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ROLE OF ICT IN SUSTAINABLE DEVELOPMENT USING BIG DATA

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Abstract:

The advanced information technology (IT) sector is a part of modern life and information in updated and reliable data has to improve the quality and access of data. With information and communication technologies (ICT), services and applications are rapidly growing with the need for big data. It can provide an opportunity to explore the use of highly emerging ICT data. The modern ICT industry is an enormously growing sector that covers big socio-economic data worldwide. With increasing mobile access, a large population of the world is involved in data access. The strongest growth of ICT in various sectors, including socio-economic, education, and other sectors, involves big data that holds great assurance for development. However, the challenge in collecting big data has an impact on sustainable development. The researcher studies the positive and negative impacts of ICT on sustainability with different approaches. The paper discusses the social and ecological compatibility of ICT with the increasing use of technology and explains the plain use of ICT for sustainable development. These approaches are discussed with issues identified with ICT uses and limitations of the technology. The use of big data in sustainable development is important for the effective use of services. Considering such challenges, digital technologies are used as a global source for internationally comparable ICT statistics that influence the sustainable growth of economies. The researcher studies the role of ICT in sustainable development in different approaches. The importance of big data in ICT is further discussed since it produces new and insightful information that is valuable for businesses, governments, and people. Big data is extensively used by the global statistical community to enhance efficiency and revenues.

Keywords: ICT, sustainable development, big data, data analysis, Role of ICT, sustainable solution, compatibility of ICT

1. Introduction:

We are already in the process of bringing the SDGs into action; most of the tools are in place to execute policies targeted at speeding up development and tracking outcomes. High-quality data (pertinent, timely, reliable, comparable) is needed to ascertain the breadth and depth of problems and recognise the affected populations in order to inform policy and investment decision making, monitor progress toward the SDGs, and evaluate policy impacts [1], [2]; this requirement has created new opportunities and challenges for broad data collection attempts. Without solid data, SDG adoption is unlikely to be effective, and the required objectives will not be met. Data can improve the efficacy and efficiency of interventions and move us closer to attaining the SDGs by acting as the "eyes and ears" of decision-makers. Fixing data gaps is critical for attaining long-term development objectives. Due to non-alignment of national/regional indicators with universal indicator framework, which

includes 232 distinct indicators and insufficient investments in SDG data creation and utilisation, data gaps are widespread [3].

The data environment has been quickly evolving recently, posing a challenge to the worldwide community to develop new methods to use new technology and form new collaborations. The unparalleled rate of technological innovation in data gathering techniques and technology, as well as the ability to freely exchange data, has broadened the range of possibilities [4]**.** These advancements will transform the way we gather data and improve our capacity to track the effect of development programmes. Reforms in environmental and resource monitoring are on the way, thanks to the rise of artificial intelligence, big data and cloud-based computations [5], which will impact both official data collecting methods and the functioning of programmes they monitor. Big data, which includes information from a large number of people, is a new way to collect information.

Big data refers to databases that are larger than the capacity of standard database software tools for capturing, managing, storing, and analysing data. Climate data, traffic reports from GPS signals, flight data points, messages on social networking sites, digital photos, movies with transaction records, and other copious data are gathered through sensors or internet portals.

Although the big data revolution is altering our lives, there are still many issues to be solved and numerous opportunities to be explored, which will take a lot of work from all disciplines. Recent debates [6] have looked at the relationship between the big data era's trend and the green revolution's in terms of developing green big data systems' whole life cycle. [6] Discusses the principles of green concerns in depth, with green concepts relating to environmental, economic, social, and/or technological challenges in a sustainable and friendly manner. Environmental challenges, such as water, air and soil pollution issues in some parts of China, and dramatic climate change in the United States, have sparked worldwide alarm and been widely addressed in recent years.[7]. Big data technology may be used to investigate hidden patterns, unexplained relationships, and trends, among other things.

The rise of big data is rapidly being seen as having far-reaching implications in the urban environment. Predictive analysis connected with these advances has the ability to empower individuals and modify how city dwellers interact with one another, their surroundings, and urban infrastructures. The greater access of the daily data we create in the urban environment has resulted in the rise of urban big data. While there is little question that vast volumes of urban data are now being gathered, there is far less clarity on how to analyse this data to solve the numerous wicked challenges that come with urban sustainability. [8]

Big data is a complicated topic, with topics stemming from technical or practical difficulties to regulatory and legal constraints. Despite progress, vital data for global, regional, and national development policies remains in short supply. Several development areas still have significant data shortages. Among the key issues are poor data quality, a lack of timely data, and the lack of disaggregated data points on crucial aspects.

