CLOSING THE DIGITAL DIVIDE: A PATH TOWARDS SUSTAINABLE KNOWLEDGE-BASED INCLUSIVE DEVELOPMENT

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ABSTRACT

Purpose: This paper highlights the importance of ICT in closing the digital divide through strengthening a country's ability to obtain information, create knowledge and improve education.

Methodology/approach: The paper examines the digital divide by using published data dealing with the information age. Most developing countries still lag behind in readiness for use of ICT in development. The paper shows how nations can address major developmental challenges to sustain economic growth.

Findings: The paper highlights important issues about the digital gap between developed and developing countries, and the impact of this gap on sustainable development. Integration into the information age is crucial for building capacity for sustainable development. The Internet facilitates access to information, allowing individuals, enterprises and nations to reduce environmental risk and sustain development.

Originality/value: In the information age, access to information plays a key role in improving the socio-economic well-being of nations by fostering economic growth and alleviating poverty. The discussion in the paper adds to the body of knowledge concerning the information society.

Keywords: Digital divide; sustainable development; ICT; knowledge; digital economy; information society

INTRODUCTION

In recent decades, the rise of globalisation and the advancement in Information and Communication Technologies (ICTs) have increased society's ability to acquire and diffuse information across sectors and regions, instantly bringing people in different geographical areas into contact with a view to promoting the exchange of ideas and knowledge-sharing in the common interest. The concept of the 'global village' highlights the role that the Internet is playing in networking and increasing human interactions worldwide. Rapid communication has helped people across boundaries to improve quality of life and enhance welfare. The information economy is linked to knowledge-creation and innovation, providing communities across the world with the information and knowledge needed to promote technological learning and foster economic growth.

The United Nations adopted 17 sustainable development goals to be achieved by 2030, with digital technology playing an important role in the implementation of these goals. Among these goals, zero hunger, no poverty, peace and justice, sustainable cities and communities, quality education, good health and well-being feature prominently. The Internet serves as a conduit, allowing people in different geographical locations to communicate and exchange ideas that address environmental conservation of resources to reduce the risk of depletion and waste. The Internet provides global fora engaging people of different educational backgrounds in constructive discussions about the future of environmental suitability and the survival of the human race. Globalisation has increased linkages, the applications of which are beyond a single country's control. Global cooperation and global participation could provide a better alternative to sustaining development. In such an interconnected world, digital technologies play a key role in bringing people together.

The main objective of this paper is to discuss the importance of digital technologies for sustainable development. Digital technologies could empower people to strengthen the fundamentals for environmental management through sharing information and diffusing innovation. Developing countries are expected to benefit from the information age to meet the challenges facing them at an affordable cost.

THE INFORMATION AGE

The adoption and diffusion of Information and Communication Technologies (ICTs) characterises economies in the information age, also dubbed as the computer age or the digital age. ICTs have revolutionised the way people communicate across national boundaries, exchanging ideas, sharing knowledge, discussing common problems and promoting cooperation and collaboration. Globalisation is offering new opportunities for people located in different geographical areas to engage in a productive and useful exchange aimed at improving human development, promoting innovation, reducing

poverty and strengthening the fundamentals for sustainable development.

In the information age, a wide-range of individuals, groups, policy makers, researchers and business people, among others, connected to the Internet have access to information, knowledge and ideas at their fingertips. This information is required for use in policy-construction and decision-making in the public and private sectors. Enhancing business competiveness and reducing costs, the availability of such information encourages enterprises, individuals and institutions alike to build capacity and diversify the economic structure. ICTs have revolutionised the way people communicate and do business at both the local and global levels. Wikipedia defines the information society as a "society where the creation, distribution, use, integration and manipulation of information is a significant economic, political, and cultural activity. Its main drivers are digital and information and communication technologies, which have resulted in an information explosion and are profoundly changing all aspects of social organization, including the economy".

Closing the digital divide is necessary to take advantage of globalisation and sustain development. The invention of the computer and the emergence of networking have increased human interactions among and within nations. In the new society, people in remote locations possess the potential to be connected with rest of the world as a means to elicit solutions to transcend common problems and to engage in knowledge-sharing for the advancement of human understanding. ICTs that integrate the Internet, email, computers and networks overcome distance by linking knowledge seekers to knowledge providers across the globe.

Cloud computing has made it possible to gather and store a vast amount of data and information with a view to converting them into knowledge used by businesses for solving problems. Facebook, Microsoft, Amazon, and Dropbox collectively boast in the order of 550 petabytes[1] of storage capacity. Prior to cloud computing, much of the bandwidth of the Internet was frittered into non-productive uses (90% or 18 terabytes/second being consumed by video-streaming, file-lockers and spamming)[2], reducing the potential of ICTs as mechanisms of knowledge exchange.

