

ICTs AS TOOLS FOR ACHIEVING SUSTAINABLE DEVELOPMENT GOALS (SDGs): A CONCEPTUAL OVERVIEW

By

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Abstract

Sustainable development is crucial in ensuring the future of humanity and their well-being and ICT should be used effectively in achieving this aim. Therefore, the purpose of this paper is to highlight the ICT tools used in achieving sustainable development goals (SDGs). The paper explains the conceptual overview of information and communication technology and sustainable development goals. It also identifies the ICT tools used in achieving SDGs, such as Internet, mobile internet, etc. It outlines the 17 goals of the SDGs, which includes: poverty eradication in all its forms, end hunger, achieve food security and improved nutrition and sustainable agriculture, ensure healthy lives and promote well-being for all at all ages, among others, were highlighted. The paper also highlights the challenges in using ICT in achieving sustainable development goals. These challenges include; inefficient and ineffective utilization of the available large volume of scientific data in solving climate change issue, little interaction between policy-makers and activists concerned with sustainable development and with ICT/Internet public policy, etc. The paper recommends amongst other things that there should be a call for greater dialogue and interaction between sustainable development and ICT/Internet public policy-makers and activists, the international ICT sector, represented for example in the UN Broadband Commission, would need to step forward to provide, advice, expertise, financing, and tools for rapid sustainable development.

Keywords: Information, Information and Communication Technology, Sustainable Development Goals, ICT tools, Internet

Introduction

According to UN General Assembly (2015), the 2030 Agenda for Sustainable Development will be at the core of international and transnational cooperation for the next 15 years. It combines economic, social and environmental aspects and defines global values for sustainable development. It is also a tool in achieving global mobilisation for the common good, manage global challenges and increase accountability for actions. The agenda formulates standard principles of development policy, and also emphasises the indivisibility and universality of the Sustainable Development Goals (SDGs) and the pledge to “leave no one behind”.

In September 2015, the agenda of sustainable development by 2030 was approved in the United Nations (UN) Sustainable Development Summit held in New York. This summit proposed a new indicator framework, associated with the global and universal indicators, for international co-operations to achieve sustainable development between 2015 and 2030, which, totally, include 17 new Sustainable Development Goals (SDGs). The 17 sustainable development goals are; No poverty, Zero Hunger, Good health and well-being, Quality education, Gender Equality, Clean water and sanitation, Affordable and clean energy, Decent work and economic growth, Industry, Innovation and infrastructure, Reducing inequality, sustainable cities and communities, Responsible consumption and production, Climate action, Life below water, Life on land, Peace, justice and strong institutions, and Partnerships for the goals (Wu, Guo, Huang, Liu & Xiang, 2018).

They stated that in the above-mentioned SDGs, it is obvious that none in particular clearly talks about Information and Communications Technologies (ICTs), but only several targets mention ICTs and relevant technologies. The 2030 Agenda for Sustainable Development still claims that the ICTs can substantially accelerate the development progress of human beings, and may greatly bridge the digital gaps, so as to construct knowledge communities. ICTs could be the key catalysts to all of the above sustainable development goals, and absolutely crucial to pursue these SDGs.

Information and Communications Technology (ICT) is seen as an extended term for Information Technology (IT) which stresses the role of unified communications and the integration of telecommunications (telephone and wireless signals), computers as well as necessary software, its storage and the audio-visual systems, which enable all users to access, store, transmit, and manipulate information. They are accelerators, amplifiers, and augmenters of change. They make it feasible to more flexibly and dynamically reconfigure, and hence transform all aspects of how resources are produced and used, fundamentally restructuring economies and redefining how we interact with each other and the world around us (Lehr, 2019).

The Concept of Information and Communication Technology (ICT)

Information and communication technology may not have universal definition, as the concepts, methods and applications involved in ICT are constantly advancing on an almost daily basis. ICT broadly covers any product that will store, retrieve, manipulate, transmit or receive information electronically in a digital form, for example, personal computers, digital television, e-mail and even the modern day robots. The last few decades have witnessed a tremendous and phenomenal growth in the field of information and communication technology. ICT is the digital processing and utilisation of information by the use of electronic computers, which comprises the storage, retrieval, conversion and transmission of information.

Information and Communication Technology (ICT) refers to technologies that provide access to information through telecommunications. Reference.com (2019) defined information and communication technology as all equipment, applications, and services that involve communication. Computers, mobile phones, televisions, radios, and satellite systems are all part of ICT.

