The impact of Artificial intelligence and big data on sustainable development

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Abstract

Egypt has adopted an approach towards achieving Sustainable Development (SD) that is characterized by a high level of ambition, firm commitment and dynamic innovation, and the core principle of the 2030 Agenda for (SD) is “universality” and “inclusivity".

To Achieve and Monitor Sustainable Development, it is necessary to use data for improving decision-making and policy, increased citizen empowerment and increased innovation and entrepreneurship.

On the other side, Artificial Intelligence (AI) is presently flourishing in our daily lives, and is starting to profoundly influence the fields of architecture and sustainability development. Due to the significant increases in internet speed and accessibility and the drops in computer prices and data storage costs in recent years, Big Data (BD) nowadays assumes a significant supplementary role to AI.

The present paper starts with an introduction to AI history and techniques. This is followed by a discussion on how AI and BD

can be used to sustainable development as it presents the opportunities and disruptive potential challenges offered by rapid technological change regarding the achievement and monitoring of the Sustainable Development Goals (SDG) across the various economic, social and environmental dimensions.

Keywords:
Artificial intelligence, Big data, Sustainability development, Decision-making.

1. Introduction

Sustainable development is a way for people to use resources without the resources running out.

Sustainability reflects a concern for the wellbeing of future generations and requires that three core elements be harmonized: economic growth, social inclusion, and environmental protection [1][2].

AI can quicken the change to a round economy, decreasing environmental pressures and the dangers of crude material stockpile stuns. Actually, AI can help improve modern generation by making physical resources increasingly shrewd and boosting data driven decision-making. This will upgrade predictive support, helping firms to broaden item life, limit squander, and streamline the exhibition of their systems and procedures [3].

AI is additionally prodding creative environmental arrangement draws near. For instance, the UK Government is working with industry to build up an electronic waste following system that records every single waste development through the economy. The system centers on boosting consistence, and diminishing waste crime, by recognizing unlawful dumping and landfill evasion.

Be that as it may, the digitalization of the roundabout economy can likewise have unintended environmental results. Bounce back impacts by expanded degrees of creation and utilization of roundabout exercises or slacking regulations are two instances of risks that require cautious management [4].

2. AI and Big Data in Sustainable Development

The AI Sustainable Development Summit is home to artificial intelligence, big data, and data-driven social innovation.

Big Data refers to a collection of data sources, technologies and techniques that have risen up out of the exponential development in data creation over the previous decades. Analytics is a significant concept including the disclosure, translation and communication of meaningful patterns from these data for effective decision making.

Big data strategies for development can be important tools to formulate policies that also help successfully implementing the SDGs. However, many emerging economies or developing countries are still struggling with collecting and managing much

smaller data sets and statistics. While a lot of "smaller" data exists, it is often not integrated, patchy and of low quality. Also, these statistics are often top-down and are missing a feedback loop to communities.

To confirm some of the anecdotal evidence about the lack of good data in developing country ministries, the Overseas Development Institute (ODI) interviewed a series of policy-makers based in line ministries to understand how they viewed capacity constraints in their respective countries.

As a result, many national and local governments continue to rely on outdated data or data of insufficient quality to make planning and decisions. Good quality, relevant, accessible and timely data enables governments to extend targeted services into communities, and to implement policies more efficiently. Many governments still do not have access to adequate data on their entire populations, and particularly true for the poorest and most marginalized, the very people that leaders will need to focus on if they are to 'leave no one behind' in the next 15 years . This is true, too, for the international community, who will not be able to support the most vulnerable and marginalized people without an overhaul of the current ways of gathering data.

Artificial intelligence the capacity of machines to communicate with the environment intelligently. With the increasingly advancing possibility of acquisition and access to data, particularly because of the accessibility and expansion of cell

phones in Africa, there emerges an ever increasing number of complexities with structure and utilization of these enormous pool of data. Big data analytics and Artificial Intelligence are incredible tools with capabilities to achieve complex tasks at levels past human aptitudes. They could be explicitly used to gather , organize and analyze, large varied data sets in order to reveal patterns and trends that can help address several problems peculiar to the developing economy. Very important of these are proffering solutions to economic problems, identifying new sources of revenue and deepening customer engagement for businesses, prediction and prevention of diseases, prediction of climatic variations and provision of energy solutions. Leveraging big data will help understand how to best provide these solutions [5].