The codification of knowledge has facilitated knowledge transfer using ICT as a powerful tool for the dissemination of knowledge across national borders. Developing countries should take advantage of the information age by building digital infrastructures to strengthen the fundamentals for development. Digital technologies provide global access to knowledge and information that these countries either do not have or cannot afford to produce. Inclusive development involves communicating information, knowledge

1 A petabyte is a unit of information equal to one thousand million million (1015) or, strictly, 250 bytes.

2 Estimated by data provided in "How Big is the Cloud" (23 May 2012) at http://www.extremetech.com/computing/129183-how-big-is-the-cloud (accessed on 11 November 2016

and exchange ideas to facilitate policy construction and strengthen project implementation across national boundaries. Digital networks would enhance communication by allowing people to share knowledge and discuss matters of common interest in different geographical areas. Networking enhances people's capabilities to become more innovative, creative and productive, producing goods and services that add value to the national economy. Table 1 provides information about Internet users in different regions around the world. For example, Africa, accounting for 16.2% of the world's population, has the lowest number of users of the Internet, whereas North America has the highest. Developing countries must initiate projects to build ICT infrastructures to increase access to the Internet and close the digital divide (see Al-Roubaie and Al Zayer, 2007).

Table 1: World Internet Users and 2016 Population Statistics

Region	*Population*	*Population % of World*	*Internet users*	*Penetration % of population*	*Growth 2000-2016*	*Users % of table*
Africa	1,185,529,578	16.2	340,783,342	28.7	7,448.8	9.4
Asia	4,052,652,889	55.2	1,801,512,654	44.5	1,476.1	49.6
Europe	832,073,224	11.3	614,979,903	73.9	485.2	16.9
L. America	626,054,392	8.5	384,751,302	61.5	2,029.4	10.7
Middle East	246,700,900	3.4	141,489,765	57.4	4,207.4	3.9
N. America	359,492,293	4.9	320,067,193	89.0	196.1	8.8
Oceania/Aust.	37,590,820	0.5	27,540,654	73.3	261.4	0.8
World total	7,340,094,096	100.0	3,631,124,813	49.5	905.9	100.0

Source: Internet World Penetration Rates, 2016 (See Internet World Stats http://www.internetworldstats.com/stats.htm)

In this regard, knowledge has become a key driver in business activities and in competitive advantage. In this age of information, knowledge is regarded as an input in production and, therefore, the term knowledge economy is used synonymously with information age. In the knowledge economy, technology represents an integral element of knowledge creation and diffusion. As a powerful tool, ICTs facilitate

> "large scale data capture and gathering, transforming this data into pertinent information and relevant knowledge as well as the ability to extract and then apply appropriate and germane knowledge to a particular context in timely fashion" (Wickramasinghe, 2007, p. 4).

An important feature of knowledge is sustainability. Unlike capital, which depreciates overtime, knowledge appreciates, allowing users to move to a new level of creativity, productivity and innovation. Nations that use knowledge are sustainable because of the

continuous high returns produced by the new knowledge and the dynamism that keeps the economy generating knowledge. In other words, knowledge will have unlimited potential to produce economic activities and sustain growth. Such tendency, however, could help developing countries to accelerate the rate of economic growth by investing in strengthening the fundamentals for producing, diffusing and absorbing knowledge. In this regard, knowledge will create new wealth by using brain power instead of using physical and natural resources.

Over the last 200 years' history of human advancement, the invention of the telephone, radio, television and the computer have increased human interactions, allowing people in different geographical areas to exchange ideas and obtain knowledge for development. In recent decades, the Internet has been able to create a network of networks that, through computers, enabled people to communicate worldwide, as well as helping governments to deliver public services in an efficient and fast manner. Currently, millions of people across the world use the Internet as a mass medium in both local and global communications. The Internet transformed societies into one 'global village', allowing rapid communication among and within regions and nations. Individuals, business people, policy makers and other key players are provided with open fora to discuss a wide range of issues, as well as to undertake collaborative work of common interest. Using digital technologies facilitates such communication and strengthens networking among policy makers and international institutions to deal more effectively with such global challenges impinging on the environment, poverty, immigration, trade, finance, terrorism and international peace. Achieving the closure of the digital divide is essential in order for developing countries to benefit fully from the information age.

Developing countries must act quickly and close the digital gap to increase communication and gain access to external knowledge for supporting development. Encouraging signs indicate that developing countries (although not the least developed countries) have been making modest strides in connectivity over the 15 year period 2000-2015: 2 billion of the 3.2 billion users of the Internet came from developing countries in 2015 (up from 100 million of 400 million total users in 2000). Notwithstanding, 4 billion people in the developing world still remain off-line. There were 7 billion mobile subscriptions in 2015 (up from 738 million in 2000), representing a 97% penetration rate. In 2015, 3G coverage in urban areas stood at 89%, but in rural areas trails at 29%. Inasmuch as rural areas predominate in developing countries, this is evidence of a perpetuating digital divide. Mobile broadband slightly trails mobile subscriptions in penetration in both developed and developing countries. However, in terms of mobile broadband speed, developing countries continue to lag significantly behind developed countries. In the least developed countries, out of a total population of 960,000,000, only 89,000,000 are Internet users, making a penetration rate of just 9.5% (ICT Facts and Figures, 2015).

