



BUILDING DIGITAL CAPACITY FOR SUSTAINABLE DEVELOPMENT

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ABSTRACT

Purpose: Digital technologies have increased communication among individuals, regions and nations by eliminating geographical barriers and promoting connectivity. E-services, driven by digital technologies, are helping countries to overcome the challenges of globalisation including knowledge acquisition, innovation diffusion, information dissemination, poverty eradication and sustainable development. Sharing knowledge and information about the environment is crucial for environmental protection and sustainable growth. Digital connectivity could have a positive impact on future sustainability by improving public understanding concerning the risk of unsustainable environment.

Design/methodology/approach: The paper examines the digital gap using published data to measure ICT readiness. The paper underscores the importance of global knowledge and information in building capacity for sustainable development and closing the digital divide. Developing countries can take advantage of globalisation to foster economic growth and promote innovation.

Findings: Building an ICT infrastructure facilitates connectivity and empowers local enterprises to invest in green technologies that are friendly to the environment. E-services, driven by digital technologies, increase the state's

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capabilities to provide inclusive coverage of services to all people. This will increase competitiveness that supports technology transfer, innovation dissemination, knowledge creation and development sustainability.

Originality/value: Digital technologies play an important role in fostering change and improving the quality of life. The paper sheds some light on the socio-economic potential of digital technologies that will broaden our understanding about the information age.

Keywords: Digital divide; sustainable development; globalisation; knowledge and information

INTRODUCTION

Digital technologies are rapidly changing human connectivity, allowing people in different geographical locations to communicate easily and gain greater access to world markets. Digital networks enable individuals, enterprises and institutions to acquire knowledge and information in order to make decisions and formulate strategies that lower risks and reduce transaction costs. Digital technologies, especially the Internet and mobile telephones, are providing inclusive access to people across the social divide, namely the poor, disabled, rural population, women and minorities, so they may engage in market activities and improve their economic well-being. Today, the Internet, mobile telephones, social networks and other communication media are extensively used across cultures and within nations, enriching public understanding of the opportunities and challenges confronting their communities worldwide.

Digital technologies have reduced distances and made contacts across geographical barriers much faster, thus helping individuals, communities and nations to make decisions that could influence human understanding, enhance cooperation, increase mobility and share knowledge and information. Today, governments can extend e-services far beyond cities and regions to provide inclusive educational, health, environmental and administrative services with greater efficiency. Digital technologies enable policy makers to provide a wide range of e-services to people in different locations to bridge the knowledge gap and sustain development. Closing the digital divide, however, remains among the biggest challenges facing many developing countries. This is due to ineffective institutions, weak infrastructure, a lack of funding and corruption.

Over the past three decades, there has been much debate surrounding environmental protection in the literature on development studies, sustainable development, political circles, and the media. This reflects the concern over the causes and consequences of environmental degradation and their impact on future sustainability. In addition to the environment, the concept of sustainable development also addresses a society's social and economic development punctuating the complex task of future sustainability. The scarcity of natural resources and the high cost of extraction impose constraints on the ability of the environment to supply resources that meet

people's basic needs. In recent decades, an increase in population, rapid economic growth, urbanisation and transportation have increased the demand for natural resources. Inadequate management of the environment has caused a rapid depletion of non-renewable resources, and has also increased the risk of future sustainability.

This paper examines the impact of digital technologies on environmental management and sustainable development. It will briefly highlight the importance of connectivity in decision-making and policy formulation concerning future sustainability. Sustainable development is concerned with correcting environmental imbalances to ensure that future generations will enjoy equal access to the natural environment. In recent decades, the excessive consumption of natural resources has reduced the ability of the natural environment to adequately produce resources in order to meet people's basic needs. Globalisation, poverty, inequality, multinational businesses, and illegal activities are increasing the threat of unsustainability, and are subjecting millions of people to a high degree of uncertainty. Digital technologies empower people with the capacity to create new knowledge, think of new ideas, develop new techniques and disseminate new innovations to protect the environment. This paper aims to shed some light on the use of digital technologies in environmental management in view of the current megatrends facing populations worldwide.

