacts compared to negative impacts in discussing the environmental impact of the pandemic.

## COVID-19 pandemic and Environmental outcomes

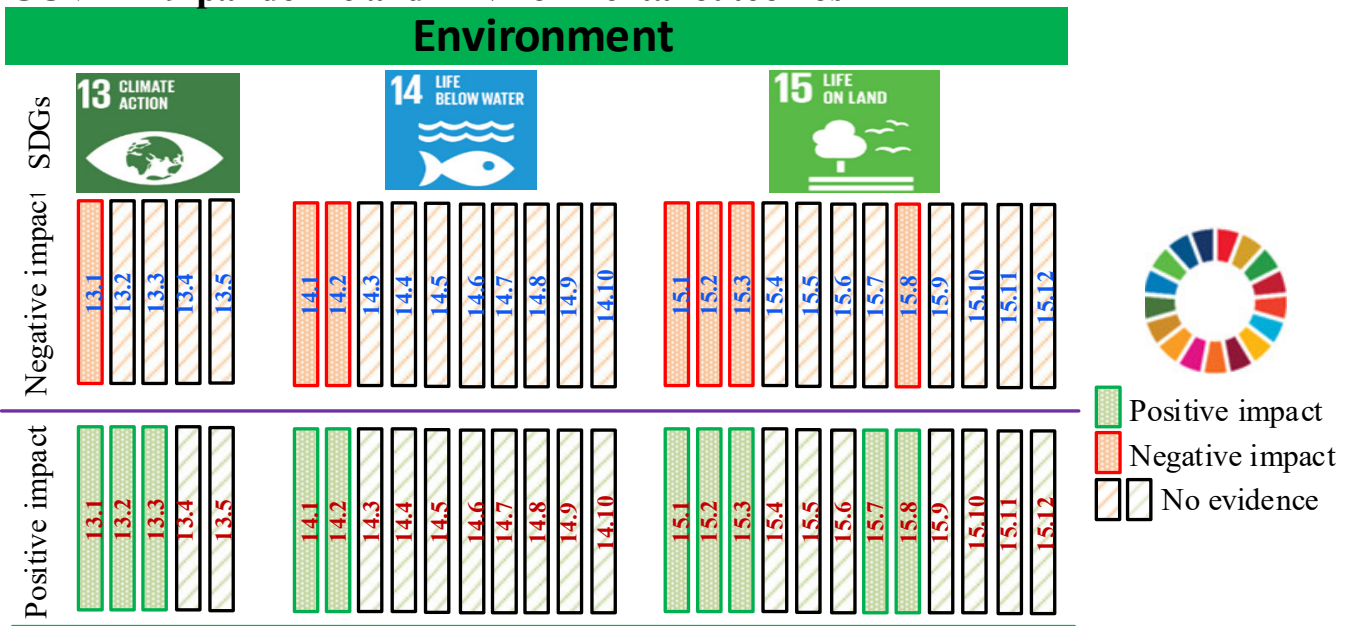


Figure 5. An analysis of the impact of COVID-19 pandemic on the SDGs within Environment group (SDGs (13, 14 and 15)).

Looking at SDG 13, this goal primarily focuses on “Climate action”, for which the COVID-19 pandemic actually is observed to act more as an enabler with the positive impact (60%) outweighing the negative impact (20%). For example, authorities/policymakers have realized the necessity of promoting effective “green” policies in reducing the effect of dramatic climate change as the threat of having numerous disasters caused by climate change is being addressed and methods to prevent them are now being discussed extensively [160]. Research by Rubén D. Manzanedo and his colleagues has provided a comprehensive study and evidence collected proves how the COVID-19 pandemic shows the importance of prevention and early action has become even more important in averting the worst outcomes of climate crisis [161]. This should further motivate countries to achieve this SDG as full attention to global climate action is as important as combatting the COVID-19 pandemic in hopes of seizing a better future for the world [162].