The challenges facing many countries today is to build capacity that strengthens connection and join the information age. Developing countries, in particular the least developed countries, still trail behind industrialised countries in their linkages to global markets. Knowledge and information are common goods that can be obtained through the Internet at an affordable cost. With the use of digital technologies, leveraging knowledge acquisition and technology diffusion, external markets could become an important source of revenue for higher value added goods exported by developing countries (rather than relying on commodity exports).

Developing countries lack adequate scientific and technical knowledge to support development and accelerate the process of economic growth. However, in the digital age, developing countries can make use of the global markets to expand trade, acquire finance and obtain knowledge and information to build capacity for development. Networking and digital technologies facilitate connectivity to international markets, providing countries with a wide range of options to choice from. The selection of appropriate knowledge and technologies will strengthen the localisation of knowledge to promote innovation and sustain development. Indigenous development enables solutions applicable to the local environment in order to ensure sustainable growth and reduce the risk of rapid depletion of resources. Multinational corporations provide technical and financial support to developing countries, which can be used to enhance local initiatives in building capacity for development.

At the national level, information increases society's ability to meet some of the immediate challenges; these include poverty reduction, environmental degradation, climate change, allocation of resources and global competitiveness. Advancements in ICT have paved the way for countries to increase global integration and acquire knowledge for development. Knowledge increases people's capabilities to make sound decisions and formulate effective strategies to manage resources and reduce the risk of failure.

Unlike capital, knowledge travels fast and countries can have equal access to it by building a digital infrastructure driven by efficient and affordable Internet access. In this respect, the ICT facilitates integration into the global economy, providing developing countries with the opportunity to acquire knowledge and diffuse technology. In the knowledge age, change occurs rapidly; workers need to develop new skills and continuously upgrade their knowledge in order to adapt to the new environment. This makes the skills required for the knowledge economy different from the traditional economy. UNESCO identifies the kind of skills needed in the 21st century to include (i) learning to do, (ii) learning to be (iii) learning to relate, and (iv) learning to learn (UNESCO, 1996).

DIGITAL ECONOMY

The digital economy, also known as the Internet economy, information economy, new economy and web economy, is an economy driven by information and communication technologies in which digital computing technologies are represented as its main features. In the digital economy, computer networks, together with communication technologies, have increased human interactions to the extent of making information instantly available for users. As long as people are connected to the Internet they will be able to communicate and access information and knowledge that were not available to them before, notwithstanding long distances, border crossings, government regulations, weather conditions and financial means. By doing so, individuals, policy makers and global players will be able to interact and exchange views, ideas, information and knowledge of common interest. Local communities, especially in developing countries, will be connected to external sources to acquire information for building capacity for education, health, skills, capital, science, technology, and innovation.

Digital networking facilitates the transfer of knowledge and dissemination of information needed for building capacity for development. In other words, access to external information enhances the capabilities of the developing countries to promote innovation, increase competitiveness and encourage new businesses to take advantage of the digital networks and start new businesses. To support such an economy, governments should take the initiative and build an ICT infrastructure to ensure connectivity and obtain access to external sources. It is estimated that by 2020, 15% of households worldwide should have access to the Internet. In developing countries, 50% should have access to the Internet whereas in the least developed countries, 15% of households are expected to obtain the Internet (ITU, 2015).

The rise of the digital age, driven by digital facilities such as cloud computing, smart grids and social media, is changing the way people do business. It is also providing greater incentives for new entrepreneurs to take advantage of the digital networks to expand market activities. Deepening integration into the global markets will enable countries to acquire knowledge and information for strengthening knowledge localisation and encouraging innovation. Currently 3 billion people are digitally connected to a rapidly changing world, rendering those unable to join the digital economy left behind.

The digital economy offers new opportunities for countries to generate wealth and create new job opportunities for young people. In high income countries, where digital networks and the Internet are widely used, the digital economy contributes about 10% to their total output. For instance, in the United States the development of mobile applications has been responsible for the creation of 500,000 new jobs, whereas in the European Union it is estimated that 1.5 million jobs will be created because of the new digital technologies in the coming two years. In G-20 economies, the digital economy

will reach €3.2 trillion. In addition, over 75% of the value added created by the Internet is in traditional industries, due to higher productivity gains (see European Commission, 2017).

ICTs allow countries to increase productivity and diversify their economic structure. An important feature of the digital economy is the potential to create linkages and promote innovation. Broadening the information base enhances the ability of individuals, institutions and organisations to become productive and innovative. Acquiring knowledge, technological learning and sharing information provides solutions to some of the important challenges facing developing countries. The new economy is an open economy driven by greater participation of both local and foreign enterprises. Developing countries can take advantage of the new economy to alleviate poverty, strengthen equity, promote development, encourage innovation and deepen integration in the global markets. As pointed out by Sharma (2005), the digital economy is identified by four important features:

1) Digitalisation and intensive use of information and communication technologies (ICT);
2) Codification of knowledge;
3) Transformation of information into commodities; and
4) New ways of organising work and production (Sharma, 2005, p. 3).