It is principal to make availability and knowledge about the probability of global joint effort with secure data – anywhere access (high-performance solution), running big data workloads directly on enterprise storage, storage of massive amounts of data with unrivaled effectiveness and using current Artificial Intelligence solutions to solve these identified problems. However, as many as those who are interested in research in this area are in Africa, the knowledge required to provide value-added results around the use of big data is limited. Lately, various significant methodological innovations have been exhibited by the scientific community; most of these revolve

around sustainability. Along these lines, solving sustainability issues by suitably utilizing big data, analytics and AI is very promising. In the world over the last few decades, debate over sustainability issues like climate change, water resources, food security, energy efficiency, healthcare and financial stability has been very prominent [6].

Additionally, in Africa, forward thinking policy-makers, innovative startups, global technology partners, civil society groups, and international global partners are already mobilizing to promote the growth of a vibrant AI ecosystem in Africa. Combining big data, analytics and AI, significant decisions that can drive comprehensive and sustainable development could be effectively made. Moreover, environmental and health disasters can be effectively turned away [7].

Figure 1 describes the sustainable development strategy (SDS): Egypt vision 2030 main pillars

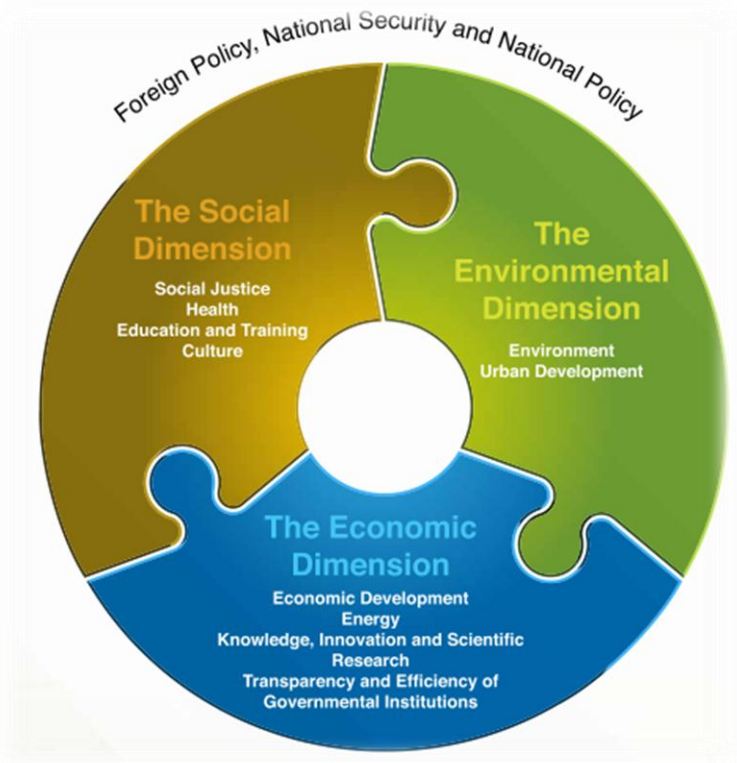

Figure 1: the sustainable development strategy (SDS): Egypt vision 2030 main pillars [14]

In table 1 and figure 2 illustrated each goal of sustainable development as general view.