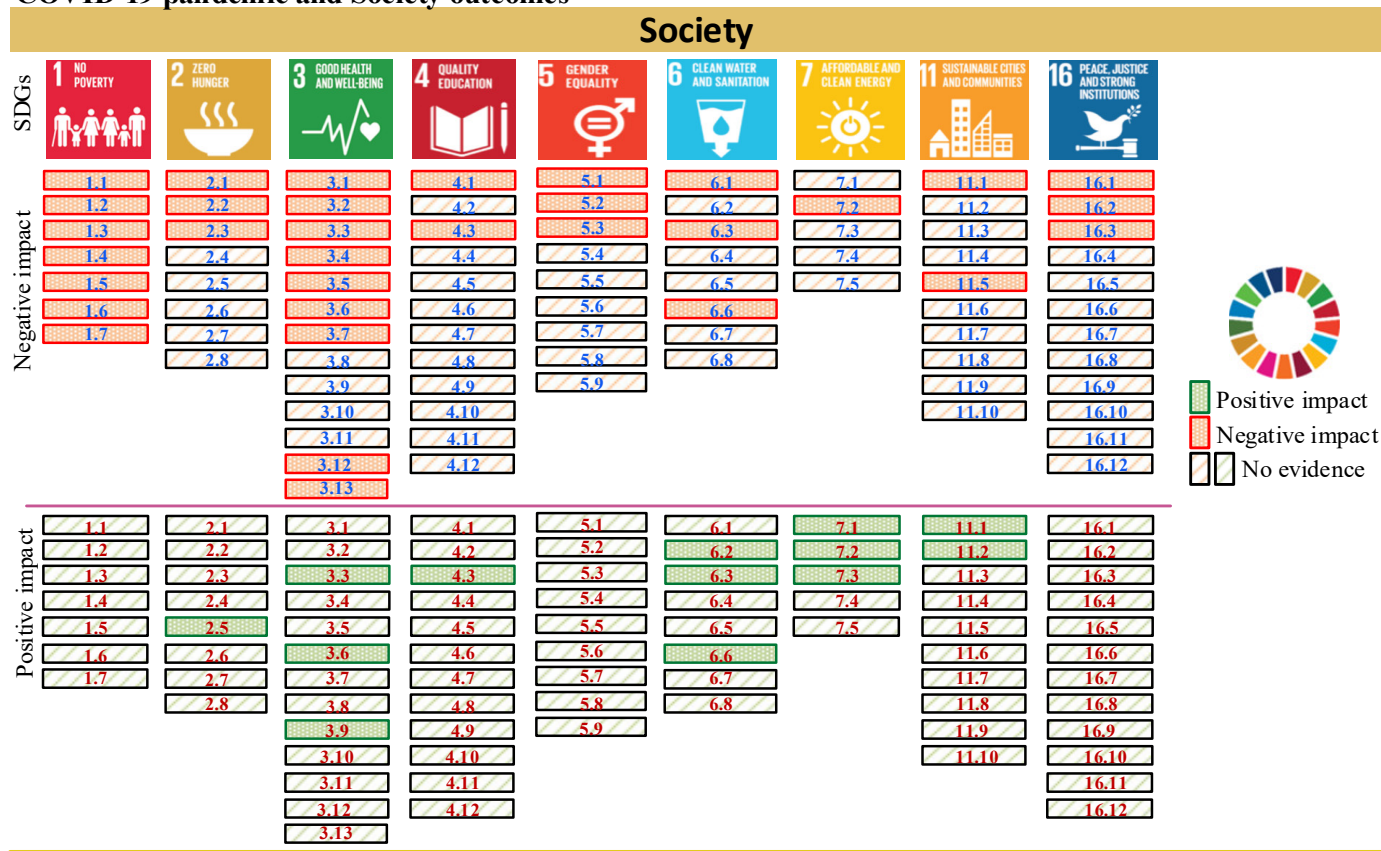
For SDG 14, the COVID-19 pandemic is observed to have an equal positive and negative impact (20%) on the “Life Below Water” targets of SDG 14. Initially, because of the pandemic, the general level of water pollution in the world has become lower due to the reduction in human activities. For instance, cessation of movement and beach closure due to the pandemic has reduced the amount of pollution leaked into the marine environment [118,163,164]. This helped prevent and reduce marine pollution to protect marine and coastal ecosystems and achieve sustainable ocean life. However, with an increase in PPEs usage in combatting the pandemic, it is observed that PPEs can contribute up to 55.1% of marine pollution due to poor disposable methods of PPE as proven by research in Kenya [118]. This is further proven by another study in Indonesia that shows that PPEs are accountable for 15–16% of pollution river debris in their river, which hinders the effort of reducing marine plastic debris [119]. The pandemic can aggravate marine pollution in the long run at a faster rate if no proper management system for increasing plastic usage is implemented [120].