The digital economy empowers businesses, individuals and nations to make sound decisions aimed at improving competitiveness and increasing productivity. The digital technology represents a powerful tool in the production, consumption, and distribution of resources that reduce inequality and establish justice. These new technologies will also have substantial impact on energy consumption and pollution by allowing people to do work from home without travelling to another location. Sustainable development entails a substantial reduction in the use of fossil fuel, which represents an important source of gas emissions. In addition, digital technologies facilitate online participation and stimulate collaboration among individuals and groups that share a common interest. They can also serve as a means of promoting democracy and increase participation in the political process.

The Internet could have a profound impact on the way society functions, including the social, political, financial, economic, and environmental features. Digital technology expands people's capacity to promote innovation and diversify productivity. In developing countries, digital technology allows people with inadequate financial support and technical know-how to access wider markets, providing them with knowledge and information that can be used to improve their capabilities. ICT is a powerful enabler for enhancing human development and improving people's lives. Knowledge and information are public goods obtained through Internet access to geographical locations far beyond the local community. Rural populations, women, poor people and unprivileged groups

are among those who can use the Internet to acquire knowledge, skills and technology to create linkages and stimulate growth.

THE DIGITAL DIVIDE

The digital divided 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)". Inequalities exist in different forms within countries, including adequate ICT readiness, ICT literacy, access to the Internet and poverty. The divide among countries is called the 'global digital divide', which is measured by ICT readiness among different countries. In developing countries, individuals and groups are not able to get connected because of geographical isolation, gender, low income, government bans, computer illiteracy and an inadequate infrastructure. The digital divide weakens society's ability to foster economic growth and promote innovation. In this age of information, ICT is a powerful tool for knowledge creation and technology diffusion, which are essential for sustaining development.

> "Digital technologies have dramatically expanded the information base, lowered information costs, and created information goods. This has facilitated searching, matching, and sharing of information and contributed to greater organisation and collaboration among economic agents—influencing how firms operate, people seek opportunities, and citizens interact with their governments." (World Bank, 2016, p. 8)

"Digital divide" is the term used to describe the gap between countries that have access to ICT (telephones, computers, Internet access) and related services, and those that do not (see United Nations, 2005a).

Figure 1 shows the digital divide measured by the percentage of individuals using the Internet in 2016 in different regions around the world and among nations. As the figure illustrates, only 25.1% of individuals in Africa use the Internet, the lowest among all the world's regions. In the Arab world, the number of individuals using the Internet is second to Africa, accounting for 41.6% of the population. On the other hand, in developed countries, Internet users are double those in developing countries, reflecting the wide divide between and among world regions.

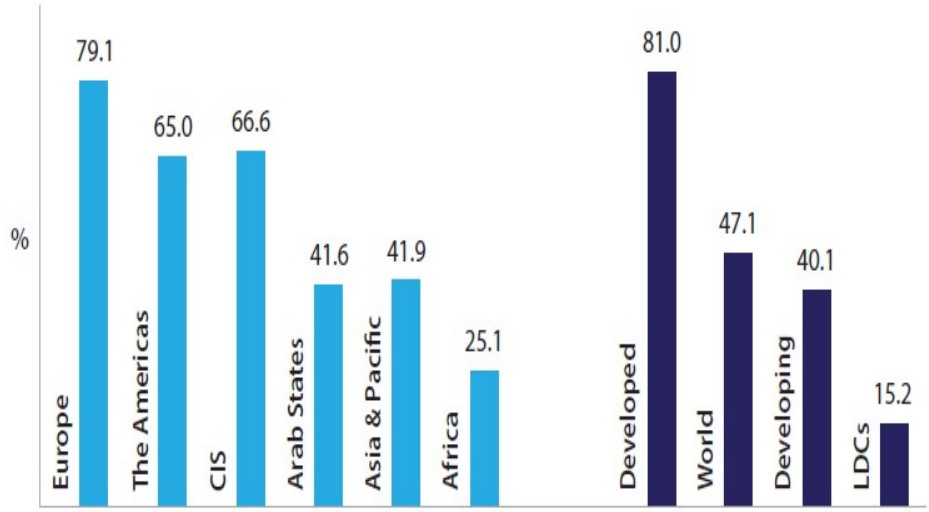

Figure 1: The Digital Divide: Percentage of individuals using the Internet, 2016
Source: ICT Facts and Figures, 2016

The term digital divide refers to those who have access to the Internet compared to those who have not. Not having access is regarded as an economic disadvantage for not being able to catch up with the rest of the world. The Internet provides services linking people at different geographical locations to discuss issues and debate matters of common interest. Such interactions facilitate knowledge sharing and diffuse technological learning that increases a nation's ability to innovate and create new knowledge. Bridging the digital divide increases a country's economic potential to improve human development, alleviate poverty, improve social mobility, provide equal opportunity, ensure political stability and reduce the risk of environmental degradation.

