UN environment programme

Sustainable Digitalization and the Triple Planetary Crisis in West Asia

ISBN: 978-92-807-4025-7
Job number: ROWA/2523/BH
doi: https://doi.org/10.59117/20.500.11822/43115

Suggested citation

United Nations Environment Programme (2023). *Sustainable Digitalization and the Triple Planetary Crisis in West Asia.*

ACKNOWLEDGEMENTS

United Nations Environment Programme is grateful to the large number of contributors and reviewers who participated in the production of this report through provision of data, analysis, and comments. Special thanks to contributors and reviewers from various organisations.

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Glossary

- **Artificial intelligence (AI):** Is a field of study bridging computer science and computer engineering, aiming to simulate biological intelligence and create intelligent entities capable of perceiving their environment and making decisions to maximize their chances of achieving the desired goal, given time constraints and restrictions in processing resources, while resisting noise and uncertainty, making decisions based on incomplete, inaccurate, or partially incorrect data (Russel and Norvig 2015). Creating synthetic intelligence comes down to combining and integrating a number of technologies and techniques from different fields, namely:

  - **Knowledge representation:** Many of the tasks that machines are expected to handle require knowledge about their environment and the word they operate in. AI needs to represent objects, categories, actions, events, their properties and relationships. This allows associating the available information with well-defined meaning, to be analysed and processed by machines (Noueihed, Harb and Tekli 2022). This includes machine-readable environment, climate, and weather ontologies, such as ENVO: an expressive semantic graph which helps humans and machines understand environmental entities of all kinds, from microscopic to intergalactic scales (Zacharopoulou et al. 2022).

  - **Machine Learning:** Refers to the science of getting computers to perform tasks without being plainly programmed for those tasks, where they evolve their own behaviours based on empirical and historical data from sensors or data repositories (Mitchell 1997). Machine learning aims to automatically recognize complex patterns and make intelligent decisions by learning from and comparing with previous experiences. Machine learning algorithms are usually classified under unsupervised learning (describing the organization of input data, namely through clustering, with no a priori information on the output) (Tekli 2022) and supervised learning (identifying an output data based on input data, i.e., mapping inputs to desired outputs, including (i) classification to determine what category an object or entity belong to, after analysing multiple samples, and (ii) numerical regression: given a set of scalar input/output samples, trying to produce a function that generates the outputs from the inputs) (Alpaydin 2020). Machine learning can help to lessen the frequency of incidents involving natural catastrophes, global warming, and human impact on the environment, by detecting and recognizing patterns and changes in the data, identifying faults in real-time, and adjusting automated decisions accordingly to ensure that such incidents have minimum effects on the ecosystem and the damage they cause (Davis 2021; Sky News 2021).

  - **Motion and Manipulation:** Refers to motion planning, environment planning, localization, and navigation for robotics and assistive systems and applications (Taylor and Rodriguez 2019) , such as automating the movement of ground robots or drones in remote natural areas to perform air pollution monitoring, gas leakage detection, and power grid failure for instance, prompting quick actions accordingly to minimize damage to the environment.

  - **Natural language processing (NLP):** Understanding and generating human language using techniques from knowledge representation, semantic/statistical analyses, and machine learning, in order to allow human-machine communication and interaction, including information retrieval, text miming, and machine translation (Goldberg 2016).

  - **Perception:** Refers to the usage of machine learning techniques to solve pattern detection and recognition problems, including face recognition, speech recognition, and object recognition (Russel and Norvig 2015) , such as detecting energy emission reductions, CO_2 emissions, air quality monitoring, detecting or predicting wildfires through pattern analysis in satellite imaging, monitoring deforestation, and predicting extreme weather conditions.

Glossary

- **Social intelligence:** Refers to the usage of machine-readable knowledge, machine learning, language processing, and perception to detect and recognize sentiment and emotion patterns in human speech and behaviour, and react accordingly (emotional robots, robotic assistants, chat bots, etc.) (Abboud and Tekli 2020; Fares et al. 2019).

- **General intelligence** consists in combining the various skills above, as different and complementary indicators of biological and human intelligence.

- **Blockchain:** It refers to a type of Digital Ledger Technology (DLT) that consists of a list of records, called blocks that are securely linked together using cryptography. The ledger is immutable in order to secure and simplify the process of storing transactions and tracking resources in a business network (Narayanan et al. 2016). Blockchains are known for their central role in cryptocurrency, such as Bitcoin, for enabling a secure and decentralized record of transactions. Blockchain aims to guarantee the fidelity and security of a transaction or a data record without the need for third-party arbitration or supervision. This is especially important for generating and transmitting environmental data and performing climate monitoring, in order to reinforce climate action while reducing the risks of tampering with the data and affecting climate action accordingly (European Environment Agency 2020).