Focusing on SDG 15, the positive impacts of the pandemic are five (41.6%) out of 12 and the negative impacts are four (41.67%) out of 12 which indicates that the pandemic acts more as an enabler instead of a disabler in achieving this SDG that focuses on “Life on Land”. As most of the nations in the world started to implement lockdowns and restrictions on economic activities, inland ecosystems were conserved as activities such as deforestation and landscaping stopped during the lockdown period [3,165]. Wildlife trading has also been dwindling in numbers due to movement restrictions during the pandemic, which helps preserve the wildlife ecosystem [37]. Certain authorities, such as the Chinese government, have decided to ban all terrestrial wildlife for food consumption, which helps to conserve them [38]. Nonetheless, other than adopting a specific policy to protect the ecosystem, all of the positive impacts discussed earlier are only for short-term solutions. Researchers found that invasive activities such as deforestation are more likely to resume or even increase due to increased demand when the lockdown and movement restriction policies are lifted [166]. Policymakers should become more proactive in developing policies that are able to preserve and conserve the current inland ecosystem.

### 3.3. COVID-19 and Society Outcomes

This is the largest key group among the other two. It contains SDGs 1–7, SDG 11 and SDG 16, with a total overall of 82 targets. The targets affected by the pandemic, either positively or negatively within this group, are shown in Figure 6. In the analysis of this key group, 18 (22%) targets out of 82 have a positive impact. In comparison, 34 (41.5%) out of 82 are shown to have negative impacts due to the pandemic. This shows that for this key group, the COVID-19 pandemic acts more as a disabler rather than an enabler in achieving the SDGs. Each SDG with its evidence will be discussed further in detail below.

### COVID-19 pandemic and Society outcomes



**Figure 6.** An analysis of the impact of COVID-19 pandemic on the SDGs within Society group [SDGs (1–7, 11, 12)].

Seven targets comprised SDG 1, and it is observed that the COVID-19 pandemic has a negative influence on all of the targets (100%). SDG 1 (No Poverty) is hugely impacted by the pandemic with the unstable economic state that the world is experiencing (as discussed in the previous section). Losing jobs and being unemployed will increase the poverty rate as most businesses affected by the pandemic have to furlough workers or shut down [29]. As of June 2020, the pandemic has generated at least 68 million additional poverty years and 4.3 million years of life lost across 150 countries [79]. Everyone across borders and regardless of race and gender suffers from the COVID-19 pandemic, but not equally. Women are said to be affected more as they are commonly working in home-based work compared to men and an increase in unpaid care-related work at home due to the pandemic might negatively impact them more [167]. The World Food Programme states that food insecurities could double worldwide and poverty leading to food insecurity will damage the health of the new generation of children [168]. Social protection systems and measures are not covered for everyone, with poor people, particularly in immigrant communities, suffering the most due to unequal socioeconomic factors [33], with people living in poverty becoming more vulnerable during the pandemic. The pandemic has made the plight of the poor and situational causes of poverty and inequality becoming more salient [34].

Focusing on SDG 2 (zero hunger), the pandemic has impacted the SDG more towards the negative side (62.5%) instead of on the positive side (12.5%), showing that the pandemic acts as a disabler for this SDG. Based on the gathered evidence, studies have shown that developing countries from Africa, Latin America, Oceania and Asia will be highly vulnerable to hunger issues due to food supply disruption with the majority of the world's countries having implemented lockdown to mitigate the pandemic, and food supply chain has been broken leading to increased hunger-related problems that might lead to mortality, and this has been seen to increase at an alarming rate ever since the pandemic started [58,169,170]. The agricultural sector suffered a huge downturn due to the impact of the pandemic with restriction of movements, causing farmers to be unable to work and export their products, leading to food supply chains becoming more vulnerable and disrupted [171]. The hunger problems will increase malnutrition cases, especially for children [61], and due to the pandemic, the number of children facing acute food insecurity is expected to double [62].