An inadequate ICT infrastructure, low quality of education, inefficient institutions and lack of training facilities are among the important challenges facing developing countries to close the digital divide. In addition, low income per capita makes access to the Internet unaffordable for large numbers of people in society, especially the poor. In other words, 'digital equity' does not provide equal opportunity to people to participate in the digital economy. In some countries, electricity is not available for people to own computers and become connected with the outside world. In recent years, however, wireless technology could ease the situation by providing connections, especially for people in isolated areas.

Among other things, education represents an important beneficiary of digital technologies. People living in rural areas can access education and training in businesses to improve local markets and support the domestic economy. It is estimated that in low income countries, 9.5% of the total population has access to the Internet compared to

81% in high income countries. In the Middle East and North Africa, the population with an Internet connection accounts for 43.7% compared to 22.4% in sub-Saharan Africa. In 2015, only 4.8% of households in low income countries had computers compared with 83.2% in high income countries, 49.8% in the Middle East and North Africa, and 44.9% worldwide (World Bank, 2015). According to the Digital Access Index (DAI), on a scale of 0 to 1, the highest access, Sweden is ranked the highest with 0.85 followed by Denmark with 0.83, South Korea with 0.82, the United States with 0.78, Singapore with 0.75, Bahrain with 0.60, UAE with 0.64, Saudi Arabia with 0.44, Indonesia with 0.34, Sudan with 0.13, Nigeria with 0.15 and in Niger with 0.04. Table 2 provides detailed information about the use of the Internet in the Middle East, reflecting the growth in digital technologies that the region has witnessed during the past few years.

Similarly, digital technologies allow women and people with disabilities to participate in the economy and earn income to support their families. Using digital technologies increased the effectiveness of government services to the public, including those living in rural areas. Governments in developing countries should realise the benefit of digital technologies and build ICT capacity to strengthen connections and close the digital divide. Investment in people's education and training becomes essential for promoting digital technologies and fostering change. During the last decades, the number of Internet users has increased from 1 billion in 2005 to 3.2 billion at the end of 2015, reflecting the depth of global connection and human interactions. "Digital technologies can make routine, transaction-intensive tasks dramatically cheaper, faster and more convenient" (World Bank, 2016, p. 4).

Table 2: Middle East Internet Users, Population and Facebook Statistis 2016

MIDDLE EAST	Population (2016 Est.)	Users, in Dec/2000	Internet Usage 30-Jun-2016	% Population (Penetration)	Internet % users	Facebook 30-Jun-2016
Bahrain	1,378,904	40,000	**1,278,752**	92.7 %	0.9 %	800,000
Iran	82,801,633	250,000	**56,700,000**	68.5 %	40.1 %	17,200,000
Iraq	37,547,686	12,500	**14,000,000**	37.3 %	9.9 %	14,000,000
Israel	8,174,527	1,270,000	**5,941,174**	72.7 %	4.2 %	4,900,000
Jordan	7,747,800	127,300	**5,700,000**	73.6 %	4.0 %	4,800,000
Kuwait	4,007,145	150,000	**3,202,110**	79.9 %	2.3 %	2,300,000
Lebanon	5,988,153	300,000	**4,545,007**	75.9 %	3.2 %	3,100,000
Oman	4,654,471	90,000	**3,310,260**	71.1 %	2.3 %	1,500,000
Palestine (West Bk.)	2,839,777	35,000	**3,007,869**	63.2 %	2.1 %	1,700,000
Qatar	2,258,283	30,000	**2,200,000**	97.4 %	1.6 %	2,200,000
Saudi Arabia	32,157,974	200,000	**20,813,695**	64.7 %	14.7 %	14,000,000
Syria	18,563,595	30,000	**5,502,250**	29.6 %	3.9 %	n/a
United Arab Emirates	9,266,971	735,000	**8,515,420**	91.9 %	6.0 %	7,700,000
Yemen	27,392,779	15,000	**6,773,228**	24.7 %	4.8 %	1,800,000
Gaza Strip	1,921,202	see Palestina	see Palestina	n/a	n/a	see Palestina
TOTAL Middle East	**246,700,900**	**3,284,800**	**141,489,765**	**57.4 %**	**100.0 %**	**76,000,000**

Source: Internet World Stats (http://www.internetworldstats.com/stats5.htm0

To facilitate participation and take advantage of the new technologies, developing countries should provide easy and affordable access to the Internet. This would increase connectivity and provide new opportunities for people to improve living standards and contribute to the national economy. Connectivity encourages people to increase trade, share knowledge and improve competitiveness. In other words, the Internet makes people more productive by participating in market activities at both the local and global level. For poor countries, the Internet reduces costs, particularly for people searching for new opportunities for work, start businesses, obtain finance and seek knowledge.