- **Circular economy:** is an emerging economic model that tackles environmental issues with sustainable solutions. A circular economy consists of a number of solutions and processes that promote sharing, repairing, reusing, refurbishing and recycling of materials (European Parliament 2022) . A circular economy relies on an integration of a number of digital technologies, including Information and Communication Technologies (ICT), Internet of Things (IoT) and Wireless Sensor Network (WSN) infrastructures, combined with Artificial Intelligence (AI) and Machine Learning techniques. Circular economy solutions aim to reduce the usage of disposable objects, and keep materials and resources in effective usage as long as possible, promoting the usage of green and renewable resources (Berg 2022).

- **Digital technologies:** These are electronic tools, devices, systems, and resources that produce, store, or process data and refers to a host of innovative and powerful state of the art technologies like artificial intelligence, computing, analytics, robotics, internet of things, sensing, digital communications, and blockchain (Hess et al. 2016).

- **Digital transformation:** Using digital technologies to produce new business processes or amend existing customer trends, cultures, and experiences to meet fast evolving business and market requirements, essentially making change a core competency as the enterprise becomes consumer-driven (Matt et al. 2015).

- **Digital Twin:** A digital twin is a virtual imitation of an actual process, product, or service occurring in the real world. It accepts as input real-world data about a physical object, entity, or system and generates as outputs predictions or simulations of how that object, entity, or system is affected accordingly (Greengard 2019) . The virtual space is the real reflection of the physical space synchronized through incorporating sensors, simulation platforms, data analytics, and machine learning capabilities. Sensors are installed on real-world objects to determine their properties, parameters, states, and changes over time. Iteratively collected data from physical sensors monitor the object's performance, operating conditions, and potential problems. The physical space and the virtual space are not isolated in a digital twin; smooth connection channels exist between the two spaces, made possible through IoT and WSN architectures (Grieves 2015). This allows analysing and aggregating historical and real-time data from both the physical -and-virtual worlds, providing the necessary simulations for analysis and predictions.

- **Digitalization:** Using digital technologies and data to transform business processes and provide openings for new income and business opportunities, evaluating, re-engineering, and re-imagining the way business is done (Wren 2020).

- **Digitization:** Refers to taking analogue information and converting it into digital data and documents that can be stored, processed, and exchanged by computer systems. The information itself is not changed or optimized: it is simply encoded in digital format (Daigle 2012).

- **E-waste** is the term used to describe waste generated by any discarded electronic and electrical equipment (EEE) such as batteries, solar panels, mobile phones and emerging and rapidly growing issue that transports significant environmental, health, and economic concerns (Sthiannopkaov and Wong 2013) . Among the many components used in the production of EEEs, the majority are plastic, heavy metals, and toxic substances non-biodegradable (MacAllister, Magee & Hale 2014).

Glossary

- **Geographic Information System (GIS):** It is a computer system for capturing, storing, processing, and displaying data related to geographic positions on Earth's surface. It is a type of database combined with a set of software tools for storing, managing, analysing, and visualizing data regarding earth locations and related information and events through their date and time of occurrence, along with longitude, latitude, and elevation coordinates (Longley et al. 2011). A geographic information system is one of the backbones of environment monitoring systems, allowing to store, manage, and retrieve climate, weather, environmental, and pollution spatiotemporal data in an effective and efficient way (Zhu 2016).

- **Information and Communication Technology (ICT):** It refers to the merging of audio-visual and telecommunication networks with computer networks through an integrated digital link system. ICT solutions integrate digital information systems including the necessary software, audio-visual, and communication tools that enable users to access, store, retrieve, manipulate, and exchange information and its associated knowledge in a digital form (Melody et al. 1986).

- **Internet of Things (IoT):** The advance of the mobile Internet (smart phone-based), digital communication (telecommunication systems and wireless networks), computing (grid, cloud), and artificial intelligence technologies, have ushered in the vision of the Internet of Things (IoT) where objects of the real-world, with added digital components (e.g., smart phones, smart cars, robotic systems, etc.) and software agents (applications, scripts) autonomously interact, sustain themselves and evolve in a virtual environment, provided with integrated communication capabilities, common knowledge representations, and addressing schemes (Santucci 2010) .The vision of the IoT entails that any physical object (e.g., car, house, mobile phone) or virtual object (e.g., software, API, social Web profile) will have a unique way of identification, creating a set of "things" able to address, communicate and exchange knowledge and services with each other (Guillemin and Friess 2010) . Also, the growth of storage capacity at lower costs, with enhanced processing capabilities in intelligent mobile terminals (smart phones, tablets, etc.), and continuous connectivity will allow terminals to handle larger volumes of data and knowledge and perform collective information processing. IoT sensing and connectivity provide adequate solutions to perform environmental monitoring, and help support a healthy ecosystem, by allowing sensory data analysis, preventative detection of contaminants, and energy safeguarding, aiming to achieve target environmental milestones like reducing carbon footprint, reducing water pollution, and minimizing wildlife contamination (Chen et al. 2021).