Looking at SDG 3 (Good health and Well-being), the COVID-19 pandemic is shown to be a disabler in achieving this SDG targets, with nine (69.3%) out of 13 targets having been impacted negatively, and the remaining four (30.7%) are impacted positively. Evidence shows that the pandemic would increase the global maternal mortality ratio and deaths of newborns and children. The COVID-19 virus poses a huge threat to pregnant women, and research has indicated that among an average of nine pregnant women that are infected with COVID-19, seven of them died with one critically ill and one fully recovered [78]. Disruption of food access and lack of proper healthcare because of the pandemic are also expected to increase the mortality rate [79,172]. Currently, having difficulty receiving medical attention and medications, premature mortality from non-communicable diseases such as cardiovascular diseases, cancers, diabetes etc., are expected to increase as well [88,173,174]. People have started to practice substance abuse, such as drug abuse and harmful alcohol consumption to cope with the pandemic, leading to declining mental and physical health, which might lead to another major public health threat [89,90,175]. However, there are positive impacts that can be observed as well, such as world governments now being pushed to focus on creating a sturdy framework that prioritizes universal health care for their people during this pandemic [98]. The number of patients diagnosed with TB has also started to decline since the pandemic due to the change towards a cleaner lifestyle, wearing masks and social distancing [82].

SDG 4 (Quality education) has a total of 10 targets in which the pandemic is seen to have a more negative impact, with two targets (20%) and one positive impact (10%). This again indicates that the pandemic is observed to be a disabler in achieving this SDG. During the pandemic, online education has become more integral to the main method of education. In China, parents have shown concern regarding their children's education as the children are only learning for less than a half-hour per day, and parents lack the skills and knowledge to support their education [109]. Students in a secluded area, such as in the north-eastern states of India, face educational disruption in which students face poor networks, which subsequently lowers the educational quality progress [176]. Even worse, students with financial constraints cannot continue their education at all due to having no access and equipment [110].

For SDG 5 (Gender Equality), only negative impacts can be found with three targets (33.3%) out of total nine targets. The pandemic has only worsened discrimination situations. For example, researchers have shown that women are 24% more likely to be affected by the pandemic and permanently lose their job than men in various countries such as Austria, Canada, Italy, Poland and Sweden [135,177]. Domestic violence in the household has also seen an escalation in number [137]. During the lockdown period, China, France, Brazil, Spain, the UK, the US and Cyprus all have seen an increase in the country's domestic violence cases [139,140,178]. An increased number of cases might be due to increasing social confinement because of the lockdown and mounting stress levels due to economic uncertainties [137].

SDG 11 (Sustainable Cities and Communities) has equal positive and negative impacts at two (20%) out of 10 total targets, showing that the pandemic acts as both an enabler and disabler for the SDG. In contrast, SDG 16 (Peace, Justice and Strong Institutions) has only negative impacts on the goal's target at two (16.67%) out of 12 total targets, clearly showing the COVID-19 pandemic as a disabler in achieving this SDG. For SDG 11, the impact differs based on the country's policy in ensuring safe and affordable housing for the people. For example, the government of India has declared a scheme for affordable rental housing complexes for people in the Slum area, providing them with access to living in safe and affordable housing [42]. In contrast, in Massachusetts, the pandemic has severely impacted their economy. With no policy/actions being taken by the government, housing conditions have been rapidly increasing and becoming unaffordable for the people, causing them to lose their houses and be at risk of the pandemic [44]. For SDG 16, the COVID-19 pandemic is seen to be a major disabler in achieving the goal. Domestic violence is seen to increase drastically during the pandemic, with people being mentally drained due to being affected by the unstable economic consequences and "stay at home" policies [66,67,179]. Violence towards children has also found to be aggravated during the pandemic with the number of cases reported being increased due to the distress caused by the pandemic [180,181].

SDG 6 (Clean Water and Sanitation) and SDG 7 (Affordable and Clean Energy) are the only goals for which the COVID-19 pandemic acts more as an enabler, with SDG 6 having four (50%) out of eight targets impacted positively and three (37.5%) targets negatively, and SDG 7 has three (60%) out of five targets impacted positively and one (20%) impacted negatively. For SDG 6, the emergence of COVID-19 has been a wake-up call in showing the great importance of having water for sanitation and hygiene in all countries, as lack of access to clean water induces higher vulnerability to COVID-19 [49]. In terms of water quality, all types of industries and activities were halted due to the majority of the world's countries implementing lockdowns leading to better water quality. In India, the Yamuna river is observed to have an improvement of 37% in its water quality index [182]. The river Ganga is also observed to have a cleaner and better water quality [57]. Water quality is observed to benefit the most from the pandemic with minor negative impacts such as the risk of transporting the virus in the water supply, but these issues can be negated with proper management of water resources by the authorities [41]. For SDG 7, the pandemic has helped ensure more access to affordable and modern energy services, especially in reducing carbon emissions due to a drop in electricity consumption [183,184]. Preventing carbon emission retaliatory rebound post-pandemic will require free trading and improving energy efficiency [77,185,186]. In fact, certain countries such as Malaysia are set to be on course in reducing carbon emissions in the coming years and will be fully carbon neutral by 2050 for a cleaner environment for future generations [75].