It is important to point out that connectivity alone should not be considered as the only feature to describe the digital divide. According to UNESCO, there are several other factors that contribute to the digital divide. These include:

1) economic factors measured by the high cost to individuals for acquiring computers;

2) language, which represents a major obstacle to the participation of all knowledge societies;

3) education and social cultural background;

4) gender inequalities;

5) geography;

6) disabilities; and

7) employment, where in some countries Internet access is limited to those who work (UNESCO, 2005).

Digital equity will require the establishment of a system that provides equal opportunity to access the Internet without exclusion.

Inclusive sustainable development must involve consumers, producers, regions, institutions, policy makers and multinational firms working in the country. Poor countries need to build affordable Internet capacity to ensure accessibility for people across the country without exclusion. Wireless technologies are offering developing countries a formidable tool for narrowing the digital divide and reducing the risk of exclusion. However, the information society should not be in conflict with indigenous knowledge of traditional societies. As pointed out by UNESCO,

> "The simple substitutions of scientific knowledge for local knowledge would have disastrous consequences for humanity, and in particular for developing countries, since scientific production does not suffice to protect certain kinds of vital knowledge" (UNESCO, 2005, p. 148).

Closing the Digital Divide

The term digital divide measures the gap between those who have access to computer technologies and the Internet and those who do not. The new technologies provide access to knowledge and information not available for users in different locations. For developing countries access to such information is vital for promoting innovation and sustaining development. ICTs are powerful tools, empowering users with information to make decisions and formulate effective strategies for development.

At the national level, ICTs offer new opportunities for economic growth by increasing choices of individuals, organisations and nations to select priorities and improve productivity. In this age of globalisation, enterprise success will depend on the ability to enter the market place learning about prices, production, supply, marketing finance and competition. In poor countries, the greatest challenge facing people is access to resources to improve their economic well-being. Inequalities, corruption and a weak infrastructure put many people at a disadvantage, unable to participate in the market place. Digital technologies bring new opportunities to the poor, those with special needs, women and underprivileged groups in society, providing them with access to information they need to make decisions and enter the market place. Not having access to resources could weaken the ability of a society to sustain development. It forces people to remain poor, leaving them with no alternative but to destroy resources and degrade the environment.

On the other hand, a high concentration of resources in the hands of a few individuals or groups could lead to excessive use of resources, further leading to a rapid depletion of stocks. An important feature of sustainability lies in the commitment to overcome poverty by providing the poor with the basic needs for survival. At the current level of consumption, the natural environment cannot continue to supply resources to ensure sustainability. In this regard, digital technologies allow societies to manage resources in an efficient manner through knowledge transfer, public awareness, appropriate technology and information dissemination. In 2015, the mobile phone industry contributed more than $3 trillion to the world economy, accounting for about 4.2% of the global GDP.

Building ICT capacity to close the digital divide is vital for expanding communication and gaining access to global knowledge. In this age of globalisation, technological innovation has been linked to the exploitation of global knowledge. Access to technological innovation can be strengthened by collaboration and establishing joint ventures with multinational firms. Priority collaboration with foreign firms should be focused on developing technologies appropriate to the local environment.

Digital technologies are powerful enablers in acquiring foreign knowledge providing cost-effective solutions to the main challenges facing developing countries. Digital technologies foster knowledge-sharing and enhance local capabilities to promote innovation and diversify the economic structure. Unfortunately, academic institutions and research centres in developing countries are not focused on finding solutions to local problems. “One way of creating incentives to work on development needs is to

rethink and endogenize the academic reward system" (United Nations, 2005b, p. 123).

Research should be integrated into national economic policy to ensure that local researchers contribute to development. In this regard, building digital infrastructure and providing affordable access to the Internet will increase a nation's capabilities to strengthen the fundamentals for development. ICT integrates researchers, industry, universities, national institutions and international organisations into the global production system, allowing users to identify, adapt, and diffuse foreign technology for development. It is important that developing countries conduct research to create knowledge, develop new technologies and promote innovation. Sustainable development is a multidimensional concept involving inclusive social, political, financial, economic and environmental factors, featuring the need for the local economy to foster change and promote development. In other words, sustainable development involves informing decision makers and the public about the management of the environment to ensure that the right of the next generations to Earth's resources is protected.

SUSTAINABLE DEVELOPMENT

Sustainable development is concerned with the allocation of society's resources to create a balance between the needs of the present population and future generations. Development promotes equity that ensures the rights of all people to benefit from society's resources. The concept of sustainable development goes beyond the rights of the present generation to recognise meeting the needs of future generations. Foods, shelter, clothing, jobs, health and educational services are vital for human survival. Therefore, not only the needs of the present should be provided, but also the needs of future generations must be secured. The concept of sustainability is rooted in the environmental movement when problems such as population growth, urbanisation, pollution, transportation, resource depletion, and deforestation have increased the call for addressing emerging environmental trends by increasing public awareness, efficient use of physical resources, equity in distribution and global cooperation among various national and international agents. Sustainable development is about the impact of human activities on the environment, which represents the place that people work and conduct their daily activities. Any damage to the environment could be reflected in human health and welfare.