Wirsiy & Shafack (2002) in Bappah (2010) defined ICT as a broad-based term that encompasses the gathering (acquisition), organization (packaging), storage and retrieval (dissemination) of information that can be in textual or numerical forms (books, documents), pictorial and vocal forms (audio-visual) or a combination of all the above (multimedia), using a combination of computers and telecommunications telephony distance learning.

ICT is the digital processing and utilisation of information by the use of electronic computers. It comprises the storage, retrieval, conversion and transmission of information. It referred to as technology that supports activities involving information, such activities include gathering, processing, storing and presenting data. For clarity, Zuppo (2016) provided an ICT hierarchy where all levels "contain some degree of commonality in that they are related to technologies that facilitate the transfer of information and various types of electronically mediated communications".

The term ICT is now also used as the convergence of audio-visual and telephone networks with computer networks through a single cabling or link system. There are large economic incentives (huge cost savings due to elimination of the telephone network) to merge the audio-visual, building management and telephone network with the computer network system using a single unified system of cabling, signal distribution and management (Yekini, 2014).

Sustainable Development Goals (SDGs)

According to Kostoko & Kocanev (2019), at the UN Sustainable Development Summit in September 2015, the world leaders adopted a new 2030 Agenda for Sustainable Development which is "a plan of action for people, planet and prosperity" designed to shift the world onto a sustainable and resilient path. At the heart of this universal, integrated and transformative Agenda are the 17 Sustainable Development Goals (SDGs) as shown in figure 1, 169 associated targets, and 232 indicators. Total number of indicators listed in the global indicator framework of SDG is 244. However, as nine indicators repeat under two or three different targets, the total number reduces to 232.

Furthermore, far more ambitious than the Millennium Development Goals (MDGs), the new SDGs framework contains several bold objectives to be achieved by the year 2030, including the end of poverty (SDG 1), and hunger (SDG 2), good health and well-being for all (SDG 3), universal secondary education (SDG 4), access to affordable, sustainable and modern energy (SDG 7), sustainable cities and communities (SDG 11), actions to combat climate change (SDG 13), protecting and promoting sustainable use of the oceans, seas and marine (SDG 14) and of the terrestrial ecosystems (SDG 15).



Rudolph (2017) states that the 2030 Agenda is much broader than a traditional development agenda, representing a multidimensional approach to development that includes development policy and other external-oriented policy fields such as foreign and security, environmental and health. The agenda features a broad range of “Means of Implementation” (MoI), including development cooperation, but does not provide clear implementation strategies for an SDG-sensitive development cooperation to support the achievement of the SDGs. Furthermore, the 2030 Agenda is transformative in nature, and promotes universality and indivisibility as core principles (or values). It calls for the transformation of our world, based on the ambition of the 17 SDGs to systematically promote change.

The table below indicates each goals and what they aim to achieve.

Table 1: SDGs goals and their targets

S/N	Goals	The target
Goal 1	No poverty	To end poverty in all its forms everywhere
Goal 2	Zero hunger	To end hunger, achieve <u>food security</u> and improved nutrition, and promote <u>sustainable agriculture</u>
Goal 3	Good health and well-being for people	To ensure healthy lives and promote well-being for all at all ages
Goal 4	Quality education	To ensure <u>inclusive</u> and <u>equitable</u> quality education and promote <u>lifelong learning</u> opportunities for all
Goal 5	Gender equality	To achieve <u>gender equality</u> and <u>empower</u> all women and girls
Goal 6	Clean water and sanitation	To ensure availability and sustainable management of water and sanitation for all
Goal 7	Affordable and clean energy	To ensure access to affordable, reliable, <u>sustainable</u> and modern energy for all
Goal 8	Decent work and economic growth	To promote sustained, inclusive and <u>sustainable economic growth</u> , full and productive employment and <u>decent work</u> for all
Goal 9	Industry, Innovation and Infrastructure	To build resilient infrastructure, promote inclusive and sustainable industrialization, and foster <u>innovation</u>
Goal 10	Reducing inequalities	To reduce income <u>inequality</u> within and among countries
Goal 11	Sustainable cities and communities	To make cities and human settlements inclusive, safe, resilient, and sustainable
Goal 12	Responsible consumption and production	To ensure <u>sustainable consumption</u> and production patterns using <u>eco-friendly</u> production methods and reducing the amount of waste
Goal 13	Climate action	To take urgent action to combat <u>climate change</u> and its impacts by regulating <u>emissions</u> and promoting developments in renewable energy.
Goal 14	Life below water	To conserve and sustainably use the oceans, seas and marine resources for sustainable development
Goal 15	Life on land	To protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss
Goal 16	Peace, Justice and strong institutions	To promote peaceful and inclusive societies for <u>sustainable development</u> , provide <u>access to justice</u> for

		all and build effective, accountable and inclusive institutions at all levels
Goal 17	Partnership for the goals	To strengthen the means of implementation and revitalize the global partnership for <u>sustainable development</u>

