



Study of Sustainable Development Goals (SDGS) on Zero Waste Management of Household Infectious Waste in the Era of the Covid-19 Pandemic

Winda Trijyanthi Utama^{1,2}; Asep Sukohar¹; Dedy Miswar²; Samsul Bakri³; Agus Setiawan³; Tugiyono⁴

¹ Faculty of Medicine, Lampung University, Indonesia

² Department of Environmental Science Doctor, Lampung University, Indonesia

³ Department of Forest Development and Environmental Management, Lampung University, Indonesia

⁴ Department of Biology, Faculty of Mathematics and Natural Sciences, Lampung University, Indonesia

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Abstract

In the recent status quo, there are about 20.1 million global confirmed cases and 742 thousand deaths during the COVID19 Global Pandemic. One of the consequences is the significant increase in the development of infectious medical waste, such as old personal protective equipment (PPE). Solid waste management (SWM) has attracted international attention over the years, owing to its ability to ensure the long-term viability of a safe, healthy, green, and clean economy, particularly during worldwide pandemics. The generation of solid trash has increased dramatically in emerging countries as a result of rising population, urbanization, and living standards. Globally, solid waste generation has become a major environmental concern. It has seen a 2.44-fold increase in solid trash during the last decade. More than half of all solid trash is collected, stored, and disposed of.

Keywords: *Solid Waste Management; COVID-19; Sustainable Development Goals*

Introduction

Sustainable development depends on the interrelationships between economic development, environmental management, and personal well-being. Sustainability initiatives include substantive interactions between stakeholders and collaborative involvement of participatory institutions (Andersen and Ratiu, 2019; Fiorini and Hoekman, 2018). September 2015; Over 150 global leaders have decided to adopt the Sustainable Development Agenda in the form of the Sustainable Development Goals (SDGs). The SDGs consist of 17 specific goals and 169 goals that help countries and stakeholders around the world adjust their actions to the urgent need to improve social, environmental and economic conditions. Interdependence are built in between the SDGs to help policy makers set policies that can affect more stakeholders (Biggeri *et al*, 2019).

During the COVID19 Global Pandemic, currently there are over 20.1 million global confirmed cases and ~ 742 thousand deaths across the globe (WHO, 2021). One of the impacts is the rapid growth of infectious medical waste generation such as used personal protective equipment (PPE), laboratory specimens, pharmaceutical materials and device, and domestic waste from isolation room of healthcare facilities. Most countries, especially developing countries, are struggling to cope with the significant increase in medical waste caused by COVID 19 (Shammi *et al.*, 2021). Therefore, the need for achieving the Sustainable Development Goals appeared in all countries.

SDGs address not only the measurable changes in the wellbeing of people, economic development of countries, and better environment on the planet but also the means of how these changes shall be induced, in addition to enabling an environment of peace and security and rule of law and conditions for inclusion and participation (Gurbo, 2017). All sectors of development can contribute to achieving SDGs, and every contribution, small or big, will make an impact on our world. Integrated solid waste management (ISWM) is one of the systems that can contribute to achieving 17 SDGs; it can act as a strong driver for achieving a wide range of specific target of goals, whether directly or indirectly. The increase of household waste is the problem, which is exponentially growing along with the economic and demographic development of the world. Problems with waste disposal are not historically new, but structure and composition of waste in the last highly industrialized century became much more complex. Some new types of waste, which are not so easily dissolved within the natural lifecycle, require specific approaches and measures for handling it. Therefore, despite the ecological nature of this problem, it is impossible to solve it without economic instruments and elaborated comprehensive approach engaging all stakeholders. The circular economy is one of the concepts, which aimed to provide the solution to waste problem, by making waste a part of the economic cycle, and to make economic development be sustainable (Kaza *et al.*, 2018).