Table 1.Sustainable Development Goals (SDG) [14]

Goal No.	Description
SDG 1	End poverty in all its forms everywhere
SDG 2	End hunger, achieve food security and improved nutrition and promote sustainable agriculture
SDG 3	Ensure healthy lives and promote well-being for all at all ages
SDG 4	Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all
SDG 5	Achieve gender equality and empower all women and girls
SDG 6	Ensure availability and sustainable management of water and sanitation for all
SDG 7	Ensure access to affordable reliable, sustainable and modern energy for all
SDG 8	Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all
SDG	Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation
SDG10	Reduce inequality within and among countries
SDG11	Make cities and human settlements inclusive, safe, resilient and sustainable
SDG 12	Ensure sustainable consumption and production patterns
SDG 13	Take urgent action to combat climate change and its impacts
SDG 14	Conserve and sustainably use the oceans, seas and marine resources for sustainable development
SDG 15	Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably Manage forests, combat desertification, and halt and

	reverse land degradation and halt biodiversity loss
SDG 16	Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels
SDG 17	Strengthen the means of implementation and revitalize the Global Partnership for sustainable development [8]

AI Goals for SDGS

Figure 2: United Nations' Sustainable Development Goals.
Source: United Nations [12]

Additionally, we divided the SDGs into the three following categories: *Society*, *Economy* and *Environment*, consistent with the classification which be discussed in [8][9]. The SDGs

assigned to each of the categories are shown in Figure 3

Figure 3: Categorization of the SDGs into the Economy, Society and Environment groups [9]

Table 2: Alignment between SDG 1 and SDS: —Egypt Vision 2030 Strategic Goals [10]

SDG Targets	SDS Strategic Goals
١.١ Eradicate extreme poverty for all people everywhere.	**Achieve inclusive economic growth**؛ increase the economic growth rates and achieve a balanced regional economic growth and increase women, people with special needs participation in the labor market and achieve economic empowerment to reduce poverty rates. (Economic Development Pillar) [7].
١.٢ Reduce at least by half the proportion of men, women and children of all ages living in poverty in all its dimensions according to national definitions.	

١.٣ Implement nationally appropriate social protection systems and measures for all، including floors, and by 2030 achieve substantial coverage of the poor and the vulnerable.	**Secure protection to most vulnerable groups;** ensure equity in income distribution and reduce gaps through supporting the most vulnerable groups and securing those who most need care (Social Justice Pillar).
1.4 By 2030 ensure that all men and women ,in particular the poor and the vulnerable, have equal rights to economic resources, as well as access to basic services, ownership and control over land and other forms of property،inheritance, natural resources،appropriate new technology and financial services, including microfinance	**Achieve equality in rights and opportunities;** stimulate social mobility system through an institutional system that achieves equality in economic, social, and political rights and opportunities. In addition enhance access to basic needs including health, education, jobs, and social protection (Social Justice Pillar) [8]

3. Challenges of Developing the Data Ecosystem in Egypt

3.1. Challenges related to strategic planning and policies and the relation to sustainable development:

a. **Absence of an Egyptian national strategy for statistics** as is the case in most developed, emerging, and developing countries, including African and Arab countries. Recent global reports (Paris21, 2017) [13] refer to shortage of such strategies in Egypt, which is also referred to by the Assessment Committee of CAPMAS Work (Bahjat, 2015) [14].

b. **Absence of a national strategy for Big Data,** especially in the light of the developments related to Data Revolution and the attitude of countries and economic blocks to adopt such type of strategies.

c. Presence of gaps in concepts and data among agencies concerned with sustainable development, especially Ministry of Planning, Ministry of Investment and International Cooperation, as for mechanisms, indicators, and conclusions of monitoring and evaluating SDS and the related development plans [11].

While big data offer various opportunities, there are also many challenges from very different directions, which are also partly linked to each other or to the listed opportunities [12].

- Analysis

Analysis is not only necessary, but also much more challenging than the data collection

Two kinds of challenges can be identified for the analysis of big data:

1. To handle the enormous amount of big data (Volume of big data)
2. To develop analysis approaches for all types of big data (Variety of big data) [10].

- Privacy

Privacy of data has been a controversial issue even before the advent of big data, which has only increased this challenge. This is desirable since these data provide insights about human behavior, which could be harnessed to increase the quality of life of these people, thereby contributing ultimately to the achievements of the SDGs.

- Access - missing million
- Cleaning/preparing data and lack of standards

This applies mostly to the big data category of unstructured data, which comprises text and multimedia content, such as videos, photos, audio files [10].

- Capacities and data literacy

Data literacy can be defined as the ability to read and analyze big data, thus creating actionable information. Capacities for this are

particularly needed in National Statistics Offices and, as often, tend to be less strong in developing countries.