Putting pressure on the environment, i.e. rapid exploitation of natural resources, could subject these resources to depletion over a given period of time. A commonly quoted definition of sustainable development is one presented by Gros Brundtland in the text, Our Common Future:

> "sustainable development requires meeting the basic needs of all and extending to all the opportunity to satisfy their aspirations for a better life …. Sustainable development requires that promotion of values that encourage consumption standards that are within the bounds of the ecologically possible and to which all can reasonably aspire … at a minimum, sustainable development must not endanger the natural systems that support life on earth: the atmosphere, the waters, the soils, and the living beings" (WCED, 1987, pp. 44-45).

This meaning of sustainable development represents a comprehensive assessment of the need for managing the environment to ensure that the Earth's life support systems will continue to provide the necessary means for human survival. Maintaining sustainability, however, will require a balanced approach that integrates human activities into a unified system to manage the environment and reduce the risk of unsustainability. In this regard, both renewable and non-renewable resources should be exploited in an efficient manner to strengthen the fundamentals for human survival.

Environmental management is a complex task that requires multidimensional initiatives comprising economic, political, technical, financial, social, institutional and ethical considerations. Modern digital technologies could facilitate sustainable development by allowing nations to disseminate information and acquire knowledge about the environment. In particular, developing countries are in dire need of digital technologies in order to build adequate capacity for managing the environment. A weak infrastructure, inadequate information, inefficient institutions and lack of awareness about the environment are among the common features characterising the current state of development in developing countries. Digital technologies strengthen environmental management by allowing these countries not only to gain access to local communities, but also to acquire external knowledge and information, i.e. digital technologies make it easier for institutions, individuals, and organisations to make decisions in support of the environment.

Most of countries in Africa, Latin America and Asia lack adequate scientific and technical knowledge about climate change, environmental pollution, green revolution and natural resources' management to deal with environmental risk and natural disasters. In addition, globalisation of production, urbanisation, population growth and rapid exploitation of resources have increased interdependencies among and within regions and nations. Such tendencies have increased cross-border activities, causing environmental linkages across geographical boundaries. Under such circumstances, environmental management becomes a global issue that requires greater cooperation from international agents.

The education system needs to be restructured to increase digital literacy and enhance people's capabilities to acquire information, share knowledge, exchange ideas and innovate in the new economy. In other words, ICT policies should be integrated into

sustainable development to ensure information diffusion and knowledge creation that supports the environment. As pointed out by Souter (2010):

> "Unless sustainable development analysis reflects the underlying changes in economy and society that are taking place as a result of ICTs, then it will be concerned with sustainability for the past rather than sustainability for the present and the future." (Souter et al., 2010, p. 27)

Building an ICT infrastructure helps narrow the digital divide and speeds up the process of sustainability. Digital technologies increase cooperation among regional players to share knowledge and information about the environment; this information includes such pressing issues as water management, climate change, resource allocation and human development. ICTs can be utilised to achieve three strategic objectives: (i) inclusive economic growth, (ii) environmentally sustainable growth, and (iii) regional integration. Focus on sustainable development should not be limited to the local environment but should be extended beyond borders regionally and internationally (see Asian Development Bank (ADB), 2014).

Regional integration increases the willingness of countries to cooperate and undertake joint projects aimed at improving environmental management and reducing the risk of cross-border externalities. Within regions, the spillover effects of market activities could improve cooperation among member countries to take action and build capacity for the environment. Digital technologies could strengthen regional policies, allowing countries to gather information, collect data, conduct joint research and act quickly in the case of natural disasters. Keeping countries connected through digital technologies provides an effective monitoring system that ensures environmental sustainability. Exchange information and sharing knowledge about the environment enhances a region's capability to promote innovation and develop new environmentally friendly technology.

Sustainable development entails not only knowledge of the environment drawn on the experience of others, but also public awareness programmes to engage citizens in the process. The Internet promotes innovation and inclusion, helping businesses to acquire knowledge, expand trade and compete in the global markets. In other words, connectivity brings new opportunities to local enterprises to diversify production and create jobs. Significantly, information and knowledge, while vital for sustaining development, enable governments to provide the necessary services for environmental protection. Digital technologies have increased the ability of the government to provide public services and improve welfare. E-services represent effective public administration, efficiently providing a range of services (educational, health, commercial, etc.) to citizen and resident end-users and consumers.

