Threats to Sustainability

Subjects: Green & Sustainable Science & Technology
Contributor: Kimendren Gounden, Festus Maina Mwangi, Turup Pandurangan Mohan

Plastics are a precious, versatile set of materials. The accumulation of plastic waste threatens the environment. Recycling plastic waste can produce many new products. The many opportunities for using plastic waste create pressure for a strategy to develop or improve current waste management systems to reduce the negative impact on humans, fauna and flora.

Keywords: global crises ; green engineering ; recycling methods ; plastic sand brick ; eco-friendly building materials ; sustainability ; plastic pollution

1. Introduction

To think of a world without the use of plastics is simply unimaginable [1]. Plastic is used in various products, from consumer goods to packaging, medical devices, automotive, and construction [2]. Plastic pollution is growing relentlessly, and the accumulation and disposal of plastic waste is a significant problem [3]. Plastic waste somehow escapes the waste management system and makes its way into the environment, inadvertently or through illegal practices. It eventually fragments into smaller pieces that severely threaten the health of humans, plants, animals, birds and marine life [4]. If no action is taken, the yearly flow of plastic into the ocean will triple by 2040, amounting to 29 million metric tonnes annually. This is equivalent to 50 kg of plastic waste per metre of coastline globally [5].

The high demand for plastic products has drastically increased the production of single-use plastic, and its end life harms ecosystems and causes environmental pollution. The harmful effect of plastic materials' end life has become a global challenge [6]. Wilcox et al. [7] warned that plastic pollution has become a worldwide problem and poses a severe environmental hazard. There have been several studies [8][9][10][11][12], which emphasise that plastic materials are the most common type of debris that make their way into the world's oceans, causing enormous problems for marine animals and bird life. Allsopp et al. [13] and Ostle et al. [14] stated that many seals, fish, dolphins, porpoises, whales, and turtles suffer or die due to entanglement in fishing gear, such as nets and strapping bands from bait boxes and ropes. These types of debris cause bodily harm, suffocation, starvation and other injuries. Derraik [8] and Nelms et al. [15] stated that marine animals, including fish, have suffered due to the ingestion of marine debris. Napper and Thompson [16] highlighted that plastic waste includes beads, foams, fibres, films, flakes from plastic bags, plastic pellets and plastic fragments from more oversized broken plastic items. Most of these ingested particles consist of 84% fibres, while the remaining 16% are broken plastic fragments. Eating these items causes digestive tract blockage, starvation and death.

According to [17], another challenge was the illegal dumping of plastic waste materials on the West African Coast. This contributes significantly to the demise of marine life. The beaches show a definite decline in their aesthetics and beauty, with plastic trash thrown all over the beaches.

Lebreton et al. [18] contended that between 1.15 and 2.41 million tonnes of plastic waste currently enters the ocean annually from rivers. Jang et al. [19] stated that the amount of plastic debris along shorelines hurts tourism. For example, the total tourism revenue of Geoje Island was lost due to the marine waste flowing from the Nakdong River in July 2011. Considerable revenue loss was estimated to be USD29–37 million.

An additional environmental challenge posed by plastic waste is the production of greenhouse gas (GHGs). The projected output of GHGs from 2030 to 2050 is increasing at an alarming rate. It is expected to reach approximately 225 million tonnes of CO_2 soon. Hence, GHGs are predicted to cause untold damage in the future [20]. The past trends show that South Africa was the highest emitter of CO_2 gas emissions in 1990 and 2017, reflecting a total of 243.8 metric tonnes (Mt) CO_2 and 421.7 Mt CO_2, respectively [21].

Therefore, the urgent need for recycling plastic to provide a solution for reducing plastic pollution, unemployment, dealing with the shortage of affordable housing and climate change has been identified in South Africa as a threat to sustainability in the country. There have been many technological advancements to produce eco-friendly biological building materials from plastic waste and other waste materials. Suresh et al. [22] proposed using straw and clay for their many advantages, such as it being cheap, durable, and having good insulation properties. Similarly, fly ash produced as a waste product by coal-powered plants is now being used to develop environmentally friendly products [23]. Various studies have found that fly ash, which was found to be strong and has relatively high compressive strength could be used as a substitute for clay-based bricks [24]. A supplementary study found that as the content of fly ash is increased, the compressive strength