- Financing big data for SDGs

There are also additional costs, especially when it comes to big data for development, such as for developing countries: Funding for official statistics, Funding for innovation, Funding for data literacy and use and Funding for partnership and leadership [10][11].

3.2 Challenges related to measures of sustainable development

The potential challenges offered by rapid technological change regarding the achievement and monitoring of the Sustainable Development Goals (SDG) **such as:**

- The need to integrate new sources to fill the gap in data required, including sample surveys.
- Shortage of technical support to integrate some indicators into the used tools to collect data.
- Shortage of specialized technical support to use models and statistical estimates to calculate projections or forecasting some indicators of sustainable development.

3.2.1 Organizational challenges

- Problems related to efficiency of statistical units within different agencies, including shortage of cadres, coordination and

integration between such units and CAPMAS, gaps between statistical activities [11].

- Problems of coordination and cooperation at the local level: among regional statistical units and many related parties at the governorate level [12].

3.2.2 Challenges related to finance of statistical work, including

- Shortage of governmental finance, which negatively affects performing vital statistical activities.
- Shortage of finance of the business sector due to weakness of communication channels with the private sector as one of the important data communities in many international experiences, especially in the light of the Data Revolution and multiplicity of data communities, especially the private sector with its companies, organizations, unions and syndicates [13].

3.2.3 Technological challenges

Infrastructure and platforms, Data Revolution, Open, Big, and Administrative Data, geographical information, innovations in data analysis and computing:

- Slow expansion of using modern technological tools, applications, and systems, including Big Data, GIS, Cloud Computing [13].

Rapid technological change will have transformative and disruptive effects that may both advance and frustrate sustainable development. While the application of new and emerging technologies represents an opportunity for faster progress towards the Sustainable Development Goals, rapid technological change can also disrupt markets and economies [12].

Problems related to handling Big Data, such as:

o Absence of a procedural or legislative framework to organize handling Big Data, the roles of different players, and data communities in this field.

o Shortage of the culture of modern handling methods, where traditional programs have no value in handling huge data sizes anymore [10].

o Challenges related to administrative registers/data, including;

- Incomplete or incomprehensive administrative records, which makes it difficult to transform into statistical registers.
- Shortage of a unified number for economic establishments, which cannot be given to any other establishment, even after closure or end of activity. Such a number is to be the only number for the establishment to treat with all sources [11].
- Shortage of mechanization of all administrative sources, which can facilitate the linkages between CAPMAS and different administrative sources.

- Shortage of unified classifications that can be used by administrative sources, which can facilitate data exchange among different agencies and CAPMAS.
- Challenges related to expanding the role of Cloud Computing in the national statistical system, including:
o Shortage of finance necessary for the related hardware, software, and technological infrastructure.
o Continuous development of human resources through training inside and outside the country.
o Challenges related to coordination and integration among data centers, especially in the governmental sector, which hinders efforts of building and spreading public clouding services [10].

3.3 Challenges related to forms and types of relationships and partnerships, coordination, and integration at global, regional, and local levels:

- Shortage of coordination and partnership with planning agencies, especially Ministry of Planning, that is responsible of implementing and assessment of sustainable development strategy and plans in Egypt [13].
- Shortage of coordination and partnership with Ministry of Investment and International Cooperation, that became a vital actor as for implementation of SDGs in Egypt, as indicated by the Report.

- Shortage of coordination and partnership with Ministry of Communications and Information Technology - MCIT, although the Ministry is responsible of many projects of digital transformation and building and developing data-bases in different fields.
- Gaps related to follow up of the related global and regional developments, and forming and publishing periodical systematic stock of global and regional experiences and lessons learned to develop statistical work and data systems in Egypt.

4. Opportunities offered by rapid technological change with regard to the Sustainable Development Goals

This section will highlight the role of science, technology and innovation in key areas of the 2030 Agenda for Sustainable Development, including opportunities, key considerations and the requisite preconditions and policies needed for their effective application to sustainable development.

Accelerating and monitoring progress towards the Sustainable Development Goals [12].