Based on the analysis discussed above, it can be concluded that the pandemic can affect most or some of SDG's targets to be achieved. It will make some goals unattainable or be an obstacle to achieving them. Moreover, reaching certain targets may have helped to prevent pandemic effects, whereas attaining a few targets might have worsened pandemic effects. In this regard, Table 3 illustrates the impacts analysis of COVID-19 on the UN SDGs with an example of the affected target(s).

**Table 3.** Impacts analysis of COVID-19 on the UN SDGs.

Group	SDG's Goal	State	An Example of the Target(s) Being Affected
Society	SDG 1	Highly affected *, jeopardized † and relieves ‡	Target 1.1: Most of the people in the working class lost their jobs due to the pandemic, and thus daily income decreased and poverty increased. Target 1.2: Half of the population will live in poverty by 2030. Target 1.4: Ensure fair access to essential services.
	SDG 2	Jeopardized †	Target 2.3: Multiple agricultural incomes and productivity of small-scale food producers. Restriction of movement and the worldwide lockdown has heavily affected local and national food production as farmers could not go to their farmlands leading to lower agricultural productivity
	SDG 3	Highly affected *, jeopardized † and relieves ‡	Target 3.4: Reduce disease-related premature mortality by one-third Target 3.8: Attain universal health coverage
	SDG 4	Jeopardized †	Target 4.1: All children should have access to a free, equitable, and high-quality education
	SDG 5	Partially Jeopardized §	Target 5.1: Eradicate all types of discrimination against girls and women around the world Target 5.4: Value domestic work and unpaid care through the provision of public services and policies
	SDG 6	Jeopardized †	Target 6.1: Ensure that everybody has access to clean and affordable drinking water
	SDG 7	Jeopardized †	Target 7.3: Double universal rate of energy efficiency improvement
	SDG 11	Jeopardized †	Target 11.2: Ensure that everybody has access to affordable, safe, and environmentally friendly transportation options Target 11.5: Noticeably reduce the death rate and people impacted by disasters by 2030
	SDG 16	Partially Jeopardized §	Target 16.1: Minimize all types of violence and deaths that result from them in all parts of the world
Environment	SDG 13	Jeopardized †	Target 13.4: Mobilize \$100 billion a year for the Green Climate Fund by 2020 to meet the needs of developing nations
	SDG 14	Partially Jeopardized §	Target 14.1: Stop all kinds of marine pollution by 2025
	SDG 15	Jeopardized † and relieves ‡	Target 15.7: Stop smuggling and animal trafficking, and solve the supply and demand of illicit wildlife products
Economic	SDG 08	Highly affected *, and Jeopardized †	Target 8.1: Sustain per capita economic growth. Experts have predicted that COVID-19 will lower gross domestic product by one-half a percentage point (from 2.9 to 2.4%) Target 8.3: Encourage production policies that encourage productive practices and the creation of decent jobs
	SDG 09	Highly affected *, Jeopardized † and aggravates	Target 9.3: Rise in access to financial services for small manufacturing units and other enterprises, especially in developing nations Target 9.4: Make industries more sustainable, infrastructure must be upgraded, and industries must be retrofitted Target 9.6: Help achieve the establishment of resilient and sustainable infrastructure in developing nations by providing greater financial, technical, and technological assistance
	SDG 10	Jeopardized †	Target 10.1: Growing and sustaining the income growth of the bottom 40% of the population at a faster pace than the national average by 2030
	SDG 12	Partially Jeopardized §	Target 12.5: Minimize the generation of waste via the prevention, recycling reduction, and reuse
	SDG 17	Partially Jeopardized §	Target 17.2: Rich countries have to devote at least 0.7% of their gross national income to developing nations' assistance and around 0.15% to least-developed countries

\* Most targets affected. † Most targets are unattainable or have an obstacle to achieving them. ‡ Reaching certain targets may have helped to prevent pandemic effects. § Some targets affected. || Attaining few targets might have worsened pandemic effects.