increased, the water absorption test did not surpass 20% of the bricks' weight, according to the testing standard [25]. Another material identified for brick production is rice husk. Rice husk is a by-product of the milling process when harvesting rice grains and is available in large quantities [26]. It found that adding rice husk in specific ratios improved building products and concrete properties. Despite these raw materials' availability and cost effectiveness, these resources would not be sufficient to address the increased demand for bricks in the construction industry. In this regard, the number of propositions and shifts towards the green economy to analyse end-of-life disposal methods in many forms of waste are increasing daily [27][28]. The amount of plastic waste is widely available and can be sourced at a low-cost. Hence, it is proposed to be used as an alternative binding material for buildings and other products [29]. Including plastic waste in construction may serve two primary purposes: firstly, providing eco-friendly brick-making materials and secondly, extracting plastic waste from the environment [30], resulting in a waste-to-profit movement. Therefore, the objective of is to consider the feasibility of using only plastic waste in plastic brick manufacturing in South Africa, while simultaneously reducing the negative impact of the four emerging crises.

This solution will not take place naturally, but the current focus on incorporating waste pickers into the formal industry in South Africa will have far-reaching implications. Godfrey [6] estimated the projected number of waste pickers to be around 215,000 in 2017, which is still growing. Government, industry, and other stakeholders identified the beneficial role waste pickers play in the diversion of valuable waste products away from landfills; thereby reducing waste pollution and redirecting it towards recycling and reuse [31].

Several studies argued for the inclusion of waste pickers into an integrated waste management system with proper regulatory frameworks since they currently face many challenges such as discrimination, working under poor conditions, compromised health and safety regulations, being overworked, workers receiving low salaries when they worked for other agents and receiving little cash for the resale of their waste products. Velis [32] proposed that it is essential to upgrade waste pickers from the informal recycling system towards a formal or structured waste management system and link them to the recycling value chain.

It is also argued that the framework must build into the system a pre-condition to ensure the transformation of the informal industry through the organisation and empowerment of the informal waste pickers. Samson [33] stated that waste pickers play a critical role in substantially contributing to the recycling industry. She believes that a coordinated and integrated approach of waste pickers into a regulated framework is compulsory since all other methods will fail.

The informal sector in Pakistan implements the recycling of waste. Masood and Barlow [34] argued that it is advantageous to integrate this informal industry with the formal sector. Hence, this forward-thinking led to the designing of a framework that offered explanations as to how to integrate the informal and formal waste management sectors in such a way as to exert a positive impact on the economic, environmental and social spheres. They also believed the integration would benefit the government, municipalities, the general public, and the informal waste sector.

Dias [35] presented a brief overview of the legal framework regarding the integration of informal waste collectors (waste pickers) in solid waste management (SWM) in Brazil. Recently, Brazil favoured the enactment of laws to include waste pickers. The new legislation gives waste pickers much more visibility and recognition for their economic contribution. Due to the inclusive way in which they integrated waste pickers into their national policies, Brazil has become one of the leading countries worldwide.

Drawing on the experience of Brazil and other countries, South Africa followed a similar path. In her speech, Molewa [36], the previous Minister of the Environment, placed an increase in plastic waste recycling rates on record. She supported the role played by waste pickers in diverting waste from landfills, thus making a huge contribution to the recycling economy in South Africa. She stressed that there must be strategic interventions to publicise economic prospects by promoting entrepreneurial activities that integrate waste pickers into a controlled and supportive environment.

2. An Emerging Global Crisis—A Threat to Sustainability

Researchers live in unprecedented times, and the world has been forced to react to many significant threats such as pollution, unemployment, shortage of affordable housing, climate change, poverty, diseases, global warming, and political, religious and food security [37]. These global threats have led to lower living standards for most people. However, gaining a better understanding of the four global crises also affecting South Africa, as indicated in **Figure 1**, requires taking immediate action, and that only by taking action now with the utmost priority can researchers secure our future [38][39][40][41][42].

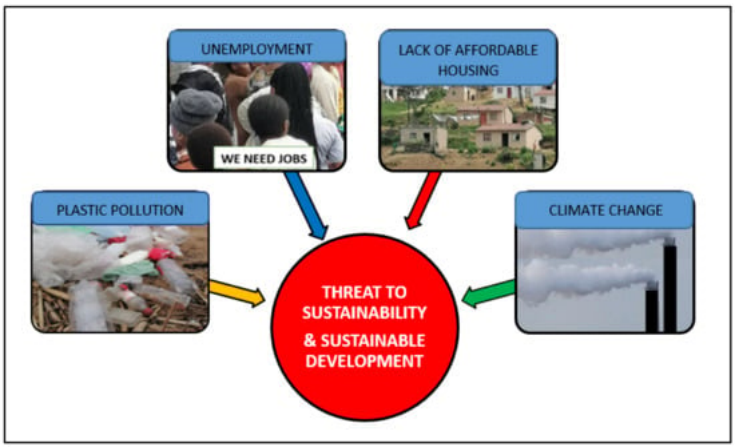

Figure 1. Four emerging global crises.