SUSTAINABLE DEVELOPMENT

In this paper, the term 'future sustainability' is used in reference to the management of natural capital in order to highlight the prospect that future generations may enjoy equal access to natural resources. Future sustainability is limited by the ability of the natural environment to supply the required natural resources to meet people's basic needs, which include water, food and energy. The rapid consumption of resources reduces productivity and speeds up the depletion of these resources, which then become costly to produce. In recent decades, globalisation, trade liberalisation, rapid economic and population growth, rising income per capita, and urbanisation have increased demand for those natural resources that are vital for people's needs.

By 2050, it is estimated that the world's population will reach 10.5 billion. This will require a substantial increase in the supply of natural resources in order to meet demand. By 2050, the demand for food is expected to increase by 60% to feed the increase in population and the demand for water will increase by 55%; global energy consumption will increase by 37% by 2040. Currently about 52% of agricultural land is already affected by moderate or severe degradation; this puts the prospect of future sustainability in jeopardy. As the OECD (2016) points out:

"Natural resources are a major - if not the primary - foundation of economic activity and thus ultimately of human welfare. Water, air, land and soil provide food, raw materials and energy carriers to support socio-economic activities. Their extraction and consumption affects the quality of life and

well-being of current and future generations. Their efficient management and sustainable use are key to economic growth and environmental quality.” (OECD, 2016, p. 32)

Therefore, if the consumption of natural resources continues to increase at the current rate, it is likely that the supply of these resources, in particular non-renewable resources, will be exhausted. To overcome this, immediate action needs to be taken to manage natural resources in a productive manner to protect the environment and ensure future sustainability.

Recent development studies focus more on sustainable development as a measure of the earth carrying capacity and the role that natural capital plays in meeting people’s basic needs. The environment is at the heart of sustainable development because it is the main supplier of natural capital. In recent decades, rapid socio-economic transformation and population growth have placed more and more pressure on natural resources, particularly on non-renewable resources, due to the rise in global demand.

The capacity to produce natural resources is limited by increasing costs, inadequate technologies and the declining reserves of non-renewable resources. In many developing countries, economic growth is driven by the production and export of natural resources; therefore, the rapid depletion of these resources makes the economy vulnerable to changes in demand and the price of these resources in the global markets. Geographically, natural resources, including energy, are not evenly distributed among and within nations. This increases the risk of accessibility, especially if they are located in countries with a high degree of political instability and widespread corruption.

Sustainable development is a multidimensional concept comprising social, economic and environmental elements; it aims to promote social and economic development of the present generation without jeopardising the sustainability of future generations. The most commonly circulated definition of sustainable development is the one used by the World Commission on the Environment and Development as: “development that meets the needs of the present, without compromising the ability of future generations to meet their own needs” (Brundtland, 1987, p. 47).

In most developing countries, scientific knowledge and financial resources are inadequate to protect the natural environment and sustain development. It is estimated that by 2050, 80% of the increase in global population will be in developing countries, the burden of which will be placed on the natural environment and its capacity to supply the resources needed to meet the basic requirements of that population. To minimise the risk of uncertainty and build capacity for future sustainability, these countries should invest in non-renewable resources, develop new technologies and create knowledge that will lead to local innovation and protect the environment. Priority should be placed on green investments and environmentally friendly technologies aimed at reducing market imperfections and protect the environment. Future

funding should be subject to an environmental review and to an assessment of the impact of building new projects on the environment (Al-Roubaie, 2013).

The Millennium Development Goals adopted by the United Nations in 2015 represent some of the biggest challenges facing communities worldwide. The objectives of these goals are to sustain development by endorsing global initiatives to eradicate poverty, reduce inequality, close the gender gap, reduce unemployment, eliminate hunger, improve health and encourage education. Poverty is perhaps among the greatest challenges facing many developing countries that the community of nations needs to resolve if sustainable development is to be achieved. The United Nations recognises the severity of the problem by saying that:

“Poverty eradication, changing unsustainable and promoting sustainable patterns of consumption and production, and protecting and managing the natural resource base of economic and social development are the overarching objectives of and essential requirements for sustainable development” (United Nations, 2013, p. xi).