Achieving Sustainable Development Goals (SDGs) Through ICT

One sector that will play a crucial role in achieving sustainable development goals (SDGs) is the Information and Communications Technology (ICT) sector. The UN itself acknowledges that leveraging ICT will play a vital role in their efforts. The UN General Assembly for the 2030 Agenda has stated that “the spread of information and communications technology and global interconnectedness has great potential to accelerate human progress, to bridge the digital divide and to develop knowledge societies.” The UN Assembly sees ICT infrastructure as a cross-cutting “means of implementation,” underpinning the achievement of every goal. All three pillars of sustainable development – economic prosperity, social inclusion and environmental protection – need ICT as a key catalyst. The 17 SDGs can be realized, but only with greater progress in the speed, degree and equality of development. Economic growth in the business-as-usual context will not achieve the SDGs. Only ICT, particularly broadband, can provide this surge in development (Crawford, 2017).

According to Lehr (2019), for a brighter future, ICTs have to be part of the solution, enabling more efficient and greener energy generation and usage models in achieving SDGs 7 on ensuring access to affordable, reliable, sustainable and modern energy for all. On better information for better decisions, ICTs expand options, but they also increase uncertainty. They have the potential to provide society with expanded tools to impact our destiny, but making good choices requires having access to high-quality research to inform our collective decision-making. In confronting these challenges, the global academic community needs to build capacity and promote capabilities for multidisciplinary, cross-cutting expertise to identify and manage the implementation of successful strategies within nations and across the global community of nations. The understanding of how best to make use of ICTs to ensure sustainable growth is expanding, but the collective knowledge gaps are large and new developments bring new questions.

Developing countries need the right ICT infrastructure, skilled workers, and institutional and policy frameworks that reflect best-practice learning but also are responsive to local context constraints and opportunities. Effective ICT-fuelled development strategies need to be continually learning and adapting. According to Atkinson (2017), on the aspect of SDGs 9, ICT has the potential to transform the manufacturing sector through advancements such as Internet of Things (IoT), cloud and robotics – all of which reduce costs, increase efficiency and drive economic growth. Nowadays many businesses are going digital and ICTs have brought about the emergence of new business models which tends to replace old business models. Digital transformation is the biggest challenge and opportunity facing most organizations today. The most successful organizations are those who are able to respond quickly to the changing demands of their customers.

The table 2 below shows how sustainable development goals are achieved through ICT services by different authors, which include; **Atkinson, 2017**; Nambi, Papaioannou, Chakraborty & Aberer, 2013; **Xia, 2007**; Mayende, Idro, Aloyo, Bitarakwate, John & Kivumbi, 2006; Kedia, 2015; Chisholm, Genda, Pailla & Martin, 2013; Liestol, Morrison & Stenarson, 2014; Wood, Gillis, Goodenough & Hall, 2002; Molinier, Rauste & Hame, 2008; Shyam, 2015; Mahabir & Shrestha, 2015; International Telecommunication Union, 2018).

Table 2: ICT application in SDGs

SDG	Goals/Target	ICT use or application
Goal 1	End poverty in all its forms	ICT provides timely and accurate information services to ensure equal rights to economic resources. It creates possibilities for the improvement of productivity among millions of people so they have better means of income and livelihood. It promotes work and financial inclusion by enabling services such as mobile banking and micro-crediting and by giving access to markets for small producers and their products.
Goal 2	End hunger, achieve food security and promote sustainable agriculture	ICTs give farmers direct access to market information, weather forecasts, logistics and storage to help increase agricultural yield, restore soil, reduce waste and improve productivity. Smart farming for agriculture makes a tremendous contribution for food sustainability.
Goal 3	Ensure healthy lives and promote well-being	ICTs allow health workers to be connected to health information and diagnostic services. Analytics can help healthcare professionals make projections about diseases and patient knowledge and attitudes, and to enable the effective and continuous management of diseases and health practices. In 2017, ITU and the World Health Organization (WHO) launched the "Digital Health for Africa" partnership to scale up the use of digital technologies to strengthen the delivery of public health care services in Africa.
Goal 4	Ensure inclusive and equitable quality education	With internet connectivity, students can access learning resources and opportunities even in remote or low-income areas. Nowadays, educators could deliver knowledge to students more conveniently using the Internet and media-rich web applications, compared with the conventional classroom based approaches performed in the face-to-face manner. These new technologies enable the students who cannot attend classes receive the same education opportunities.
Goal 5	Achieve gender equality and empower all women and girls	ICT supports gender equality by leveling the playing field for women and girls. Internet connectivity gives them access to information that helps them with their productive, reproductive and community roles. ICTs give access regardless of gender to markets, education, training and employment for greater opportunities in sustainable livelihood.
Goal 6	Ensure availability and sustainable management of water and sanitation	ICTs make smart water management possible, something crucial to making water and sanitation more widely available. There are different sensor-cloud based systems used to improve the water