Four emerging crises have been identified that need to be addressed as a matter of urgency; failure to do so will have a ripple effect, leading to an explosion of crises. It has been highlighted worldwide that unimaginable damage to our planet will occur if these emerging global crises are not given sufficient attention [28]. Sadan and de Kock [43] stated that: "the amount of unmanaged plastic waste entering the environment, particularly the ocean, has reached crisis level". The expansion rate of plastic doubles every subsequent decade. Our environment is becoming more polluted due to current development, urbanisation, population growth and changes in peoples' lifestyles [3]. Page [44] alerts us by saying that "the growing population of more educated and urbanized youth who are hampered by finding few jobs is a crisis in the making". Rodríguez-Caballero and J. E. Vera-Valdés [45] stated that as the number of unemployed individuals increases and the longer they are outside the labour force, the more difficult it will become for them to be employed. Therefore, it has become imperative for the Federal Reserve to increase employment opportunities by introducing various programmes and strategies. Henley [46] flagged the housing challenge and stated that: "the problem of inadequate or non-existent housing has reached crisis proportions globally". Lastly, climate change and its consequences that arise around the world have become one of the biggest challenges to date, which will be addressed [47]. Climate change has been identified as one of the biggest threats to sustainability in the 21st century. Extreme climate changes have led to significant disasters. These observations showed that weather patterns pose a huge challenge to disaster risk management, which calls for increased efforts from all stakeholders [48][49].

Figure 2 provides a holistic view of these four disturbing scenarios that are snowballing rapidly. These four crises are intentionally dealt with separately to present a deeper and more comprehensive understanding of each one. However, it must be understood that all four concerns exist concurrently and simultaneously, affecting sustainability as one common challenge, see **Figure 2**a. The four emerging crises, namely, plastic pollution, unemployment, shortage of affordable housing and climate change, are integrated and directly linked to the three pillars of sustainability, viz. pollution (environmental), housing (social) and employment (economic), see **Figure 2**b [50][51][52][53]. Several studies [54][55][56] indicated that recycling (see **Figure 2**c) presents excellent opportunities and innovations for individuals, companies and governments to convert plastic waste into other valuable products. While plastic waste harms human health, it can be used for business and wealth creation [57]. Covenant University engaged in a waste-to-wealth scheme, which focused on managing and processing used plastic materials to create other reusable products [55]. It is showed that recycling plastic waste converted into plastic sand bricks can reduce the impact of the four emerging crises.

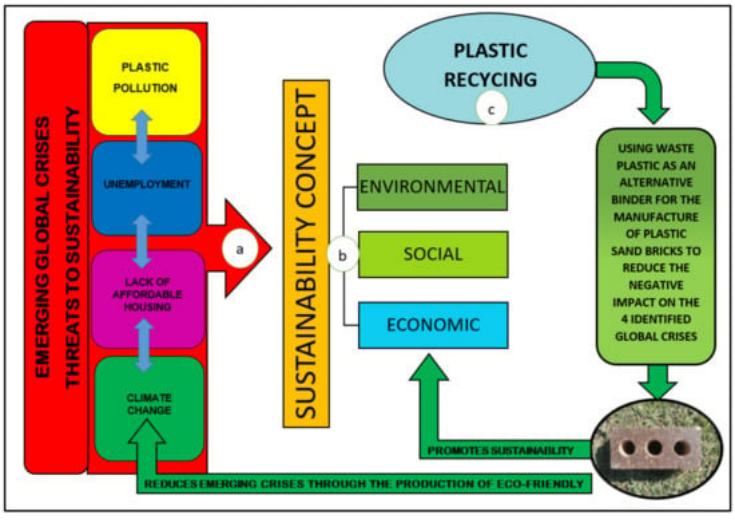

Figure 2. Plastic recycling as a solution to reducing emerging global crises.