Some of the environmental linkages are external due to cross-border flows and illegal market activities. Both national and international institutions must work together to manage, monitor and protect the environment against abuse by international firms and local enterprises. Governments need to strengthen corporate governance guidelines to ensure that the exploitation of natural resources will be within the framework of sustainable growth. Digital technologies have a critical role to play in future sustainability by providing e-services to increase awareness and educate the public concerning matters related to the environment.

Future sustainability is influenced by forces that require action to be taken now to lessen the future impact on the environment. Currently, there are several ‘megatrends’ at work that can be seen to extend long into the future. The OECD has identified several of these megatrends, including demography, natural resources and energy, climate change and the environment, globalisation, the role of government, the economy, jobs and productivity, health, inequality and well-being. It is estimated that the global population will exceed 10 billion by 2050, the majority of which will be in poor countries that lack access to adequate resources to meet their current needs. Supporting this increase in population will require food production to increase by 60%, water by 55%, and global energy demand by 40%. The use of digital technologies can have a major influence on the production and consumption of natural resources. It may enhance efficiency and strengthen future sustainability. As the United Nations points out:

“These challenges to sustainable development are driven by broad underlying economic, social, technological, demographic and environmental megatrends. Megatrends are understood in this context as major shifts in economic, social and environmental conditions which change societies and substantially impact people at all levels” (UN, 2013, p. 2).

As an important input in production, energy is crucial for future development. Investment in renewable energy has become essential in order to reduce pollution and protect the environment. Renewable energy is considered an environmentally friendly resource with little or no impact on the environment. It reduces the costs of pollution, minimises the impact of climate change on health, and contributes to a reduction of greenhouse gas emissions. For resource-poor countries, renewable energy offers long term solutions to energy vulnerability and reduces dependency on global markets for the supply of energy. For oil producing countries, building capacity for renewable energy encourages economic diversification and reduces dependency on foreign markets. The production and consumption of conventional energy sources produces a substantial amount of chemicals and waste, which are harmful to the environment. In addition, developing countries will benefit from investments in renewable energy by improving productivity of the economy and creating new job opportunities for younger generations.

INFORMATION AND COMMUNICATION TECHNOLOGIES (ICTs)

ICTs have increased connectivity within and across nations. This has brought people closer, allowing them to share useful information and exchange ideas of common interest. In the new economy, knowledge is a global good that can easily be acquired through trade, multinational business and the Internet with little or no costs. ICTs facilitate the transfer of knowledge and promote innovation across sectors; this consequently accelerates economic growth and sustains development. Acquiring knowledge for development through digital technologies has become more convenient, especially for countries with limited technical and scientific knowledge. For developing countries, it is cheaper to make use of the existing global knowledge, given the status of their financial, technological and educational limitations. To this end, building capacity for the digital divide will speed up the process of knowledge transfer, technology diffusion and innovation dissemination. Digital infrastructures encourage people to participate in market activities. They provide new opportunities to acquire funding, access to information and create knowledge. Politically, digital technologies increase awareness and improve choices that promote participation and strengthen democracy (Elmasry et al., 2016).

Developing countries must incorporate digital technologies into their national policy on the environment in order to provide the public with the information they need to not only participate in environmental protection, but also to take full accountability for their involvement in activities related to the production and consumption of natural resources. Responding to the mega-challenges facing these countries will require the collective efforts of individuals, groups, businesses and governments towards building green technologies and creating innovative systems that support the environment. In doing so, with regard to future sustainability, educational institu-

tions, research and development, science and technology and public support programmes must be given top priority in government strategy. Sharing information and acquiring knowledge encourages public involvement in environmental management, which supports sustainable development and builds a future for the generations to come. E-services can improve government delivery and could empower people to make sound decisions to protect the environment. Digital technologies could improve the management of natural resources by reducing the risk of resource depletion and by finding new alternatives (Al-Roubaie and Al-Zayer, 2007).