Hence, waste management is now regarded not only as an environment protection activity, which require consistent financial investments, but also as a prosperous business sector, where finance can be also generated. Nevertheless, in most of the countries the potential of this field is not properly used. In the developing, poor and middleincome countries the potential of waste management is usually underestimated or not considered at all. However, the opportunities which are hidden in waste practices could be especially beneficial for these countries, as they solve a wide range of problems, including resources scarcity, unemployment, GHG emissions, environment and air pollution itself. Therefore, waste sorting at source and recycling, various innovative solutions should not be considered as a privilege of developed countries only, but on the contrary, the opportunity for all countries at the different level of economic development in order to be sustainable (Starovoytova D, 2018). Currently, there are more than 20.1 million confirmed cases worldwide and approximately 742,000 deaths worldwide during the global COVID 19 pandemic (WHO, 2021). One of the effects is the rapid production of infectious medical waste such as used personal protective equipment (PPE), laboratory samples, pharmaceutical materials and devices, and household waste from medical facility isolation rooms. Is increasing to. Most countries, especially developing countries, struggle to cope with the significant increase in medical waste caused by COVID 19 (Shammi, Behal *et al.*, 2021). Therefore, the need to achieve the Sustainable Development Goals has become clear in all countries. The SDGs are the measurable changes in human well-being, the economic development of the country, the better environment on earth, as well as the conditions of peace, security and the rule of law and entry and participation (Gurbo, 2017). All areas of development can contribute to the achievement of the SDGs, and all contributions, large and small, affect our world. Integrated Waste Management (ISWM) is one of the systems that can contribute to the achievement of 17 SDGs. Directly or indirectly, it acts as a powerful engine to achieve a variety of specific objectives.

The increase in household waste is an exponentially increasing problem with the development of the world economy and demographics. The problem of waste disposal is not historically new, but the structure and composition of waste has become much more complex in the past highly industrialized centuries. Some new types of waste that do not dissolve easily in the natural life cycle require specific

approaches and measures to deal with them. Therefore, despite the ecological nature of this problem, it is impossible to solve it without economic tools and a well-developed and comprehensive approach involving all stakeholders. The circular economy is one of the concepts aimed at solving the waste problem by integrating waste into the business cycle and making economic development sustainable (Kaza et al., 2018). Therefore, waste management today is seen as a prosperous sector of the economy that can generate financial resources as well as environmental protection activities that require consistent financial investment. However, in most countries, the potential in this area is not being used properly. In developing, poor middle-income countries, the potential for waste management is largely underestimated or not considered at all.

However, the opportunities hidden in waste disposal can be particularly beneficial to these countries as they solve a variety of problems, including resource depletion, unemployment, greenhouse gas emissions, the environment and air pollution itself. Different innovative solutions should be considered sustainable not only as a privilege of developed countries, but conversely, all countries at different levels of economic development (Starovoytova D, 2018).

The waste hierarchy is a waste management guideline idea that indicates the preferability of activities toward trash in terms of treatment (UNEP 2013). Waste prevention, or detailed solutions from the very beginning of the product lifecycle, new ways in the way products are designed and produced in order to prevent potential waste, lies at the bottom of the pyramid. Longer usage or reuse of products, as well as minimizing product loss during transit and storage, are all examples of waste reduction principles. Waste reduction and prevention have a long-term economic impact by lowering waste collection expenses.

The waste prevention principle forces us to reconsider our attitude to trash at its earliest stage, before it becomes a waste. At the start of the manufacturing process, consider the recyclability of the product and its packaging. This is an important step toward achieving circular economy. Waste is a natural part of the product life cycle because it is the leftover of the finished product. Product residues were naturally dismantled and biologically recycled in nature for hundreds of years, but the industrialization and expansion of the chemical industry has resulted in the emergence of some types of durable materials and waste that are not easily dissolved. If we take plastic as an example, it will remain dissolved in the natural environment for dozens or hundreds of years because the majority of frequently used polymers are not biodegradable (Geyer et al, 2017)

The concept of zero-waste cities is an excellent example of the circular economy principle in action at the urban and societal levels. The concept of a zero-waste society advocates the preservation of all resources from production to consumption in order to avoid waste. This approach may appear utopian at first glance, because it's difficult to picture a city without litter, using only recyclable products, and obtaining a 100% recycling rate. Despite the fact that none of the countries fully reached this lofty aim, this effort reduces waste and ignites social movements. Even if this notion contributes to waste reduction and positive behavior change in individuals and the community, the influence can be deemed a success with long-term benefits.