2.1. Plastic Pollution as an Emerging Crisis

Plastic pollution has become one of the most unrelenting environmental issues locally and abroad. South Africa is facing a rapid increase in plastic pollution, and poor waste disposable methods make it difficult for communities to manage the crisis. Plastic, a common material, is widely used by everybody in daily life, e.g., for containers, bottles, and food packaging materials [28][58]. The disposal of plastic waste is a huge problem nowadays. Although plastic products are compact in shape, light weight and have various advantages, the problem is that their daily use increases at an alarming rate and they become a hazard by damaging human and animal life. Victory [59] emphasised that plastic disposal has become a waste pollution crisis over the last decade and collaborative effort will be needed to determine its future effects on the planet and its inhabitants. Plastic pollution is becoming extremely dangerous to the environment due to its enormous production and usage, which has harmful environmental effects [60]. Additionally, plastic waste on land and water has harmful effects on all living species in the marine ecosystem of our planet [61].

2.2. Unemployment as an Emerging Crisis

Unemployment is a massive problem faced by both developed and developing countries. In particular, youth unemployment in South Africa is escalating, despite desperate efforts and initiatives implemented by the government to reduce the very high unemployment rate. Unemployment is a “disease” faced by individuals and society that require careful and planned intervention for it to be eradicated. Statistics South Africa has revealed that the unemployment rate among the youth in South Africa is very high although they possess educational qualifications. The graduate unemployment rate is shocking for those in the various age categories, namely 15–24 at 40.3% and 15.5% among those aged 25–34 years. However, the rate among adults (aged 35–64 years) was 5.4% [62]. The presence of unemployment nationally and worldwide has many adverse effects, such as increased depression and other mental health problems, increased crime rates, overall lower economic productivity and consumption, lower rates of volunteerism, and erosion of skills. Hence, the inherent problem of unemployment needs to be urgently addressed since it affects sustainability and sustainable development [63].

2.3. Shortage of Affordable Housing as an Emerging Crisis

The shortage of affordable housing is emerging as a significant challenge in almost all sectors of society throughout South Africa and abroad. Finding an affordable house is difficult as housing prices and rents are increasing across the country. Favilukis et al. [64] warned that: “the increasing appeal of major urban centres has brought on an unprecedented housing affordability crisis”. The UN habitat [65] links housing to a sustainable future and states that there is a continuous demand to provide decent adequate and more affordable housing to the millions of people worldwide in such a way that it guarantees a sustainable future for cities. De Villers et al. [66] argued that there are alternative ways to address this shortage of houses, in line with environmental sustainability. They also argued that despite the number of alternative building materials and systems (ABMS) that have been implemented in place at a commercial level, there is still poor or very little implementation of ABMS occurring in South Africa. The world population is growing, and there is currently a shortage of affordable housing worldwide. Furthermore, the use of clay brick becomes a question for debate and the demand for greener housing using more sustainable material is increasing.

2.4. Climate Change as an Emerging Crisis

Climate change is already impacting all nations of the world in myriad ways. South Africa is no exception due to frequent extreme changes in weather patterns such as heatwaves, storms and floods that have recently taken place. Climate change is a threat to millions of lives. Tsakona et al. [67] argued that “The triple planetary crisis- climate change, biodiversity loss and pollution including plastic pollution—has its greatest impacts on the world’s poorest and most vulnerable populations.” Currently, there is great emphasis on the severity of the environmental crisis that threatens us, such as climate change, ozone depletion, degraded air and water quality, land contamination and global warming. The depletion of the ozone layer directly affects the quality and sustainability of human life.

Morales-Mendez [68] defines the ozone layer as “a band of natural gas called ozone”. He emphasised that one of the main functions of the ozone layer is to act as a protective shield against harmful ultraviolet rays from the sun. He mentions the concern that the ozone layer is being damaged and depleted by the release of many pollutants such as carbon dioxide (CO_2), chlorofluorocarbons, water vapor, methane, and nitrous oxide gases. The National Geographic Society [69] explained that the excess heat that is accumulated in the atmosphere increases the average global temperature, which is known as global warming.

Climate change is affecting many parts of the planet, which results in today’s extreme weather conditions from severe droughts to flooding and increase in sea levels. Researchers are experiencing new weather conditions that are already negatively affecting all life on earth [70].