Digital technologies are important enablers for the creation of new knowledge, the dissemination of information to improve the quality of the environment, and to support future sustainability. The Internet allows people in different geographical locations to share knowledge and information of common interest, including environmental management. Connectivity could help nations to leapfrog, in other words, to surpass several development stages using these global linkages, knowledge acquisition and innovation diffusion. In this regard, science and technology, boosted by the emergence of networks, can address some of the major challenges facing development. Learning from the rest of the world provides developing countries with a wider array of choices to stimulate local innovation and improve the protection of the environment (Al-Roubaie and Al-Zayer, 2007).

ICTs could be effectively used in environmental management and sustainable development. As powerful enablers, these technologies increase awareness about the need for environmental protection by providing knowledge and information to people across national boundaries, including the rural population and other isolated settlements. The current rate of development in many developing countries is not sustainable due to the depletion of non-renewable resources, deforestation, climate change, an increase in pollution and ineffective institutions. Overcoming unsustainable activities will require an investment in alternatives to reduce the risk of resource depletion and improve the capacity of the earth to sustain future development.

The International Telecommunication Union (ITU) adopted the Connect 2020 Agenda: this represents “a series of goals and targets for improvement in ICT access, use and sustainability, and in contribution of innovation and partnerships” (ITU, 2015, p. 4). The ITU endorses a vision shared by ITU Member States, to build an information society empowered by the “interconnected world, where telecommunication/ICTs enable and accelerate social, economic, and environmentally sustainable growth and development for everyone” (ITU, 2015, p. 5).

There are four major targets identified by the Connect 2020 Agenda:

1. Growth - enabling and fostering access to and increased use of ICTs
2. Inclusiveness - bridging the digital divide and providing broadband for all
3. Sustainability - managing challenges resulting from ICT development
4. Innovation and partnership - leading, improving and adapting to the changing technology environment (ITU, 2015, p. 5).

The use of ICTs enables developing countries to close the digital divide and provide access to people to participate in environmental management. Digital technologies can improve technological learning and give rise to innovation through information sharing and knowledge creation, both within and among nations.

Table 1 provides information about connectivity in different regions classified by access to the Internet. Developing countries remain far behind in comparison to developed nations in terms of access to the Internet; this reflects the size of the digital divide. Connectivity is still worse in least developed countries and Africa; this illustrates the challenges facing those countries in terms of building an infrastructure for connectivity and sustainable development. Only 9.7% of the total population in LDCs (Least Developed Countries) is connected to the Internet, compared to 82.3% in developed countries, and 43.4% worldwide. Only 32.3% of women in developing countries have access to the Internet, compared to 80.1% in developed countries and 40.8% worldwide. Connectivity should be inclusive to provide greater opportunities to all people and increase their access to a wider range of opportunities and services. Inclusive also means that more people will become aware of the challenges facing sustainability. They will be able to make decisions about reducing waste in society, without impacting the environment. It is estimated that closing the gender gap in terms of mobile phone usage will benefit 300 million women in low-income countries, adding \$13 billion in incremental revenue for operators (World Bank Group, 2015, p. 22).

Table 1 Percentage of Individuals using the Internet by Gender, Development Status and Region 2015

<i>Region</i>	<i>Female</i>	<i>Male</i>	<i>Total population</i>
Developed	80.1	84.6	82.3
Developing	32.3	38.2	35.3
World	40.8	45.9	43.4
LDC	8.1	11.3	9.7
Africa	18.4	23.1	20.8
Arab states	34.1	39.8	37.0
Asia & Pacific	33.3	40.4	36.9
CIS	57.8	62.2	59.9
Europe	74.3	81.0	77.6
The Americas	66.2	65.8	66.0

Source: ITU, Measuring the Information Society Report 2015

In the Information society, access to information is essential in order to make decisions and improve the ability to forecast future trends. Greater access to ICT will have a positive impact on a society's ability to enhance connectivity and strengthen future sustainability. However, bridging the digital divide requires inclusiveness to ensure that ICT benefits will reach everyone, without excluding the poor and other vulnerable groups. ICT empowers a society, not only in terms of accelerating social and economic transformation, but also in terms of improving future sustainability by protecting the environment.