		quality. For sharing the information about the requirement of water supply and sanitation services, a web-based system called DevClear has been developed, which enables organizations to meet the needs of its host communities.
Goal 7	Ensure access to affordable, reliable, sustainable and modern energy	ICT-based solutions have already been a crucial tool in helping organizations achieve energy efficiency and reduce emissions. The ICT industry has also been making strides in more environmentally sound and less carbon-intensive products and services. These include smart grids technology, smart buildings and homes, and smart logistics that improve energy efficiency and lower energy consumption across different sectors.
Goal 8	Sustained, inclusive and sustainable economic growth, employment and decent work.	ICTs or digital technologies are transforming day-to-day business in both traditional and new sectors. Many forms of employment in the 21st century require ICT skills. ITU has launched a Digital Innovation Framework to assist countries, cities and other ecosystems to accelerate their digital transformation and stimulate ICT-centric innovative entrepreneurship and vibrant small and medium enterprises.
Goal 9	Build resilient infrastructure, promote inclusive and sustainable industrialization, and foster <u>innovation</u> .	The Union International Telecommunication (ITU) contributes to SDG 9 in particular by helping to build resilient infrastructure, promoting inclusive and sustainable industrialization and fostering innovation. Efficient and affordable ICT infrastructure and services allow countries to participate in the digital economy and to increase their overall economic well-being and competitiveness. Most little developed countries are recording impressive progress towards SDG 9, with significant impact in the areas of financial inclusion, poverty reduction and improved health.
Goal 10	Reduce income inequality within and among countries.	The ICTs play a special role in today's low-income countries, a point strongly and cogently emphasized by the UN's Broadband Commission. In essence, the ICTs are "leapfrog" technologies, enabling poor countries to close many technology gaps at record speed.
Goal 11	Make cities and human settlements inclusive, safe, resilient, and sustainable.	ICT has brought about smart city mobility and building, which has reduces resource consumption, improves energy efficiency and reduces air pollution, for example mobile ride sharing, e-mobility, driverless transportation, connected infrastructure/Internet of Things (IoT), alarm management and automation, big data analytics and

		energy management, smart metering, Sensors, detection and diagnosis technology.
Goal 12	Ensure <u>sustainable consumption</u> and production patterns. using <u>eco-friendly</u> production methods and reducing the amount of waste	An archetype of sustainable factory have been implemented for solar cells, which ensures high productivity, quality and assurance. Global strategies, standards and policies that offer guidelines for the sustainable management of ewaste are developed. To monitor the demands of energy, the plug-level meter based appliance have been explored for power and resource consumption in house.
Goal 13	Take urgent action to combat <u>climate change</u> and its impacts by regulating <u>emissions</u> and promoting developments in <u>renewable energy</u>	ITU develops policies and international standards that help reduce the amount of energy required to provide ICT products and services. For example, ITU has developed standards on green data centres and green power feeding systems. A situated simulation that visualizes the climate change using augmented reality technologies, which can effectively convey the essential information of climate change to the public have been developed.
Goal 14	Conserve and sustainably use the oceans, seas and marine resources for sustainable development.	ICT has improves protection and monitoring of oceans, marine life and water quality through the radio-frequency spectrum, satellite orbits, advanced mapping and data analytics, sub-marine, coastal and inland smart sensors, Smart Ocean Sensor Project, SmartBay, drones, real-time satellite imaging, smart monitoring, real-time weather forecasting, integrated ocean observing and prediction system.
Goal 15	Protect, restore and promote sustainable use of terrestrial <u>ecosystems</u> , sustainably manage forests, combat <u>desertification</u> , and halt and reverse <u>land degradation</u> and halt <u>biodiversity</u> loss	The space-based sustainability of forests have been developed in Canada based on the technologies of earth observation. Using TerraSAR-X imagery, investigation was done on the forest cutting monitoring in images over Kuortane, Finland. Geospatial technologies was adopted to examine the climate change and sustainable forest management. Remote sensing data is also used to assess the land degradation. Remote-sensing has been viewed as a useful tool in the natural resource studies. An Internet Geographic Information System application has been developed for water resource management.
Goal 16	Promote peaceful and inclusive societies for <u>sustainable development</u> , provide <u>access to justice</u> for all and build effective, accountable and inclusive institutions at all levels.	Thanks to the technology advances and the progress brought by the Information and Knowledge Society, the electronic-justice emerges as new tools that provide people more convenient access to justice than the conventional manner. There is the establishment of electronic-government that offers society great opportunities to receive information justice services. Recently, electronic-justice emerges as a necessary sector of the electronic-