References

1. The New Plastics Economy: Rethinking the Future of Plastics & Catalysing Action. Available online: https://ellenmacarthurfoundation.org/the-new-plastics-economy-rethinking-the-future-of-plastics-and-catalysing (accessed on 21 October 2022).
2. Goodship, V. Plastic recycling. Sci. Prog. 2007, 90, 245–268.
3. Bansal, N.; Jain, R. Comparison of mud brick, sand mud brick and plastic sand mud brick. Int. Res. J. Eng. Technol. 2020, 7, 671–677. Available online: https://www.irjet.net/archives/V7/i1/IRJET-V7I1108.pdf (accessed on 30 September 2021).
4. Fok, L.; Cheng, I.N.Y.; Yeung, Y.Y. Mismanaged plastic waste: Far side of the moon. Environ. Sustain. Educ. Waste Manag. 2019, 57–71.
5. Breaking the Plastic Wave: A Comprehensive Assessment of Pathways towards Stopping Ocean Plastic Pollution. Available online: https://www.systemiq.earth/wp-content/uploads/2020/07/BreakingThePlasticWave_MainReport.pdf (accessed on 23 October 2022).
6. Godfrey, L.; Oelofse, S. Historical review of waste management and recycling in South Africa. Resources 2017, 6, 57.
7. Wilcox, C.; Van Sebille, E.; Hardesty, B.D. Threat of plastic pollution to seabirds is global, pervasive, and increasing. Proc. Natl. Acad. Sci. USA 2015, 112, 11899–11904.
8. Derraik, J.G. The pollution of the marine environment by plastic debris: A review. Mar. Pollut. Bull. 2002, 44, 842–852.
9. Wilcox, C.; Hardesty, B.; Sharples, R.; Griffin, D.; Lawson, T.; Gunn, R. Ghostnet impacts on globally threatened turtles, a spatial risk analysis for northern Australia. Conserv. Lett. 2013, 6, 247–254.
10. Van Sebille, E.; Spathi, C.; Gilbert, A. The ocean plastic pollution challenge: Towards solutions in the UK. Grant. Brief. Pap. 2016, 19, 1–16. Available online: https://core.ac.uk/download/pdf/77016253.pdf (accessed on 26 February 2022).
11. Vegter, A.C.; Barletta, M.; Beck, C.; Borrero, J.; Burton, H.; Campbell, M.L.; Costa, M.F.; Eriksen, M.; Eriksson, C.; Estrades, A.; et al. Global research priorities to mitigate plastic pollution impacts on marine wildlife. Endanger. Species Res. 2014, 25, 225–247.
12. Naidoo, T.; Glassom, D.; Smit, A.J. Plastic pollution in five urban estuaries of KwaZulu-Natal, South Africa. Mar. Pollut. Bull. 2015, 101, 473–480.
13. Plastic Debris in the World's Oceans. Available online: https://www.greenpeace.to/greenpeace/wp-content/uploads/2011/05/plastic_ocean_report.pdf (accessed on 13 October 2022).
14. Ostle, C.; Thompson, R.; Broughton, D.; Gregory, L.; Wootton, M.; Johns, D.G. The rise in ocean plastics evidenced from a 60-year time series. Nat. Commun. 2019, 10, 1622.
15. Nelms, S.E.; Barnett, J.; Brownlow, A.; Davison, N.J.; Deaville, R.; Galloway, T.S.; Lindeque, P.K.; Santillo, D.; Godley, B.J. Microplastics in marine mammals stranded around the British coast: Ubiquitous but transitory? Sci. Rep. 2019, 9, 1075.
16. Napper, I.E.; Thompson, R.C. Plastic debris in the marine environment: History and future challenges. Glob. Chall. 2020, 4, 1900081.
17. Bashir, N.H.H. Plastic problem in Africa. Jpn. J. Vet. Res. 2013, 61, S1–S11. Available online: http://hdl.handle.net/2115/52347 (accessed on 13 January 2022).
18. Lebreton, L.; Van Der Zwet, J.; Damsteeg, J.-W.; Slat, B.; Andrady, A.; Reisser, J. River plastic emissions to the world's oceans. Nat. Commun. 2017, 8, 15611.
19. Jang, Y.C.; Hong, S.; Lee, J.; Lee, M.J.; Shim, W.J. Estimation of lost tourism revenue in Geoje Island from the 2011 marine debris pollution event in South Korea. Mar. Pollut. Bull. 2014, 81, 49–54.
20. Shen, M.; Huang, W.; Chen, M.; Song, B.; Zeng, G.; Zhang, Y. (Micro) plastic crisis: Un-ignorable contribution to global greenhouse gas emissions and climate change. J. Clean. Prod. 2020, 254, 120138.
21. Ayompe, L.M.; Davis, S.J.; Egoh, B.N. Trends and drivers of African fossil fuel CO2 emissions 1990–2017. Environ. Res. Lett. 2021, 15, 124039.
22. Suresh, A.; Muhammed, A.H.A.; Krishna, S.N.; Rafi, N. Light Straw Bale Construction. Int. J. Res. Eng. Sci. Manag. 2022, 5, 1–2.
23. Surul, O.; Bilir, T.; Gholampour, A.; Sutcu, M.; Ozbakkaloglu, T.; Gencel, O. Recycle of ground granulated blast furnace slag and fly ash on eco-friendly brick production. Eur. J. Environ. Civ. Eng. 2022, 26, 1738–1756.
24. Jayaram, M.; Kiran, V.K.; Karthik, T. Characteristics of Bricks with Virgin Plastic and Bottom Ash. In Proceedings of the IOP Conference Series: Materials Science and Engineering, Hyderabad, India, 10–11 December 2020.
25. Elavarasan, S.; Priya, A.K.; Kumar, V.K. Manufacturing fired clay brick using fly ash and M-Sand. Mater. Today Proc. 2021, 37, 872–876.
26. Jittin, V.; Bahurudeen, A.; Ajinkya, S.D. Utilisation of rice husk ash for cleaner production of different construction products. J. Clean. Prod. 2020, 263, 121578.