ICTs offer new opportunities for women to obtain resources and participate in the economy. In developing countries, opportunities for women are limited due to social, cultural and religious restrictions. Thus, access to ICT can improve gender equality and may increase the participation of women in market activities by providing them with new economic opportunities and greater access to finance, knowledge and information. ICT also allows people to work from home, providing women with the opportunity to negotiate business deals without face-to-face meetings. In other words, empowering women with ICT access will increase the productivity of the economy and create jobs, especially for the youth. In the Arab world, for example, the percentage of women going to school at all levels is increasing. This will enable more women to take advantage of the new technologies and participate in finding solutions to problems of development.

The environmental dimension of sustainability includes local solutions that can integrate external knowledge into the local knowledge system. Knowledge transfer and adaptation to technological change are possible through connectivity to external markets and institutions. Access to scientific applications strengthens environmental management and empowers the country's ability to reduce the risk of environmental degradation.

DIGITAL DIVIDE

The digital divide is defined by Wikipedia as: “an economic and social inequality with regard to access to, use of, or impact of Information and Communication Technologies (ICT). The divide within countries (such as the digital divide in the United States) may refer to inequalities between individuals, households, businesses, or geographical areas, usually at different socioeconomic levels or other demographic categories. The divide between different countries or regions of the world is referred to as the global digital divide, examining this technological gap between developing and developed countries on an international scale.” (Wikipedia: https://en.wikipedia.org/wiki/digital_divide) The global divide hinders development by reducing the ability of developing countries to benefit from globalisation. Access to global markets facilitates technology transfer and knowledge diffusion, which is badly needed to promote innovation and foster economic growth. Initiatives to close the digital divide require

the building of an ICT infrastructure and providing Internet connectivity to ensure access to global knowledge and information. Governments may facilitate the use of digital technologies by reducing the impact of such forces such as digital illiteracy, a lack of financial resources, poverty, the age gap, the educational gap, and gender on the country's ability to join the information age. State support for digital services must ensure that access to the Internet is provided across the nation without exclusion. In other words, building digital networks for use by all, including the poor, women and the disabled, provides people across national boundaries with new opportunities to participate in decision making and allows them to contribute to the natural environment. Digital technologies improve public awareness surrounding environmental protection and increase support for future sustainability.

Digital technologies provide access to knowledge and information for people living in far off places and in isolated areas. Governments, particularly in developing countries, can make use of digital technologies to connect people in different geographical areas and provide them with educational and environmental services in order to build local capacity for sustainable development. Providing services through digital technologies could help governments save a substantial amount of money by reducing the cost of delivery and boosting productivity in various geographical regions. Poor regions stand to benefit from such services by acquiring new knowledge and being exposed to new technologies for regional development.

Building an efficient ICT infrastructure will make it attractive for both local and foreign investors to take advantage of the new opportunities and set up new operations; this will stimulate linkages, create jobs, increase the participation of women, promote innovation and increase productivity. Greater access to resources will also provide incentives to the young and small and medium enterprises. This will mean that they may compete in both local and global markets. In countries where jobs are scarce, self-employment could increase market activities because new businesses would be created. To this end, providing new knowledge and information surrounding the use of digital technology allows users to make better choices and enables them to select environmentally friendly technologies more suitable to the environment (Al-Roubaie and Al-Zayer, 2007).