2. Data Revolution and emergence of Big Data

The Data Revolution and Big Data Big Data is a set of data sources, tools, and processes that have developed from, and are being used to exploit, the exponential development in data generation over the last decade. Big data is a catchphrase that refers to a high volume of unstructured and semi - structured data that is hard to process using typical database and software approaches. Data is becoming an increasingly important part of our lives. As more data is created and referred to as "big data" in popular media, its use is becoming more widespread, and its potential for policymaking and global relations is only beginning to be explored.

For corporations, government, and consumers, the sheer volume of data collected, stored, and analysed for insights has become commercially relevant. Big data may be used in policymaking to improve awareness (e.g., by collecting public attitudes), comprehension (e.g., by explaining variations in food costs), and prediction (e.g. forecasting migration patterns). In most nations, government agencies collect massive volumes of data via census, tax filings, and public health studies, among other sources. Although most of this data is nominally "public," getting access to it may be difficult, and mining it for useful insights might necessitate technological knowledge and training that governments and organizations with limited resources may not be able to pay for. To make excellent use of big data, diverse actors, particularly data practitioners and researchers, will need to work together, leveraging their competencies to grasp the technological capabilities as well as the environment in which insights might be applied.

3. Green Information and Communication Technology using Big Data

Greening ICT is a critical part of long-term sustainability. In fact, challenges related to developing green big data are a subgroup of those related to greening ICT. It's critical to emphasise that big data technologies, with the exception of greening big data, may help with ICT sustainability challenges. Big data technology may be able to aid with a variety of computer and communication system scalability, intricacy, and efficiency challenges. Green ICT has a propensity to assist ICT sustainability in ways other than energy consumption and product concerns, such as supporting ecological strategies in processes, behaviour, and organisational culture, and integrating economic systems with social and environmental responsibility [9]. In order to achieve energy efficiency, an early architecture that merged Big Data and semantics overlay components was designed in [10].

There have been enormous volumes of garbage, as well as old information technology gadgets and electronics that have been abandoned when they are damaged or outdated, posing a threat to the environment. Big data technologies might help recyclability processes run more smoothly, reducing the negative environmental effects of discarded hazardous materials.

4. Environmental Problems and Big Data

Technologies have the potential to affect the environment and result in a slew of negative consequences, including pollution, waste, resource depletion, and ecological upheaval. We can successfully address these environmental challenges by employing appropriate big data.

4.1 Environment

Excessive and incorrect manufacture and usage of electronic equipment in the technological period can result in water, air, oil, and electromagnetic (EM) pollution, all of which are major goals to be addressed by green applicable technologies and actions. Amongst the most serious types of pollution is air pollution. A study semi-supervised learning method based on a framework consisting of two separate classifier, spatial and temporal classifiers, with the aid of both traditional and real-time air monitoring data to gain fine-granularity urban air quality data based on minimal air quality monitor stations. Oil spills not only pollute beaches, coasts, and seas, but they also emit carbon dioxide, which contributes to the greenhouse effect. Fingasa and Brown [11] gathered a range of aerial large data from various water bodies where oil spills had previously happened. Through qualitative data analysis, a supervised oil system may be developed for real-time early warning. The acquisition, interpretation, and use of data with regards to water may alter how water pollution is prevented or decreased. Fertilizers and chemicals that are not utilized by crops, for example, can pollute water [12], and farmers could become even more effective fertilizer users by acquiring and analysing data on their own fields' nutrient requirements.

4.2 Climate

Over the last century, sea levels have risen roughly 7%, and the Arctic ice sheet has been disappearing at a rate of around 13% for the past decade. At the same time, the earth's surface air temperatures have been continuously rising statistically. Big data technology has the potential to aid in the mitigation of climate-related issues. Faghmous and Kumar [13] discuss some of the challenges and opportunities associated with mining huge climate change data, and proposed a data science paradigm theory based on other scientific concepts to constrain both big data techniques and the pertinent interpretation process in order to gain accurate insight from sizable climate data. Remote sensing data, model outputs, assimilated datasets, and climate predictions are the major sources of climate data. Governments and industry may monitor and study climatic features using the data, and make educated actions to avert climate change. The anticipated carbon emissions might decline by roughly 10 gigatons if improved efficiency are applied across the whole global economy, which motivates people to think about climate change and improving environmental quality.