Discussion

ISWM is used to refer to the management of the chain of processes, which starts with discharge/storage and extends through the collection, intermediate, treatment, and final disposal of all waste materials. The core concept of ISWM has been developed out of the experience to address certain common problems with municipal waste management. The international agencies realized that improvements in waste management could not be achieved through a piecemeal approach. An integrated approach was required to reduce the increasing amount of waste that requires the proper collection,

treatment, and disposal. This integrated approach tries to take into account all the dimensions that may affect the solid waste management processes, in addition to taking into account all the actors and influencers on the solid waste management processes.

Considering SDGs, which encompass multiple sectors of urban governance. It can be seen that the interconnectedness and the basic interdependence between it and the solid waste management sector, where environmentally sound and integrated solid waste management programs and plans affect the achievement and improvement of many indicators of SDGs, whether that effect is directly or indirectly (Elsheekh *et al*, 2021). Sustainable development goals framework appeared in 2015 as the result of UN Summit and designated the commitment of countries to sustainable development by achieving results by 17 domains (SDGs, Appendix I). Waste management has an impact to the three fields of SDGs, providing environmental, economic and social benefits. In many of the goals out of 17, can be seen the direct impact of waste management.

SGD 1. No Poverty

Waste management helps to alleviate poverty by producing jobs and employing people from all walks of life, including the most disadvantaged individuals and communities. It offers occupations ranging from low-skilled to high-skilled. In certain circumstances, waste collecting is a significant source of money or perhaps the primary source of income for a group of people. For the impoverished, the opportunity to work in rubbish collecting is a means out of poverty (UNEP 2013). The first SGD, which is related to Solid Waste Management (SMW), may be achieved by including waste pickers and improving their economic situations, which has reduced poverty rates in developing countries. Solid waste recycling and reuse offer a lot of promise for creating jobs and opportunities.

SWM that is both participatory and inclusive is an important step toward poverty alleviation (Gutberlet, 2018). With the coordination of effective institutions and governance, this has addressed sustainable livelihood concerns such as creating income for the socially excluded, enhancing public and environmental health, and raising the quality of human development. Indonesia's GDP could increase by IDR593 to 638 trillion (USD42 to 45 billion) in 2030 (than it would under a "business-as-usual" approach); 4.4 million cumulative net jobs could be created economy-wide between 2021 and 2030, with 75 percent of them being for women; CO₂e emissions and water use could be reduced by 126 million tonnes and 6.3 billion m³ in 2030, respectively (than they would under a "business-as-usual" approach (UNDP, 2021).

SGD 2. Zero Hunger

In the context of the SDGs, zero hunger and zero food waste are goals that are strongly linked. The United Nations has set a target of halving food waste and preventing product loss across the supply chain. Food waste is a worldwide problem that accounts for roughly 30% of all food produced (UNEP 2013, p.13). Food products can be lost during the preparation, storage, and consuming processes. Food waste contributes to the increase in waste volumes, but it also represents a loss of a valuable resource, and food scarcity is a major issue in low-income nations. One of the most important SDGs is to eliminate world hunger and malnutrition by 2030. 14 In several countries, supermarkets are prohibited from throwing food away and are instead required to donate it to charitable groups (Kaza *et al* 2018, p.31). Facilitating collaboration between units that generate food waste.

According to the food waste management hierarchy, food waste should be managed in the following order: prevention, optimization, recovery, and disposal (World Biogas Association, 2018). Food waste must be minimized in order to prevent waste. Optimization accounts for distributing food to the destitute and providing food for animals to eat (Lin and Wahiqvist, 2009). Recovery refers to the

anaerobic decomposition of food, which produces biogas that can be utilized as a fuel, and the waste is used as a soil fertilizer (Iaoan, 2012).

SDG 3: Maintaining and Improving One's Health and Well-Being

In 2020, the number of disposable face masks used in Indonesia during the COVID-19 Pandemic is predicted to be 538,40-807,59 million pieces/day, or 1,345.99-2,018.98 tons/day. When combined with medical waste, Indonesia's total infectious waste output per day might exceed 1,699.46-2,372.45 tons per day. West Java produces the most face mask trash in Indonesia, followed by East Java and Central Java of 247.83-371.74; 199.78-299.67; and 173.69-260.54 tons/day, respectively (UNEP, 2020). The results confirmed that the larger population in an area, the more disposable face masks are used, and the more waste is generated. On the other point of view, a high demand of face mask has also led to the scarcity for unsafe mask recycling (HA *et al*, 2020).