In countries suffering from low economic growth, high population growth and scarce natural resources, connectivity could empower people and offer new knowledge and creative ideas that support innovation and foster productivity. ICT enables decision makers to gather information and acquire knowledge to build strategies that strengthen future sustainability. Access to global markets facilitates the transfer of knowledge and technology diffusion, especially in developing countries where local knowledge concerning the environment is inadequate. As pointed out by the International Telecommunication Union:

“Bridging the digital divide requires focus to be given not just to access but also to accessibility, affordability and use of ICTs in all countries and regions

and by all people, female and male, and including marginal and vulnerable populations such as children and older people, indigenous peoples, persons with disabilities, and those on lower incomes” (ITU, 2015, p. 12).

The new information age, driven by the Internet, will have a substantial impact on human communication and regional and national connectivity worldwide. Connecting people facilitates human understanding and brings the threat of unsustainable challenges facing our planet to people across the political boundaries. This will put pressure on decision makers at both national and international levels to take action and support the natural environment. Greater connectivity encourages knowledge sharing and information dissemination among and within nations towards finding common solutions for human survival. Individuals in isolated regions can acquire and communicate knowledge and information in response to some of the challenges facing their own communities and support future sustainability. Scientific knowledge is a global good that can easily be transferred for use in regions that lack adequate environmental knowledge. In this regard, governments should facilitate access to knowledge by building ICT capacity; this will increase public participation and take advantage of the information revolution.

For many developing countries, connectivity is still limited to a few, mainly to those who can afford to pay for Internet usage. However, it is important that access to the Internet be inclusive to avoid the risk of people being excluded. Exclusion hinders the ability of some individuals and groups in society to access external resources for sustainable development. Under such circumstances, the state should ensure that Internet connection is affordable to all, including the poor, women and other underprivileged groups in society. The digital divide is measured by the “differences in the quality of available networks as well as basic connectivity” (ITU, 2015, p. 3).

The ICT Development Index (IDI) measures developments in Information technology among countries. It comprises 11 indicators representing ICT readiness, ICT use and ICT capabilities. These indicators are aimed at empowering a country to make use of ICT in order to foster innovation and sustain development. The IDI index is also used to measure the digital divide among nations, their ICT readiness to close the digital gap and support development. As Table 2 shows, the index ranks countries according to both regional and global use of ICT. Globally, most countries, particularly in Africa, are yet to make effective use of ICT to increase connectivity and benefit from global access. As powerful enablers, ICT promotes development through the use of natural resources in a sustainable manner to support the quality of life.

In regions such as Africa, digital technologies can have a positive impact on economic development through their contribution to economic growth, job creation, productivity improvement, poverty reduction and environmental management. Transforming Africa into a digital economy will require improvements in ICT infrastructure to increase connection and provide digital services. Governments in the region should integrate their ICT strategy into the national development agenda, and formulate na-

tional digital policies and strategies to speed up the process of digitalisation across and within regions and sectors. Initiatives should focus on digital literacy by providing inclusive educational services to all. Empowering society with digital services speeds up the process of economic change and increases the prospects for future sustainability.

Digital technologies improve public services via a wider coverage and faster delivery of government services across regional and national boundaries. Using digital technologies provides governments with more choices in making decisions and selecting programmes aimed at strengthening the national objectives and improving living standards for all. Setting targets to meet the challenges facing society imply that government policies will be directed towards solving urgent structural problems and reducing imbalances within the socio-economic system.

Well-structured ICT services could be less costly for poorer countries by providing digital services across sectors without having to build costly physical infrastructures.

