



Race to Digitalization – Sustainability Challenges for Developing Countries

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By the beginning of the twenty-first century, the trend of digitalization has been widely appreciated. At first, digitalization became famous for social networks (e.g., Facebook, Twitter etc.), professional networks (e.g., LinkedIn, ResearchGate etc.), online banking, cryptocurrencies (e.g., Bitcoin etc.), education (e.g., Coursera etc.), and dating (e.g., Tinder etc.). Digitalization has been widely accepted by governments for state businesses. International chambers of commerce and multinational companies are utilizing digital means to access new markets and to operate and expand their businesses. A revolutionary shift in digitalization occurred in famous start-ups, such as Uber and Airbnb etc. The current COVID-19 pandemic has promoted digitalization on a mass scale, when social distancing has become a primary infection prevention measure (1).

Europe and the United States (US) have been points of origin for digital products, later extending to China, India, and the rest of the world. Digitalization has been a good management practice for developed economies but a challenge for developing countries. Usually, developing countries develop digitalization from foreign aid because of a lack of local funding and economic instability. Dependence on foreign aid usually limits independent policymaking because of the funding agency's interests. In this editorial, we present digitalization in Pakistan as an example of sustainability challenges faced by developing countries.

National Laptop Scheme

In 2008, the provincial government of Punjab in Pakistan initiated the Chief Minister Youth Initiative Program (CMYIP) to digitalize universities to enhance university education quality and to cope with poverty and ignorance of youth. Under this program, 400,000 laptops were distributed to undergraduate and graduate university students across the province. Later, the federal government opted for this project in 2014 as the Prime Minister's National Laptop Scheme (PMNLS) and expanded it nationwide. A total of 500,000 laptops were distributed to the university students under the PMNLS umbrella. Both of these projects not only brought a digital revolution in universities but also promoted education quality and mass-scale digitalization in university teaching methods (2, 3).

Promotion of Freelancing Jobs

Following CMYIP and PMNLS, in the next stage of digitalization, Pakistani youth became open to information technology and software development industries. All these factors, together with an insufficient job market, led to the development of freelancing as a profession in the country (4). The

development of freelancing not only led to a reduction in the economic burden of unemployment but also the waiving of traditional barriers, for example, more women's empowerment (5). Further promotion of freelancing occurred when the national government announced a zero-tax policy for freelancers. One freelancer works 34 hours a week for \$20 per hour and earns \$34000 per year on average in Pakistan (4). Freelancing helped people raise their income by 27%, and Pakistan is among the top four freelancing countries after India, Bangladesh, and the United States, with more than 150,000 freelancers.

Sustainability Concerns

Where national laptop schemes and freelancing jobs brought better quality education and alternate employment opportunities, they also brought sustainability concerns. Digitalization, in general, is considered a green practice, as it reduces solid waste, especially paper waste (6-8). Moreover, the burden on transport can also be reduced by adopting freelance jobs, which ultimately leads to lower carbon emissions. The same was observed in Pakistan. However, recent studies have quantified greenhouse gas (GHG) emissions from computer usage (9, 10). According to these research results, 0.3725 watt is utilized for every gigabyte (GB) memory used for any task. These statistics raise sustainability concerns, especially for countries that produce electricity through thermal power.

In Pakistan, most electricity (64%) is produced by thermal power. Thermal power sources include regasified liquefied natural gas (RLNG), furnace oil, coal, and high-speed diesel (11). Combining thermal power with hydraulic power, wind power, solar power, and nuclear power cannot fulfil a country's energy demands. There is a gap of 2000 – 3000 megawatts (MW) in the demand and supply of electricity in the country. To fill this gap, most of the time, the government leans from rental power companies, which also run on thermal power. This leads to an increased carbon footprint in Pakistan's ecosystem. The increase in the country's cumulative emissions from 1850 to 2020 was the 36th highest in the world. Moreover, carbon emission has increased by 45% in the last decade (2010-2019) only (source: <http://berkeleyearth.org> last accessed June 4, 2022). Pakistan has already faced a shortage of forests, and thus, less carbon sequestration capacity. Together, these factors lead to climate change in the country, particularly in the region (12).

The reliance of digitalization on thermal power in Pakistan not only increased the carbon footprint but also air pollution and temperature. Pakistan is among the top ten most air-polluted countries in the world

according to the national average particulate air pollution (Source: <http://berkeyearth.org/air-quality-country-list>; last accessed June 4, 2022). The World Health Organization (WHO) reports 7 million deaths each year due to air pollution, but unfortunately, none of the top 10 air polluted countries meet the WHO Global Air Quality Guidelines compliance (13). Moreover, high temperatures have frequently been observed in Pakistan according to the records of the Berkeley Earth Temperature Dataset (BETD), as shown in Figure 1. BETD reported $2.72 \pm 0.28^\circ\text{C}$ warming in the country since 1960, 1.2°C in 2020 and heading towards 3.5°C more warming by 2100.

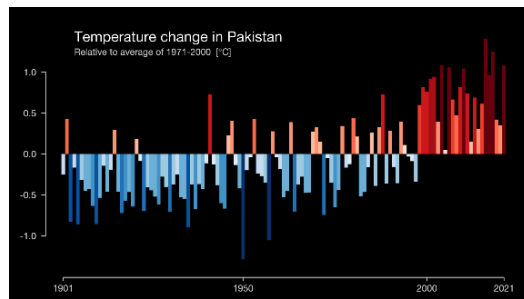


Figure 1: Temperature change index (-1.0 to 1.0) from 1901 to 2021 in Pakistan. where 0 is the mean annual temperatures between 1901-2000. ± 1.0 is equivalent to ± 2.6 standard deviations from mean of annual temperatures between 1901-2000 (15).

Another sustainability challenge brought about by digitalization is e-waste. Roughly all digitalization devices and means use electronic systems and turn into e-waste post-usage. Currently, there are no regulations on e-waste management in the country. Most e-waste is used for informal recycling, for example, acid baths, blow torches, open burning, and physical dismantling. The objective of such informal recycling is not to dispose of e-waste appropriately but to extract valuable materials (14). Icing on the cake is lack of appropriate facilities, protective clothing, and respiratory equipment. E-waste in Pakistan is not only limited to computers and laptops, but also includes used mobile phones, televisions, and many other electronic appliances. In addition to local e-waste, Pakistan has also been a dump site for imported e-waste from the European Union and United States. However, political and economic instability always limits the development and implementation of e-waste management policies by the ruling government.

Future directions

Recently, Billion Tree Tsunami Afforestation and Ten Billion Tree Tsunami Projects were launched and fulfilled by the government to plant one billion and ten billion trees, respectively (sources: <https://mocc.gov.pk>; <https://www.unep.org>; last accessed August 4, 2022). However, efforts to increase carbon sequestration by planting trees alone may not

be sufficient unless carbon emissions are controlled. The government of Pakistan should develop a green energy policy to reduce carbon emissions. The country can produce energy using solar, wind, and tidal power. If the government cannot produce green energy, then a public-private partnership, entrepreneurship, and financing of green energy to households will not only reduce the economic burden on the state but will also produce competition to launch the green energy market.

Pakistan (other developing countries as well) needs to develop “Green Digitalization Policy” for effective use of digitalization and making digital technologies more environment friendly. Such a policy not only assesses the demand for power required for digital means in the country but also formulates appropriate green resources for required power production. In addition to green energy, such policies should formulate laws for the disposal of e-waste and used digital devices. The United Nations’ current notion of Sustainable Development Goals (SDGs) also supports these highlights and suggestions.

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