#### 4. Conclusions

This paper presents an assessment of COVID-19 impact on achieving the UN Sustainable Development Goals (SDGs). This assessment is conducted to discuss the implications of how COVID-19 pandemic can either enable or inhibit the delivery of all 17 goals and 169 targets recognized in the 2030 Agenda for Sustainable Development. For this purpose, the 17 SDGs were divided into three groups, including environment, society, and economy, per the three key pillars of sustainable development. To achieve the objectives of this study, an expert elicitation method-based consensus is used. The review of relevant evidence shows that the economy and society are the most affected sectors by the



pandemic. However, the environmental sector is less affected, and the pandemic may aid in the achievement of some goals within this group. In this context, the pandemic positively affects the achievement of 34 targets (20.12%) of all SDGs, but it may negatively impact the accomplishment of 54 targets representing 31.95% of all targets. Within the three groups of SDGs, COVID-19 can positively affect the achievement of 37%, 22%, and 10% of the environment, society, and economic targets, respectively. On the other hand, it acts as an inhibitor towards achieving 26%, 41.5%, and 22% of the environmental, economic, and society targets, respectively. For the rest targets, no pieces of evidence are found. In conclusion, the global economy and the social well-being of millions of people have been severely harmed by the COVID-19 pandemic, and recovery will take years. Current trends suggest that the process of the implementation of the SDGs might be delayed: the many socio-economic pressures and set-backs are lowering the level of priority given to the SDGs. Further, the potentials and opportunities offered by the SDGs, such as fighting poverty or eradicating hunger, may be at least partly undermined by COVID-19. It is thus wise to issue a note of caution, warning about the need to continue to put an emphasis on the implementation of the SDGs, so that the progress achieved to date is not endangered. Indeed, the global crises triggered by COVID-19 mean that pursuing and implementing the SDGs are more important now than they were before, since they represent some of the means via which quality of life can be restored and the many problems associated with the lack of water, food or poor health conditions may be addressed. In doing so, the momentum created by the pandemic may lead to a transformation from what currently is regarded as a global threat, to a global opportunity, providing a new impulse leading to the realization of the UN Agenda 2030 as a whole, and of the SDGs in particular.

Based on the expert elicitation method conducted, the paper suggests that, due to its wide scope and areas of influence, COVID-19 may also jeopardize the process of the implementation of the SDGs. It sends a cautious warning about the need to continue to put an emphasis on the implementation of the SDGs, so that the progress achieved to date is not endangered. Finally, to obtain optimal results by performing elicitation, the objective should be to obtain an expert's carefully considered judgment based on a systematic consideration of all relevant evidence. For this reason one should take care to adopt strategies designed to help the expert in expert elicitation based-method to avoid overlooking relevant evidence.

**Author Contributions:** A.Q.A.-S. and R.A.B.; resources, A.Q.A.-S. and M.S.A.R.; writing and original draft preparation, Z.Y.D., review and comment, M.S.M. and M.J.H.; visualization, M.A.H. and T.M.I.M.; supervision and coordination, M.A.H.; project administration, P.J.K. and M.M.; funding acquisition. All authors have read and agreed to the published version of the manuscript.

**Funding:** This research and the APC was funded by Universiti Tenaga Nasional through UNITEN Bold Refresh 2025 Grant, Centre of Excellent. The research is associated with Institute of Sustainable Energy (UNITEN). The authors also thankful to the Deanship of Scientific Research at Najran University for funding this work under the General Research Funding program grant code (NU/RC/SERC/11/9). Special thanks to Centre of Green Technology, School of Electrical and Data Engineering Faculty of Engineering and Information Technology, University of Technology Sydney, Department of Electrical Engineering, Fahad Bin Sultan University, Centre for Corporate Sustainability and Environmental Finance, Macquarie University, and School of Electrical and Electronic Engineering, Nanyang Technological University for providing collaborative support.

**Conflicts of Interest:** The authors declare no conflict of interest.

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