Table 2 ICT Development Index (IDI), Selected Countries 2017

<i>Country</i>	<i>Regional rank</i>	<i>Global rank</i>	<i>IDI</i>
Bahrain	1	31	7.60
UAE	3	40	7.21
Saudi Arabia	4	54	6.67
Jordan	7	70	6.00
Egypt	12	103	4.63
Sudan	16	145	2.55
South Korea	1	2	8.85
Japan	3	10	8.43
Malaysia	9	62	6.38
Indonesia	19	111	4.33
India	25	134	3.03
Denmark	3	4	8.71
France	10	15	8.24
Turkey	37	67	6.08
United States	1	16	8.18
Brazil	10	66	6.12
South Africa	3	92	4.96
Nigeria	15	143	2.60
Mali	22	155	2.16
Chad	36	174	1.27

Source: International Communication Union, Measuring the Information Society Report, Volume 1, 2017 (Geneva, ICU)

In other words, digital technologies will have a positive impact on future sustainability by enlarging inclusive government services representing all individuals. In the case of the Middle East region, for example, it is expected that the digital market will add \$95 billion per year to the GDP of the Middle East by 2020. However, the digital contribution to the GDP in the Middle East is just 50% of that of the United States (Elmasry et al., 2016).

Education, knowledge and information are important inputs in the alleviation of poverty and to foster economic growth. Not having adequate knowledge and information weakens the participation of people in creative activities and their contribution to development. An effective programme to reduce poverty should engage the poor in market activities by providing them with access to financial, technical and digital resources in order to encourage entrepreneurship and stimulate linkages. For example, providing basic educational services through ICT technologies, will help the poor to acquire skills and knowledge about markets both locally and internationally, i.e. basic knowledge of marketing, management, prices, demand and supply will increase business success and open new opportunities, especially for local enterprises. Similarly, computer literacy becomes essential for connectivity and communication across sectors and regions in society. To this end, providing equal opportunities to all will encourage the poor, women and those with disabilities to take part in business activities. In turn, this will improve their economic well-being and support the community. The initiative to participate in the economy enhances competitiveness and encourages people to be innovative and develop new products.

THE DIGITAL ECONOMY

In the Digital economy (driven by ICT technologies), innovation, knowledge creation, technology diffusion and information play an important role in promoting social and economic change and sustaining development. Innovation stimulates linkages and increases economic diversification; this reduces an economy's dependence on the production and export of a limited number of commodities. Using digital technologies will benefit individuals, enterprises and institutions to get connected to bigger markets where they can share knowledge and expertise in order to create new products and develop new techniques more suitable for the local environment. Learning from the experience of others empowers local populations to manage resources in a productive and protective manner that results in less pollution and reduces the risk of environmental degradation. The digital economy can also be described as an open economy where ICT facilitates an ever greater flexibility in both labour and product markets. Furthermore, integration into the global market and improvements in competitiveness will help domestic producers gain a comparative advantage over other competitors.

Improvement in productivity helps the economy create new jobs, lower production costs, alleviate poverty, and reduce inequality, mainly in developing countries, where some of these features are still common. Digital technologies improve productivity and increase product quality, encouraging firms to increase production and sales in larger markets. For example, in developing countries, labour productivity, measured by dollar value added per worker, increased by 65% in firms using ICT compared to firms without ICT. Similarly, users of ICT increased their sales by 750% and their profitability by 113% compared to non-users (World Bank Group, 2015, Table 3.1, p. 16).

ICT has made it possible for countries to select appropriate technologies and obtain knowledge more applicable to the domestic environment. Being an open economy, the digital economy provides greater incentives for people who wish to engage in business activities and take advantage of the new opportunities offered by digitisation. The inclusive nature of the digital economy fosters economic growth and broadens market activities through the creation of linkages, employment, investment and innovation. Global linkages also facilitate technology transfer and knowledge acquisition, which can be used to strengthen economic fundamentals and promote sustainable development.

Investment in science, technology and innovation will increase a society's capacity to generate productivity and sustain development. Governments should encourage scientific research by providing greater incentives for universities and research institutions to conduct research and contribute to the development of knowledge. Joint research programmes with private enterprises, and partnerships with foreign research institutions may provide solutions to some of the environmental, social, and economic challenges facing many countries.

Educational reforms that support such research undertakings become necessary in order to build digital capacity for sustainable development. Future sustainability will be influenced by a country's ability to produce knowledge and promote innovation. Education improves labour market flexibility by providing workers with the skills required to keep pace with changes in technology and market demand for knowledge workers. Inclusive public education ensures a greater economic potential because of its coverage to all individuals in society. Education also increases public knowledge and information concerning the environment, and this in turn increases public support with regards to protecting the environment.