27. Loiseau, E.; Saikku, L.; Antikainen, R.; Droste, N.; Hansjürgens, B.; Pitkänen, K.; Leskinen, P.; Kuikman, P.; Thomsen, M. Green economy and related concepts: An overview. J. Clean. Prod. 2016, 139, 361–371.
28. Chen, Y.; Awasthi, A.K.; Wei, F.; Tan, Q.; Li, J. Single-use plastics: Production, usage, disposal, and adverse impacts. Sci. Total Environ. 2021, 752, 141772.
29. Mak, S.-L.; Wu, T.M.Y.; Tang, F.W.F.; Li, J.C.H.; Lai, C.W. A Review on Utilization of Plastic Wastes in Making Construction Bricks. In Proceedings of the IOP Conference Series: Earth and Environmental Science, Changsha, China, 3 February 2021; Available online: https://iopscience.iop.org/article/10.1088/1755-1315/706/1/012001/meta (accessed on 14 February 2022).
30. Lamba, P.; Kaur, D.P.; Raj, S.; Sorout, J. Recycling/reuse of plastic waste as construction material for sustainable development: A review. Environ. Sci. Pollut. Res. 2021, 28, 29773–29780. Available online: https://link.springer.com/article/10.1007/s11356-021-16980-y (accessed on 8 February 2022).
31. Department of Environment, Forestry and Fisheries; Department of Science and Innovation. Waste Picker Integration Guideline for South Africa: Building the Recycling Economy and Improving Livelihoods through Integration of the Informal Sector. 2020. Available online: https://wasteroadmap.co.za/wp-content/uploads/2021/02/Waste-Picker-Integration-Guidelines.pdf (accessed on 4 November 2022).
32. Velis, C.A.; Wilson, D.C.; Rocca, O.; Smith, S.R.; Mavropoulos, A.; Cheeseman, C.R. An analytical framework and tool ('InteRa') for integrating the informal recycling sector in waste and resource management systems in developing countries. Waste Manag. Res. 2012, 30, 43–66.
33. Integrating Reclaimers into Our Understanding of the Recycling Economy. Available online: https://www.researchgate.net/profile/Melanie-Samson-3/publication/342976626_Integrating_reclaimers_into_our_understanding_of_the_recycling_economy_Lessons_from_Waste_Picker_Integ reclaimers-into-our-understanding-of-the-recycling-economy-Lessons-from-Waste-Picker-Integration-Initiatives-Development-of-Evidence-Based-Guidelines-to-Integrate-Waste-Pickers-into-South.pdf (accessed on 5 November 2022).
34. Masood, M.; Barlow, C.Y. Framework for integration of informal waste management sector with the formal sector in Pakistan. Waste Manag. Res. 2013, 31, 93–105.
35. Dias, S. Overview of the legal framework for inclusion of informal recyclers in solid waste management in Brazil. WIEGO Policy Brief Urban Policies 2011, 6. Available online: https://www.wiego.org/sites/default/files/publications/files/Dias_WIEGO_PB6.pdf (accessed on 5 November 2022).
36. Speech by Minister Edna Molewa at the 5th Waste Khoro. Available online: https://www.dffe.gov.za/speech/molewa_5th_wastekhoro (accessed on 4 November 2022).
37. Jones, E.A.; Stafford, R. Neoliberalism and the Environment: Are We Aware of Appropriate Action to Save the Planet and Do We Think We Are Doing Enough? Earth 2021, 2, 331–339.
38. Kumar, R.; Verma, A.; Shome, A.; Sinha, R.; Sinha, S.; Jha, P.K.; Kumar, R.; Kumar, P.; Shubham; Das, S.; et al. Impacts of plastic pollution on ecosystem services, sustainable development goals, and need to focus on circular economy and policy interventions. Sustainability 2021, 13, 9963.
39. Soekarni, M.; Sugema, I.; Widodo, P.R. Strategy on reducing unemployment persistence: A micro analysis in Indonesia. Bull. Monet. Econ. Bank. 2018, 12, 151–192. Available online: https://bmeb.researchcommons.org/bmeb/vol12/iss2/3 (accessed on 23 March 2022).
40. Jubane, M. Strategies for Reducing Youth Unemployment in South Africa. 28 April 2021. Available online: https://ssrn.com/abstract=3835752 (accessed on 23 March 2022).
41. Shuid, S. The housing provision system in Malaysia. Habitat Int. 2016, 54, 210–223.
42. Fawzy, S.; Osman, A.I.; Doran, J.; Rooney, D.W. Strategies for mitigation of climate change: A review. Environ. Chem. Lett. 2020, 18, 2069–2094.
43. Sadan, Z.; de Kock, L. Plastics: Facts and Futures Moving beyond Pollution Management towards a Circular Plastics Economy in South Africa; WWF: Cape Town, South Africa, 2020; p. 136.
44. Harnessing Africa's Youth Dividend: A New Approach for Large-Scale Job Creation. Available online: https://www.brookings.edu/wp-content/uploads/2019/01/BLS18234_BRO_book_007_CH3.pdf (accessed on 23 March 2022).
45. Rodríguez-Caballero, C.V.; Vera-Valdés, J.E. Long-lasting economic effects of pandemics: Evidence on growth and unemployment. Econometrics 2020, 8, 37.
46. Henley, M. Give me shelter: The global housing crisis. Environ. Health Perspect. 2003, 111, A92–A99. Available online: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1241368/pdf/ehp0111-a00092.pdf (accessed on 21 March 2022).
47. Goshua, A.; Gomez, J.; Erny, B.; Burke, M.; Luby, S.; Sokolow, S.; LaBeaud, A.D.; Auerbach, P.; Gisondi, M.A.; Nadeau, K. Addressing climate change and its effects on human health: A call to action for medical schools. Acad. Med. 2021, 96, 324–328. Available online: https://journals.lww.com/academicmedicine/Fulltext/2021/03000/Addressing_Climate_Change_and_Its_Effects_on_Human.15.aspx (accessed on 15 July 2022).

