Sustainable Waste Management Innovations

Subjects: Environmental Sciences
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The problem of e-waste persists given the absence of sustainable waste management innovations and policies. We advocate for the engineering of policies that create conditions for doing more with less resources, eliminating waste, and recycling as crucial steps in creating sustainable waste management innovations.

Keywords: market violence ; planned obsolescence ; sustainability ; waste management innovations

1. Introduction

Sustainable manufacturing (SM) or green manufacturing … is a method for manufacturing that minimises waste and reduces the environmental impact. Therefore, sustainable manufacturing may be defined as a system that integrates product and process design issues with issues of manufacturing, planning and control in such a manner as to identify, quantify, assess, and manage the flow of environmental waste with the goal of ultimately reducing the environmental impact to that of the self-recovery capability of the Earth could deal with while also trying to maximise resource efficiency" [1].

The global economy is characterized by the migration of polluting industries from high-income nations to developing economies. This occurs via foreign direct investment and trading of goods, which further amplifies the environmental sustainability issues [2]. Green manufacturing (GM) is a growing recognition that climate change is now an existential threat not only to societies, but also businesses that are unable to embrace green practices in ways that keep abreast of the speedily changing times. The potential positive effect of businesses' operations can be further amplified with green manufacturing. This is necessary for minimizing pollution, water contamination, or e-waste while simultaneously generating new and renewable sources of energy. Nevertheless, most industries remain largely hamstring by a host of factors.

The world's population is on track to increase from around 7.7 billion in 2020 to around 10 billion by the year 2050 [3]. This increase will far likely exacerbate the already intense competition for natural resources, exerting further demand for food, renewable energy, and resources. In this regard, environmental sustainability can no longer be regarded as a strategic option but a strategic necessity to curtail CO_2 emissions.

As the world is increasingly becoming a global village [4], global solutions encompassing all countries are needed for this century. The COVID-19 pandemic has elevated the climate issue to the fore as well as propelling new streams of scholarly works on environmental sustainability [5][6][7][8][9]. One of the most pertinent issues facing developing countries is how to usher in green business practices in resource-constrained environments.

Although Africa as a continent contributes less to environmental pollution compared with regions such as Asia, North and South America and Europe, it remains the "the most vulnerable continent to climate change" and the accompanying consequences [10] (p. 21993). This is further exemplified by the fact that the 2015 Climate Change Vulnerability Index observed that seven out of the ten nations (i.e., Chad, Ethiopia, Nigeria, Sierra Leone, South Sudan, Central African Republic, and Eritrea) most vulnerable to climate change risk are situated on the continent [10].

There are potential contributions of sustainable waste management and green manufacturing. That notwithstanding, past studies have largely failed to examine the barriers and challenges in fostering green practices. In this closing editorial, we examine the current challenges and opportunities in leapfrogging to waste management innovations in the post-COVID-19 era. Despite the positive effects of an embrace of environmental sustainability initiatives [11][12], it remains unclear as to how governments can better usher in a culture of environmental sustainability specifically in creating green innovations. Such green innovations will make little difference if systems for proactive environmental awareness and enforcement mechanisms are not put in place to control plastic consumption and disposal. For example, Figure 1 below shows the

countries in Africa with the highest importation of plastics. The 230 Mt of imported plastic is a clear demonstration of the gravity of the situation. The same countries are also responsible for a great portion of the ocean littering with plastic [13].

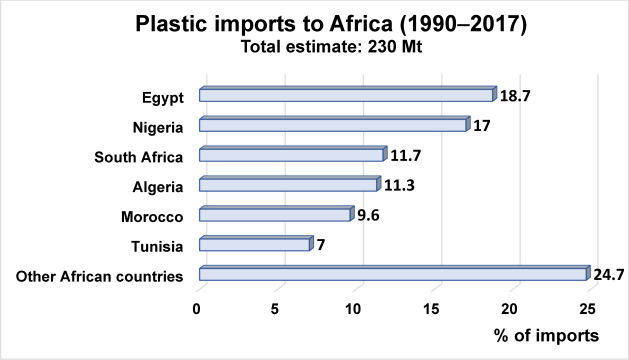

Figure 1. Plastic imports to Africa from 1990 to 2017. The total estimated amount of imported plastics (both in primary form and as products) was 230 megatons, based on extrapolation of available data from 33 selected African countries. Data from reference [14].