Poverty, inequality, hunger, and gender are among the important megatrends common to many developing countries. Finding solutions to these megatrends will influence the ability of many nations to improve environmental protection and support future sustainability. In developing countries, several groups including the poor, women, farmers and urban dwellers, are excluded from market activities and are left on their own to manage their daily survival. According to the World Bank:

“Lack of assets and lack of an effective voice for large segments of the population block the emergence of competent institutions that can pick up

signals early, balance interests, and commit to implementation of decisions. As a result, policies to avoid wasting of assets, particularly environmental and social assets, are not adopted and implemented. The more people heard, the fewer the assets that are wasted” (World Bank, 2013, p. xxi).

Without equal opportunity and fair access to resources, these people usually resort to cutting down trees, polluting rivers and engaging in illegal activities that can be harmful to the environment. Digital technologies could ease such pressures on the environment by providing people with knowledge and information that will enhance decisions regarding natural resource management and protection of the environment. In addition to the environment, the concept of sustainable development meets the basic needs of a people, including their economic well-being, health, freedom of choice and equal opportunity for all. Achieving these objectives will ensure that a society enforces the rules of justice and fairness by redistributing income in ways that eliminates poverty, reduces illiteracy, establishes equity and enhances public capability to participate in decision making. ICT encourages the use of e-services provided by e-commerce, e-government, e-shopping, social networking, e-health, etc. It also allows a reduction in the use of transportation and reduces energy consumption. In the digital economy, it is expected that the demand for transportation reduce, and this will have a positive impact on dioxin gas emissions especially in big cities and crowded regions.

CONCLUSIONS

Digital technologies facilitate a society’s access to knowledge and information, which in turns empowers individuals, businesses, institutions, and communities. Using e-services, governments can encourage people to reduce their consumption of resources and protect the environment, i.e. digital literacy improves the public’s capability of becoming aware of the value and contribution of knowledge sharing and information dissemination to development.

The Internet has increased connectivity providing information of a significant magnitude to all with little or no cost. Countries lacking in adequate scientific and financial resources for development can acquire knowledge and information by building capacity for digital technologies, and by participating in the digital economy. Having more people who are digitally literate will strengthen a country’s capacity to create new knowledge and promote new innovation.

Science, technology and innovation plays an important role in future sustainability by increasing the productivity of natural resources through the development of new methods and the discovery of new techniques. Scientific applications and research have had a substantial impact on human advancement throughout human history. It has promoted innovation and improved the ability of people to become more pro-

ductive and creative. Technical progress has been largely responsible for the rise of Western economic power and industrial productivity, which gave rise to Western civilisation.

The digital age, driven by ICT services, facilitates access to global trade, finance, knowledge, and information; this can be used to build capacity for sustainable development and improve human ability to manage the environment. In particular, developing countries can benefit from digital services in order to increase the productivity of natural resources that will lead to economic growth and sustainable development. Bridging the gap between the needs of the present generation and the needs of future generations requires building digital capacity to enhance connectivity and encourage innovation. In countries where scientific and financial resources are slow to respond to megatrends raised by globalisation, economic growth and the rapid increase in population, ICTs provide new opportunities to acquire resources produced globally for use locally.

By 2050, the global population is expected to exceed 10 billion, the majority of which will be living in countries with shortages in terms of natural resources that cannot support additional demand. The task of environmental protection is beyond the scientific and technical capabilities of many nations, and therefore, a global strategy for the environment becomes essential in order to minimise the spillover effects of environmental linkages. In other words, nations should invest in science and technology to correct environmental imbalances and foster economic growth. Environmental innovation, particularly in developing countries, should be given top priority so that environmental protection will be assured and people will become empowered to become productive and protect the environment. Digital technologies are important enablers that provide people with equal opportunities to participate in environmental protection and development sustainability.

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