Rapid technological change can contribute to the faster achievement of the 2030 Agenda for Sustainable Development through several mechanisms by: improving real incomes (through increased productivity and reduced cost of goods and services); enabling faster and wider deployment of novel solutions to economic, social and environmental obstacles that

operate as binding constraints on development; supporting more inclusive
forms of participation in social and economic life; replacing environmentally costly modes of production with more sustainable ones; and giving policymakers powerful tools to design and plan development interventions [13].

Big data and machine learning, can also be used to create, measure and develop and monitor more broadly the effectiveness of development programs and progress towards the Sustainable Development Goals. Models based on both mobile telephone activity and airtime credit purchases have been shown to estimate multidimensional poverty indicators accurately.

Various opportunities are caused by the main characteristics of big data volume, variety and velocity as the following:

- Access - deluge of data
- Access - data philanthropy
- Low costs
- Real-time availability
- Predictive analytics [14]

4.1 Developing Infrastructure and Technological Solutions to Produce, Distribute, and Publish Data Internally and Externally

a) Studying establishment of specialized institutes and centers for data similar to regional and global experiences, such as:

- Establishing specialized organizational unit for Big and Open Data (institute or center) affiliated to CAPMAS. It can be established in collaboration with universities, CAPMAS, INP - or any other local agency - with global, Arab, and African partnerships.
- Establishing organizational unit for cloud computing (institute or center) affiliated to CAPMAS to develop and enhance statistical activities technologically, in collaboration with universities, research centers, and Ministry of CIT [15].
- Integrating administrative data and registers into work programs and applications of the national statistical system.

b) Developing joint programs and projects between CAPMAS and Ministry of CIT in the following fields:

- **Enhancing infrastructure and technological** computing capacities to process and analyze Big Data and different digital projects.
- **Using modern computing applications,** such as cloud computing, to enhance national data and statistical system.

- **Developing specialized electronic portals and gates** to publish and exchange data, and enhance digital transformation in the community, such as the Egyptian Government Open Data Platform, health and education platforms, climate change platform, etc.
- **Organizing uses of phones and postal records** and other important data sources by the Ministry to enhance national capacity to produce and handle data to enhance development [15].

c) Encouraging invention and innovative solutions to enhance national data and statistics system through the following:

- Communicating and networking with all national data communities, and encouraging them to present solutions and initiatives to create better opportunities to use data in improving life quality in all fields in Egypt.
- Allocating national prizes to inventors and innovators in the field of handling and administering data - to be granted to individuals, agencies, or institutions - in collaboration with Egyptian universities [17].

4.2 Enhancing and diversifying partnerships and cooperation - internally and externally - to enhance sustainable development in Egypt

a) Forming continuous joint work-teams between CAPMAS and Ministry of Planning to be interested in the following:

- Issues of continuous development of indicators and data sources related to SDGs and SDS.
- Integrating policies and programs related to Big Data, Open Data, and Administrative Data into annual and medium-term development plans.
- Utilizing and coordinating related current and continuous programs and projects, especially the project of completing and relating national data bases (National Project of Integrated Data System)[16].

b) Signing a joint collaboration protocol between CAPMAS and Ministry of Investment and International Cooperation to coordinate, exchange, and integrate experiences related to sustainable development issues inside and outside the country.

c) Preparing a joint work program with Information and Decision Support Center as for establishment of (Egyptian Open Data Portal) to enhance planners and decision takers, enhance trust between citizens and government agencies, enhance transparency and accountability in community, and improve efficiency of performing and delivering public services.

d) Developing programs and partnerships with different universities and scientific research centers to enhance developing new data and statistical systems, and utilize capacities of regional universities in developing statistical branches in different governorates.

e) Signing a cooperation protocol, and forming joint work teams among CAPMAS and some government agencies, to develop new data projects and administrative registers in the country. For example, joint projects with tax agencies assume high priority.

f) Diversifying partnerships, providing necessary finance and technical support with foreign concerned agencies, especially in rapidly changing and developing fields, such as Big Data, Open Data, Satellite Data, and Social Media Data [17].

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