Furthermore, according to the region of Indonesia, there is a capacity gap in Health Care Waste Management (HCWM). In the current COVID19 pandemic crisis, rural and remote locations have a lack of HCWM treatment capacity, while the amount of infectious waste has rapidly expanded. The production of medical waste has expanded significantly as a result of population growth and the expansion of health-care institutions (Mohee 2005). Around 10–25% of medical waste is infectious and thus dangerous, according to estimates (Chartier 2014).

Waste management is to safeguard the environment from contamination and to ensure that human settlements are safe to live in. The huge impact of waste management on the maintenance of public health is in the collecting and elimination of garbage away from residential areas, as well as keeping it in sanitary conditions. Litter and waste that are left untreated in cities increase the spread of viruses and infections, as well as smells and respiratory ailments.

SDG 6. Strive to Prevent Water Contamination

The provision of adequate water, sanitation, and sanitary conditions is vital to protecting human health throughout all infectious disease epidemics, including the COVID-19 outbreak. The COVID-19 virus may be avoided from spreading from person to person if WASH and waste management were implemented in communities, households, schools, marketplaces, jails, and health care facilities (WHO, 2020).

Access to improved drinking water and sanitation is one of the basic needs that must be met in order to enhance health, avoid stunting, reduce poverty, and improve the quality of human resources, according to the Sustainable Development Goals (SDGs). Clean water and sanitation might be included in 17 SDGs, including Goal 6: Clean Water and Sanitation. It is not only possible to attain universal access to safe and affordable drinking water by increasing sanitation, but also by eliminating the practice of open defecation, promoting efficient waste management and reduction of untreated wastewater (BAPPENAS, 2019).

In order to meet the aim of 100% access to safe drinking water and sanitation by 2030, Indonesia must enhance access to both, as well as commit to achieving the Sustainable Development Goals (SDGs). According to the Central Statistics Agency's 2018 Nationwide Socio-Economic Survey, national availability to drinking water reached 61.29 percent. Meanwhile, just 74.58 percent of Indonesia's population, or roughly 188 million people, has access to basic national sanitation (Ady, Yos and Edy, 2020).

Uncontrolled dumpsites or landfills, which typically lack constructed ground protection (Bain, Tom, and Robert, 2017), contaminate soil, surface water, and groundwater. Efforts to reduce water

contamination include reducing waste disposed to landfills and improving dumpsite engineering (Barbier and Burgess, 2020).

SDG 7. Affordable Clean Energy

The global demand for and disposal of personal protective equipment (PPE) has increased as a result of the COVID-19 epidemic. This paper presents a new waste personal protective equipment processing system that allows for energy recovery by generating renewable fuels and other basic chemicals (Xiang et al, 2021). While the coronavirus has prompted medical centers to look for ways to reuse PPE in the face of shortages (KJ et al, 2020), demand continues to outstrip supply. To deal with the scarcity, a number of enterprises, notably 3 M Corporation, have increased their PPE output (Hufford, 2021). Plastics are used to make most PPE, such as face shields, surgical masks, surgical gowns, N95 respirators (Y and F, 2021), and surgical gloves (J.C, 2021). Their monomeric constituents, such as propylene, are notably derived from nonrenewable fossil resources like as crude oil or shale gas (Bruijninx and Weckhuysen, 2013).

Energy demand continues to rise in tandem with population expansion and urbanization. While traditional source of energy as fossil fuels have negative impact on climate change and the environment, the use of alternative energy sources is required. Waste treatment provides one of the solutions. Anaerobic digestion, for instance, already deal with the issue of converting waste into clean fuel – the biogas. Methods of waste reprocessing with energy recovery has great potential in affordable clean energy solutions (Vanapalli *et al*, 2021).

SDG 8. Decent work and Economic Growth

The coronavirus disease pandemic (COVID-19) has shook the global economy, and it will have a far greater impact than the 2008 Global Financial Crisis (GFC). This pandemic has wreaked havoc on both the demand and supply sides, reducing consumption and investment while also disrupting the supply chain. As a result, it has an impact on business operations and the supply chain. Due to the pandemic, the world economy is expected to fall by 5.2 percent and 4.4 percent in 2020, according to the World Bank and the International Monetary Fund (IMF).