		administration, especially since it contributes a lot to the constitution of modern justice administration system and the openness in public services.
Goal 17	Strengthen the means of implementation and revitalize the global partnership for <u>sustainable development</u> .	Public-private partnerships, one of the comparative advantages and foundations of ITU's work, are key to bringing ICTs to all nations, peoples and communities. Partnerships are particularly needed to build the physical infrastructure required to deliver Internet services in hard-to-reach areas and to currently disadvantaged populations, as well as to facilitate the investment, inclusion and innovation required by the SDGs.

ICT serves as a support structure for all of the 17 Sustainable Development Goals (SDGs), helping bring about their advancement, especially in relation to the universal coverage of basic services. Thus, national policies should realize that the universal roll-out of ICT infrastructure and services within the public and private sector will better serve the SDGs.

Challenges and Demerits of Using ICT in Achieving SDGS

In spite of the important roles ICT plays in achieving the goals of sustainable developments, there still exist some challenges and demerits of ICT in achieving the said sustainable development goals (SDGs). These include; inefficient and ineffective utilization of the available large volume of scientific data in solving climate change issue, little interaction between policy-makers and activists concerned with sustainable development and with ICT/Internet public policy, a networked economy is far more vulnerable to network failures than a pre-ICT economy; massive performance failures of the Internet or power grid could bring the economy to a grinding halt.

Others are that disruptions of the networked economy will become deliberate acts of cyber-warfare and an ICT-based economy is a surveillance economy, with pervasive spying and loss of privacy. The spying may be by government, giant ICT firms, or a partnership of the two. The online world will literally reshape brain development, perhaps leading a loss of "human" skills, while virtual (online) communities will in some way "crowd out" real human communities, leading to a decline of human interactions, trust, and sociality; this is the "bowling alone" phenomenon argued by sociologist Robert Putnam. Also, robots will displace human work to the point of causing mass unemployment and economic misery.

Conclusion

Although SDGs are directly relevant to so-called United Nations 2030 Development Agenda, SDGs actually might still have challenging issues in a long future human history, which might linger far beyond 2030, if appropriate ICTs are not employed in achieving its goals. ICT would have great potentials in playing important and key roles to support global economic, social, and environmental sustainability, which wait for the relevant discovery based on global and multi-disciplinary efforts. ICT provides timely and accurate information services to ensure equal rights to economic resources and efficient and affordable ICT infrastructure and services allow countries to participate in the digital economy and to increase their overall economic well-being and competitiveness. Most little developed countries are recording impressive progress towards SDG 9, with significant impact in the areas of financial inclusion, poverty reduction and improved health.

Recommendations

The following recommendations are made.

1. The international ICT sector which is being represented in the UN Broadband Commission, need to step up in providing advice, expertise, financing, and tools for rapid sustainable development.
2. The universities, in partnership with governments and businesses, would have to undertake massive training programmes, and hosting of new ICT business incubators.
3. Global donors would have to provide quick seed funding to get these activities underway.
4. The SDGs represent a complex, global-scale problem-solving exercise that cuts across all sectors of the economy and that must engage all parts of the world.