48. Gholami, R.; Watson, R.T.; Hasan, H.; Molla, A.; Bjorn-Andersen, N. Information systems solutions for environmental sustainability: How can we do more? J. Assoc. Inf. Syst. 2016, 17, 2.
49. Murray, V.; McBean, G.; Bhatt, M.; Borsch, S.; Cheong, T.S.; Erian, W.F.; Llosa, S.; Nadim, F.; Nunez, M.; Oyun, R.; et al. Case studies. In Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation. A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change; Field, C.B., Barros, V., Stocker, T.F., Qin, D., Dokken, D.J., Ebi, K.L., Mastrandrea, M.D., Mach, K.J., Plattner, G.-K., Allen, S.K., et al., Eds.; Cambridge University Press: Cambridge, UK; New York, NY, USA, 2012; pp. 487–542.
50. Statistics South Africa. Sustainable Development Goals: Country Report 2019—South Africa. Available online: http://www.statssa.gov.za/MDG/SDGs_Country_Report_2019_South_Africa.pdf (accessed on 5 February 2022).
51. Sarkis, J.; Helms, M.M.; Hervani, A.A. Reverse logistics and social sustainability. Corp. Soc. Responsib. Environ. Manag. 2010, 17, 337–354.
52. Carter, C.R.; Rogers, D.S. A framework of sustainable supply chain management: Moving toward new theory. Int. J. Phys. Distrib. Logist. Manag. 2008, 38, 360–387. Available online: https://www.emerald.com/insight/content/doi/10.1108/09600030810882816/full/html?fullSc=1&fullSc=1 (accessed on 13 March 2022).
53. Department of Public Works. DPW Green Building Policy. 2011. Available online: https://www.ecsa.co.za/news/News%20Articles/181113_DPW_Green_Building_Policy.pdf (accessed on 2 March 2022).
54. Kehinde, O.; Ramonu, O.J.; Babaremu, K.O.; Justin, L.D. Plastic wastes: Environmental hazard and instrument for wealth creation in Nigeria. Heliyon 2020, 6, e05131.
55. Olukanni, D.O.; Aipoh, A.O.; Kalabo, I.H. Recycling and reuse technology: Waste to wealth initiative in a private tertiary institution, Nigeria. Recycling 2018, 3, 44.
56. Baishya, P.; Jain, A.; Bora, M.P.; Goswami, K. Reduction of Groundwater Contamination by Converting Plastic Waste to Plastic Lumber. 2022. Available online: https://www.researchgate.net/profile/Milan-Bora/publication/360874193_REDUCTION_OF_GROUNDWATER_CONTAMINATION_BY_CONVERTING_PLASTIC_WASTE_TO_PLAST OF-GROUNDWATER-CONTAMINATION-BY-CONVERTING-PLASTIC-WASTE-TO-PLASTIC-LUMBER.pdf (accessed on 20 October 2022).
57. Gupta, P. Plastic Waste Management, A Concern for Community. Holist. Approach Environ. 2021, 11, 49–66.
58. Chauhan, S.; Kumar, B.; Singh, P.S.; Khan, A.; Goyal, H.; Goyal, S. Fabrication and Testing of Plastic Sand Bricks. In Proceedings of the IOP Conference Series: Materials Science and Engineering, Greater Noida, India, 3–5 May 2019.