2. Green Practices: Drivers for Change

Encompassing green manufacturing (GM) or environmentally conscious manufacturing are manufacturing matters related to pollution control, waste recycling, conservation, environmental protection and fulfilling legal and regulatory obligations [15][16]. GM revolves around lessening the "environmental impact by reducing toxic waste, pollution, optimizing use of raw material, and energy by applying end of life (EOL), cradle to cradle and close loop approach" [15] (p. 20). It broadly seeks to ensure the minimization of adverse effects on the environment in designing and delivering in the production process [15].

Past studies have demonstrated that GM represents a combination of a set of actions and initiatives that can lead to the mitigation of adverse environmental effects of firms' activities [15][17]. By incorporating the green design of products, and the use of recyclable materials and packaging, GM can pave the way for firms to enhance their competitiveness via cost saving from waste [17]. Indeed, with resource conservation, effective and robust waste management, and environmental protection measures coupled with pollution control, firms can mitigate the negative or bad press stemming from the lack of attention to the negative effects of their production activities. This also helps firms to adopt superior processes and standards in their industry that enhance their market competitiveness.

2.1. Green Manufacturing

Manufacturing is viewed as one of the panaceas to fostering rapid industrialization and economic development not only in Africa, but across the global south. It has historically played a pivotal role in the development of many advanced nations and newly industrialized nations in Asia, including South Korea and Japan. In recent decades, manufacturing production across the African continent has surged and in West, East, Central and southern Africa increased in value from USD 73 bn in 2005 to around USD 157 bn in 2014 [18]. However, manufacturing as a share of GDP declined from 19% in 1975 to 11% in 2011 [18]. Accordingly, there is a need for the greening of industries to develop and enrich the manufacturing base to combat unemployment and foster industrialization. Indeed, GM can emerge as a means to combat social problems such as youth unemployment and environmental depletions in both urban and rural areas in Africa. In responding to recent "calls to action" for combating climate change, there has been a growing emphasis on GM [19].

2.2. Impediment of Transition to GM

For many developing nations such as Ghana, Nigeria and Kenya, manufacturing firms' growth are often curtailed by intense competition from cheap imports, a lack of access to finance and erratic power supply [20]. Many African nations have generally failed to capitalize on the relatively low labour rates to compete with rivals domiciled in Southeast Asia due to "very low levels of output per hour" [21] (p. nd). Another issue is the lack of size/scale to build large factories with the potential to accrue synergetic benefits and ultimately be able to compete with imports [21]. However, the success of GM might be predicated on skills development and the application of latest manufacturing technologies. From a public policy standpoint, ECOWAS and EAC countries: Ghana and Nigeria, and Kenya, focusing on green has potential for these to become hubs for GM on the continent. The Switch Africa Green project that Ghana, Nigeria and Kenya have ratified is another channel to realizing their green economic goals.

3. Conclusions and Limitations

We propose a framework that delineates the structural composition of costs imposed by market violence that ranges from extraction to e-waste disposal. These include: (i) loss of economic rents and initial environmental cost due to exploitative extraction, (ii) net exportation of resources, (iii) stagnation of local industries, (iv) loss of national brand attraction due to being a dump site for other nations' wastes and (v) the final environmental and health costs resulting from the unsustainable management of waste.

We explore the need for green manufacturing as a solution to the on-going waste problem. However, this may be inadequate unless the initial problem of exploitation and structural inefficiencies are made to accommodate sustainable innovations. As matters stand, it no longer seems possible to deflect the main arguments about responsible production and consumption or the accompanying individual and collective responsibilities in managing waste. As markets rise, there also seems to be a fall in the quality of health [22][23] and a weakening of other determinants of health [24]. The policy interventions are few, inconsistent, and not sufficiently radical to fix the problem with urgency despite the scale. The lack of repair resulting from planned obsolescence and high costs of spare parts/components should now receive serious regulatory and research attention. The suggested green manufacturing agenda must be met with a change in attitude towards green consumption, increased investments in technical education and other incentives, without which the sustainability agenda will not succeed.

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