References

- Atkinson S. (2017). *ICT as driver for achieving the sustainable development goals: How technology can help towards achieving the UN SDGs to drive sustainable economic growth*. Retrieved from <https://www.ca.com/en/blog-highlight/ict-as-driver-for-achieving-the-sustainable-development-goals.html>.
- Bappah, M. A. (2010). *Availability and use of information and communication technology (ICT) in six Nigerian University Library Schools*. Retrieved from www.webpages.edu/-mbolin/bappah-abubakar.htm.
- Chisholm, A. A., Genda, C. L., Pailla, S. & Martin, J. L. (2013). Devclear: An information-sharing platform for rural development, in *Proc. IEEE Systems and Information Engineering Design Symposium. (SIEDS)*, 201–206.
- International Telecommunication Union (2018). *ICTs to achieve the United Nations Sustainable Development Goals - ITU PP-18 - Plenipotentiary Conference*. Retrieved from <https://www.itu.int/web/pp-18/en/backgrounder/6050-icts-to-achieve-the-united-nations-sustainable-development-goals>
- Kedia, N. (2015). Water quality monitoring for rural areas- a sensor cloud based economical project, in *Proc. 1st International Conference. Next Generation Computing Technologies (NGCT)*, 50–54.
- Kostoska, O. & Kocarev, L. (2019). A novel ICT Framework for Sustainable Development Goals. *Sustainability*, 1-31.
- Lehr, W. (2019). *ICTs are critical for sustainable development*. Retrieved from <https://news.itu.int/icts-are-critical-for-sustainable-development/>
- Liestol, G., Morrison, A. & Stenarson, T. (2014). Visualization of climate change in situ, in *Proc. 2014 International Conference on Virtual Systems Multimedia (VSMM)*, 251–256.
- Mahabir, R. & Shrestha, R. (2015). Climate change and forest management: Adaptation of geospatial technologies, in *Proc. 2015 Fourth International Conference on Agro-Geoinformatics (Agro-geoinformatics)*, 209–214.

- Mayende, E., Idro, R., Aloyo, J., Bitarakwate, E., John, C. C., Kivumbi, G. W. (2006). Severe malaria in children in areas with low, moderate and high transmission intensity in Uganda. *Tropical Medicine & International Health*, 11(1), 115-124.
- Molinier, M., Rauste, Y. & Hame, T. (2008). Clearcut mapping for sustainable forest management using terrasars-x imagery, in *Proc. 2008 IEEE International Geoscience and Remote Sensing Symposium (IGARSS 2008)*, 4, 647– 650.
- Nambi, S. A. U., Papaioannou, T., Chakraborty, D. & Aberer, K. (2013). Sustainable energy consumption monitoring in residential settings, in *Proc. 2013 IEEE Conference on Computer Communications Workshops (INFOCOM WKSHPs)*, 1–6.
- Reference.com (2019). *Definition of information and communication technology*. Retrieved from <https://www.reference.com/technology/meaning-ict-d11bb87f61c29a70#>
- Rudolph, A. (2017). *The concept of SDG-sensitive development cooperation: Implications for OECD-DAC members*. Bonn: German Development Institute / Deutsches Institut für Entwicklungspolitik (DIE).
- Shyam, R. (2015). IT for water resource management, in *Proc. 2015 the 2nd International Conference on Computing for Sustainable Global Development (INDIACom)*, 499–502.
- UN General Assembly (2015a). *Transforming our world: The 2030 agenda for sustainable development*. Retrieved from <https://sustainabledevelopment.un.org/post2015/transformingourworld>.
- UN General Assembly (2015b). *About the sustainable development goals*. Retrieved from <https://www.un.org/sustainabledevelopment/sustainable-development-goals/>.
- Wood, J. E., Gillis, M. D., Goodenough, D. G. & Hall, R. J. (2002). Earth observation for sustainable development of forests (EOSD): Project overview, in *Proc. IEEE International Geoscience and Remote Sensing Symposium (IGARSS '02)*, 3, 1302.
- Wu, J., Guo, S., Huang, H., Liu, W. & Xiang, Y. (2018). Information and communications technologies for sustainable development goals: State-of-the-Art, needs and perspectives. *IEEE Communication Survey*, 20, 2389–2406.
- Xia, Y. (2007). E-government: Engine or obstacle of the establishing social information justice, in *Proc. 2007 International Conference on Wireless Communications, Networking and Mobile Computing (WiCom 2007)*, 3533–3536.
- Yekini, N. A. (2014). *Information communication technology (ICT): Concepts and application.self-directed & collaborative learning approach volume I*.Lagos: Hasfem Publication.
- Zuppo, C. M. (2016). Defining ICT in a boundaryless world: the development of a working hierarchy. *International Journal of Managing Information Technology (IJMIT)*. 2(1), 19. Retrieved from en.wikipedia.org/wiki/information_and_communicationtechnology.