5. Application of Big data for enhanced Energy Efficiency

One of the most essential measures for determining the extent of energy savings is energy efficiency. Developing big data might be one method to improve energy efficiency and lessen environmental concerns. It's critical to understand how much energy is utilised and squandered. Energy information may be retrieved and appropriate energy plans can be developed using big data. Operational inefficiency, such as turning on lights all the time, can waste a lot of energy and can be recognised and corrected using big data technology. IBM is one of the world's top organisations that uses big data analytics to anticipate the presence of notoriously variable renewables in order to decrease energy waste. [14]

Reducing energy needs in the household sector, especially electric appliance power usage, is a major

concern across the world. The introduction of big data analytics might help gadgets become more energy efficient. Sensors are often installed in electric equipment to monitor the entire structure, and the sensing data is then aggregated at a central location. Users may use the central point to examine data and make educated power management decisions. Power usage data is now easily accessible because of the widespread use of sophisticated metering.

In terms of industrial studies, if smart metres were installed across the country, a large amount of data would have to be controlled. IBM has developed color-coded mobile measuring technology to detect hot locations in data centres so that only targeted equipment receives air conditioning or is isolated with chimneys to prevent needless cooling. Microsoft is leveraging big data to save energy, with a team installing 30,000 sensors that generated massive amounts of data per week from air conditioners, heaters, lighting, and fans, which were evaluated to minimise energy waste and financial loss. [14] For example, after reviewing the data, it was discovered that a garage exhaust system had been running incorrectly for a year, costing the firm $66,000.

Transportation is one of our most important daily activities, however only roughly 14 percent to 30 percent of the energy from a traditional car's gasoline is actually taken up to move the vehicle on roadways, with the remainder being squandered owing to inefficiencies in the engine and driveline. As a result, there are plenty of opportunities for various types of transportation vehicles to enhance energy efficiency, such as buses, metros, trains and so on. Meanwhile, big data may provide an unparalleled potential for developing energy-efficient mobility by utilising mobile data from cars connected to clouds. Qin et al. [15] examined how to employ data sensor nodes and big data analytic to optimize smart grid management, using EV as a use case, and highlighted the prerequisites to construct such a system.

6. Big Data for Sustainable Development

6.1 Renewable Resource

Reduced nonrenewable resource usage, as well as the discovery of new renewable energy sources, are critical for environmental conservation and long-term development. Big data might aid enterprises in improving the efficiency of alternative energy research and production. Sensors on the networks of wind generators, solar energy fields, hydroelectric generators, and other crucial network components might collect terabytes of real-time data. It is feasible to gather useful data and efficiently use renewable energy by analysing billions of recordings in real time. For instance, the Solar Energy Evolution and Diffusion Studies programme has established seven big data projects to investigate techniques for expediting the development of solar energy technology using advanced computational and numerical tools, pilot trials and market data.

6.2 Sciences and Technologies

Big data technology may potentially aid long-term research and development in a variety of disciplines and technologies. High-resolution sensors create a vast amount of experimental, reference, and observational data in a variety of scientific disciplines. Yoo et al. [16] described how data mining methods, such as those for categorization, clustering, and association, have been used in

biological and healthcare research. The volume levels of data in astronomy frequently reach petabytes, and the book [17] provided detailed talks on state-of-the-art practical methodologies of data mining, statistics and deep learning to efficiently evaluate astronomical complex datasets.

7. Conclusion

The growing developments in big data has led to many applications. This article has covered various aspects of big data applications using ICT pertaining to sustainable development. It begins with exploring the big data revolution and transforming to green information and communication technology with the help of big data. Subsequently, the environmental problems were analysed which can be addressed using big data technology contributing to some vital sustainable development goals. The importance of energy efficiency and its influence on the environment has been emphasised. In addition, different energy efficiency approaches for large data applications were examined. Finally, the role of big data in sustainable development emphasizing on renewable energy, science and technology was discussed.

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