As a result, the global economy will face a lengthy and challenging period ahead, with some downside risks. To answer to the pandemic's problem, all countries throughout the world have implemented both health-related measures, such as attempting lockdown to prevent the virus's spread, economic policies, and tracing dampen the adverse impact of the pandemic. The Government of Indonesia has implemented several policies to mitigate the impact of COVID-19. While these policies might be useful to accelerate the recovery process, it is worth noting that COVID-19 not only affected the economy but also revealed the shortcomings of the current system (Sharma *et al*, 2021).

Economic expansion will continue to be a top priority, but it must be sustainable and unrelated to trash volumes. According to a variety of data, trash generation increases in lockstep with GDP development (Webb, 2008; UNEP 2013). The goal of solid waste management in this area is to use waste hierarchy concepts and introduce circular economy solutions to divorce trash growth from economic growth. 15 Waste management has a variety of different effects on economic growth. It expands commercial potential by establishing a secondary resource market, increasing job opportunities, and providing incentives for resource conservation (Filho et al, 2020).

SDG 9. Industry, Innovation and Infrastructure

Even before the COVID-19 epidemic, global manufacturing growth had been progressively falling. The pandemic is wreaking havoc on manufacturing companies, producing disruptions in global value chains and product supply. Innovation and technical advancement are critical to finding long-term

solutions to both economic and social problems. and environmental challenges, such as increased resource and energy-efficiency. Globally, investment in research and development (R&D) as a proportion of GDP increased from 1.5 per cent in 2000 to 1.7 per cent in 2015 and remained almost unchanged in 2017, but was only less than 1 per cent in developing regions (UNESCAP, 2021)

In terms of communications infrastructure, more than half of the world's population is already online, and nearly everyone lives in a mobile network coverage region. In 2019, 96.5 percent of the population was expected to be covered by at least a 2G network. The epidemic of the coronavirus has highlighted the critical need for robust infrastructure. Despite the region's strong economic growth and development over the last decade, vital infrastructure in many countries remains inadequate, according to the Asian Development Bank. Making infrastructure robust to catastrophes and climate change, according to the Economic and Social Survey of Asia and the Pacific, will require an additional investment of \$434 billion each year. In other subregions, such as the Pacific small island developing states, this amount may need to be considerably higher (BAPPENAS, 2020).

To turn trash into resources and energy, waste management necessitates new solutions and infrastructure development. Whether it's a landfill, incineration, or recycling, solutions should be technologically improved to reduce waste's environmental costs and make it easier to get the most out of it (Sarkis, 2020). Waste treatment has already improved because to innovation and technology. The utilization of incineration facilities that reduce air pollution, the conversion of garbage into energy, and the reprocessing of plastic into new products are all instances of creative waste treatment techniques (Mukkaram, 2020).

SDG 11. Sustainable Cities and Communities

Solid waste management ensures the long-term viability of towns and communities by safeguarding them from pollution and viruses that would otherwise spread if proper waste collection and storage were not in place (Adiyoso, 2020). Solid waste management aims to combat these issues, since unmanaged dumpsites generate odors and are a source of virus propagation, in order to improve the quality of life in cities and make them safe, clean, and enjoyable. One of the top priorities is to reduce the impact of MSW on the urban environment (Sachs *et al*, 2021).

SDG 12. Responsible Consumption and Production

Success in waste programs based on the waste hierarchy necessitates a fundamental shift in consumption mindset and production practices (UNEP, 2013). The development of responsible consumers and producers is essential for achieving this shift and achieving sustainable development goals. This is the problem for producers who bring things to market, as well as customers who make informed decisions about which product to buy. Extended producer responsibility refers to acts in which producers are responsible for their product to the end of its life cycle and agree to accept it for recycling after use, often known as a take-back scheme. Producers who accept responsibility for collecting and reprocessing waste linked with their products are more likely to seek out better product design solutions, utilize more easily recyclable or reused packaging, and pay more attention to the items they make (Perkins, Velazquez and Munguia, 2021)

The emergence of COVID-19 drastically shifted the landscape of sustainable consumption. The Executive Secretary of the Economic Commission for Latin America and the Caribe (ECLAC) notes our civilization is at a crossroads where it is possible to take the path toward a different future (ECLAC, 2020). There is no doubt that the COVID-19 is marking a before and an after for humankind and has put the value of responsible consumption into sharper focus than ever before. In recent months, there has been an increase in published material on the effects of COVID-19 on a diversity of sustainability issues.