Closing the Digital Divide

To boost connectivity, policies at both the national and global level need to be formulated and designed to enhance Internet access to those in need to improve their economic well-being and support their communities. At the national level, local governments need to adapt to technological change and build strong ICT infrastructures capable of delivering the knowledge and information required to sustain growth to the general public. They will also need to encourage individuals and enterprises to take advantage of the new technologies and promote innovation. Inclusive connectivity must ensure that schools, rural populations, health centres, financial institutions and women are given access to the Internet, as well as encouraging them to participate in the information society.

At the regional and global level, governments should increase linkages, share information, exchange knowledge, undertake joint research, and facilitate networking among government officials and support regional integration. Tourism, migration, pollution, water management, energy, finance, the environment and people-to-people communication represent common challenges, especially for developing countries. Solving these problems will require closing the digital gap by having closer cooperation among regional players.

There is a need for building capacity for joint programmes to manage cross-border movements and enhance national capabilities to strengthen the fundamentals for sustaining development. Nations must realise that ‘ecological interactions do not respect the boundaries of individual ownership and political jurisdiction’ and therefore, protecting the environment is in the common interest of all people (see WCED, 1987, p. 46).

Narrowing the digital divide will increase developing countries’ capacity to innovate and meet the challenges of sustainable development. Digital technologies allow these countries to strengthen knowledge sharing and enhance global cooperation to protect the environment. Environmental protection may require scientific knowledge and technological learning not available to many developing countries. Providing access to scientific and technological facilities becomes possible through networking and knowledge transfer using digital technologies. In addition, digital services can happen instantly, especially at times of natural disasters and human error. Under these circumstances, digital technologies allow sufficient connectivity and Internet access to deal with urgent circumstances as they happen anywhere.

The emergence of the digital economy in recent years has encouraged countries to acquire, absorb and communicate knowledge to foster economic growth and sustain development. Knowledge-based economies entail building a digital infrastructure to increase connectivity and obtain access to global markets. Developing countries can use existing knowledge somewhere else to strengthen the fundamentals for building knowledge capacity. Knowledge as a public good can be easily obtained with an Internet

connection and ICT services. As pointed out by the World Bank, integrating management of the environment with development requires:

> "Managing environmental knowledge by building the capacity to gather and disseminate knowledge, improving private sector environmental management, and broadening public policy models to include environmental variables." (World Bank, 1999, p. 100).

Globalisation of technology represents new opportunities for developing countries to speed up the process of development and build capacity for development. Strengthening the process will depend on these countries' ability to invest in human capital resources, infrastructure for high-tech industries and effective institutions. Also, the fostering of scientific and technological collaboration with global research institutions by enhancing digital networks is essential for building capacity for development.

Digital technologies can speed up the process of development and accelerate growth in developing countries, endowing them with the potential to catch up with the rest of the industrialised world. Countries that are investing in digital technologies will be able to obtain substantial dividends, whereas those that are not will be left behind. Development must ensure equity by providing equal access to resources and a fair distribution of society's wealth to promote equal opportunity. Digital technology is a powerful tool that can broaden the economic base and make development inclusive to compromise all members of society without exclusion. To promote equity, governments must formulate strategy to close the digital divide by building capacity for an affordable, accessible and comprehensive infrastructure to ensure availability for all.

CONCLUSIONS

The main objective of this paper is to shed light on the role that digital technologies play in building capacity for sustainable development. Digital technologies have increased human interdependencies by allowing people to communicate more efficiently, sharing knowledge, ideas and information with others at great distances. Globalisation is providing new opportunities for countries to access global markets and obtain knowledge and information for development. Deepening integration in the global market facilitates technology transfer and strengthens the fundamentals for rapid economic growth. International trade, while an important source of capital goods and technology, also serves to stimulate growth through knowledge acquisition and transfer of know-how and innovation across borders.

In the early stages of their development, developing countries can take advantage of access to global knowledge. Building a sound digital infrastructure encourages local enterprises, students, institutions and young entrepreneurs to make use of the Internet

and computer technology to increase participation in market activities. Networks facilitate communication among key players in different markets to share business information of common interest. In the case of developing countries, the returns on investment in digital technologies could be substantial due to the high cost of knowledge production combined with the weak infrastructure necessary to produce knowledge at home. Initiatives to build digital infrastructures should be given high priority by governments in order to build capacity for narrowing the digital divide.

Sustainable development underscores the importance of environmental management in creating a balance between present and future consumption. Rapid exploitation of resources, especially non-renewable resources, hinders sustainability by causing waste and ultimately depletion of those resources. Thus, the survival of coming generations will depend on the ability of the present generation to manage and develop natural resources to reduce the risk of environmental degradation and sustain human survival.

In developing countries, digital technology strengthens local capabilities to manage the environment inasmuch as networking, education, knowledge transfer, access to relevant information and innovation positively influences environmental policies. ICTs serve as powerful enablers for the effective and efficient use of resources to foster productivity and sustain development. Investment in education, lifelong learning and training will strengthen labour market flexibility and help workers to respond to changes in the labour market. In this respect, building capacity for digital technologies will engender sustainable development.

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