59. Victory, M. Regulation Risks Less Sustainable Alternatives to Plastic; Independent Commodity Intelligence Services: London, UK, 2020; Available online: https://s3-eu-west-1.amazonaws.com/cjp-rbi-icis/wp-content/uploads/sites/7/2020/01/29120959/WP_310120_Sustainable-Alternatives-to-Plastic_v7.pdf (accessed on 8 May 2022).
60. Nadiruzzaman, M.D.; Shewly, H.J.; Esha, A.A. Dhaka Sitting on a Plastic Bomb: Issues and Concerns around Waste Governance, Water Quality, and Public Health. Earth 2022, 3, 18–30.
61. Awoyeraa, P.O.; Adesina, A. Plastic wastes to construction products: Status, limitations and future perspective. Case Stud. Constr. Mater. 2020, 12, e00330.
62. Department of Statistics South Africa. Youth Still Find It Difficult to Secure Jobs in South Africa. Available online: http://www.statssa.gov.za/?p=14415 (accessed on 5 February 2022).
63. World Population Review. Unemployment by Country. 2022. Available online: https://worldpopulationreview.com/country-rankings/unemployment-by-country (accessed on 26 February 2022).
64. Favilukis, J.Y.; Mabille, P.; Nieuwerburgh, S. Affordable housing and city welfare. Soc. Sci. Res. Netw. 2021, 87, 1–86. Available online: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3265918 (accessed on 21 March 2022).
65. United Nations Habitat. The global housing affordability challenge: A more comprehensive understanding of the housing sector. Urban Data Digest. 2020. Available online: https://unhabitat.org/sites/default/files/2020/06/urban_data_digest_the_global_housing_affordability_challenge.pdf (accessed on 26 February 2022).
66. De Villiers, W.I. Regulation of Alternative Building Materials and Systems in South Africa. In Proceedings of the Southern African Housing Foundation International Conference, Exhibition & Housing Awards, Cape Town, South Africa, 16–19 September 2012.
67. Tsakona, M.; Baker, E.; Rucevska, L.; Maes, T.; Appelquist, L.R.; Macmillan-Lawler, M.; Harris, P.; Raubenheimer, K.; Langeard, R.; Savelli-Soderberg, H.; et al. Drowning in Plastics. Available online: https://wedocs.unep.org/xmlui/bitstream/handle/20.500.11822/36964/VITGRAPH.pdf (accessed on 9 March 2022).
68. Morales-Méndez, J.D.; Rodríguez, R.S. Environmental assessment of ozone layer depletion due to the manufacture of plastic bags. Heliyon 2018, 4, e01020.
69. National Geographic Society. Global Warming. Available online: https://www.nationalgeographic.org/encyclopedia/global-warming/ (accessed on 20 March 2022).

70. Short, J.R.; Farmer, A. Cities and Climate Change. Earth 2021, 2, 1038–1045.