Sustainability researchers must adapt to new research routines defined by access to knowledge through information technology, which are marked by a high level of ambiguity and heated disagreement (Leal et al., 2020). So far, no one has been able to precisely forecast the long-term consequences of COVID-19's nature on humanity's future, let alone Agenda 2030 and SDG 12. COVID-19, on the other hand, according to the World Economic Forum (WEF) (2020), could work as a catalyst for accelerating progress toward the 2030 Sustainable Development Goals.

SDG 13. Action on Climate Change

The impact of trash on greenhouse gas emissions must be evaluated in the context of increased attention to climate change. In 16 different ways, waste adds to GHG emissions. For starters, unregulated dumpsites are a source of GHGs like methane and carbon dioxide, which are produced during trash breakdown (Weizmann, 2015). Emissions from landfills have already been measured and reached up to 1.6 billion tons of carbon dioxide in emissions, 5% of total GHG in 2016. According to the estimates, assuming present solid waste disposal continues at its current rate, landfill emissions will account for 2.6 billion tons of GHG by 2050. (Kaza et al, World Bank, 2018, p.5). Solid waste management can help to mitigate climate change by reducing greenhouse gas emissions by offering trash disposal and storage alternatives. Another indirect contribution to climate change mitigation is the fight against deforestation, which can be accomplished through recycling paper to reduce the need for raw wood fiber (UNEP 2013, p.28).

SDG 14. Life Below Water

Plastic and microplastic contamination in the oceans is one of the most difficult problems to solve, as it causes a variety of issues. A number of international accords safeguard marine resources against waste pollution by imposing restrictions on sea pollution. The widespread reverberation was raised by the Ellen MacArthur foundation at the World Economic Forum in 2016 in Davos, stating that around 8 million tons of plastic ends in the ocean and harm marine animals. The aim of waste management is to protect oceans from hazardous and unbiodegradable waste and prevent plastic falling into waterways (Lee, 2019).

SDG 15. Life on land United Nations SDG

Set goals to reduce overall waste using the "reduce, reuse, recycle" philosophy, as well as to reduce waste's negative environmental effects. Sound waste management has a good impact on the conservation of virgin resources and the slowing of natural resource depletion, as well as the battle against deforestation and all of the issues that come with it (Ang and Van, 2012).

SDG 17. Partnerships for the Goals

The generation of solid trash has increased dramatically as a result of population growth, urbanization, and industry. The traditional government sector has been unable to meet the growing demand for SWM services on its own. As a result, the conventional government sector is giving way to government as a partner (Mappasere & Idris, 2016). It is proposed that the private sector, non-governmental organizations (NGOs), and community-based organizations (CBOs), with their dynamism and flexibility, can assist the public sector in closing the gap that currently exists (Sukholthaman, 2015). The process of SWM will be more effective with the participation and involvement of a wide range of stakeholders, including the public sector, waste generators, waste managers, the informal sector, the private sector, CBOs, and NGOs. Higher accountability and improved delivery of SWM services will result from these stakeholders sharing their ideas, visions, preferences, restrictions, and responsibilities (Storey, 2015).

On a global and local level, waste challenges necessitate a holistic strategy and teamwork. Global collaboration is required to share responsibility and experience, as well as to assist developing economies in dealing with the rapid rate of garbage generation. Many parties, including governments, businesses, and consumers, must work together to solve waste concerns. Sustainable development can only be realized if all stakeholders act more thoughtfully when it comes to resource usage. Although waste management will not be able to fulfill all of the SDGs, it can have an impact on a few of them.

Conclusion

While the complete impact of COVID-19 on SDGs around the world has yet to be fully explored, this study provided a detailed review of COVID-19's impact on SDGs. Building on the foundation of previous literature. This study has derived the perceived direct and indirect consequences of waste management of COVID-19 on multiple SDGs. Given the paucity of research on the implications of COVID-19 to date, it is envisaged that this study would provide important insights and guidance to decision-makers for improving SDG implementation in the post-COVID-19 period. COVID-19 has an unfavorable impact on all 17 SDGs, according to the findings. According to Indonesia's four pillars of sustainable development, COVID-19 has the most influence on the SDGs in the social and economic development pillars, whereas the pillars of environmental and law and governance development have less impact.

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