- **Robotics:** It is an interdisciplinary branch of computer science and engineering that involves design, building, operation, and usage of robots (German National Library 2022). Robots are automated or autonomous machines that can replace humans or replicate human behaviour. They can be used in a number of situations for different purposes, including solar-powered monitoring robots, autonomous robots and drones create early warning systems to detect unusual environment indicators or climate patterns, as well as microscopic radio transmitters and radar-reflecting tags that track invasive pests and abolish their colonies (Pell 2021).

- **Smart city:** It refers to a city that integrates Information and Communication Technologies (ICT) with an Internet of Things (IoT) infrastructure and Wireless Sensor Networks (WSNs) to increase functioning efficiency, share information with the community, and advance the quality of governance and citizen welfare (Fourtané 2018). It allows collecting and monitoring data from citizens, devices, smart homes, and smart buildings to be analysed and processed for operations' optimization, allowing for improved city governance.

- **Smart grid:** It is an electrical grid which contains a battery of computing-based operations and energy measures including: advanced metering (smart meters like fibre optic routers), smart distribution boards and circuit breakers, smart distribution boards, circuit breakers, and load control switches integrated with home control and automation, designed for renewable energy integration including the capacity to change electric batteries or other energy storage, as well as utility grade fibre broadband to connect and monitor the above (Hu and Lanzon 2019).

- **Smart home:** It is an IoT system deployed in a household where lighting, heating, and electronic appliances and devices can be controlled remotely via the Internet. In addition to controlling a number of functions remotely (such as managing security access to the house, controlling temperature and lighting parameters, among other appliances), a smart home is also designed to be (fully or partly) autonomous, continuously monitoring the state of the household, taking action and making adjustments according to user preferences (Caccavale 2018).

Glossary

- **Telecommunication** is the broadcast of information by different types of technologies over wire, radio, optical, or other electromagnetic systems (International Telecommunication Union [ITU] Library & Archives 2012). Communications signals can be sent by analogue signals via analogue communication systems, or digital signals via digital communication systems (Ambardar 1999). Analog signals vary continuously with respect to the information, while digital signals encode information as a set of discrete data values (e.g., a set of digits: ones and zeroes) (Ambardar 1999). During propagation and reception, information contained in analogue signals is degraded by noise, while digital signals' resistance to noise represents a key advantage over analogue. Telecommunication systems constitute a founding and indispensable pillar behind the development of Internet of Things (IoT) and Wireless Sensor Network (WSN) architectures.
- **Wireless sensor networks (WSNs):** Refer to networks of sensors spread across a certain geographic area in order to monitor and record its physical conditions. The data can partially process at the sensor level (performing data cleaning, filtering, or de-noising), before forwarding the collected data to a central location for processing. WSNs can measure environmental conditions such as air quality, pollution levels, temperature, humidity, wind, and sound (Ullo and Sinha 2020). Developments in sensor networks, coupled with enhancements in network technologies such as RFID (Radio Frequency Identification), wireless communication technologies, and network addressing schemes, become critical to the Internet of Things (IoT) vision, allowing to reach and connect more objects in the physical and virtual worlds.

LIST OF ABBREVIATIONS

5NR	Fifth National Report
6NR	6th National Report
AI	Artificial Intelligence
AQI	Air Quality Index
AWS	Amazon Web Services
CBD	Convention on Biological Diversity
CBECI	Cambridge Bitcoin Electricity Consumption Index
CO2	Carbon Dioxide
CODES	Coalition for Digital Environmental Sustainability
COP	Conference of the Parties
DAI	Digital Adoption Index
EEE	Electronic and Electrical Equipment
EPR	Extended Producer Responsibility
EWS	Early Warning System
GIS	Geographic Information System
GHG	Greenhouse Gas
HDI	Human Development Index
IoT	Internet of Things
ITU	International Telecommunication Union
NBSAP	National Biodiversity Strategies and Action Plans
NDC	Nationally Determined Contributions
NFT	Nonfungible Tokens
SDGs	Sustainable Development Goals
TWh	Terawatt-hour
UAE	United Arab Emirates
UN	United Nations
UNBL	United Nations Biodiversity Lab
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
WEF	World Economic Forum

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This report is designed to be read on screens. Some pages may not print with a legible font size on a standard A4.

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Foreword

The world is facing insurmountable challenges against the backdrop of the triple planetary crisis. The steps we are currently taking towards achieving the SDGs are insufficient. Systemic reforms to reach all SDGs and planetary boundaries need to be addressed at speed, impact, and scale.

The West Asia Region is no exception to the environmental risks driven by climate change, political conflicts, and human displacement among others. Digital Transformation (DT) can be a key player in encouraging decision making towards more sustainable actions in managing these risks.

In West Asia region, digital technologies are getting more attention and being included in governments' vision and roadmap. From one side, this may be a crucial enabler for many West Asian nations to conduct evidence-based analyses of environmental trends in climate, nature, and pollution and track advancements in achieving the Sustainable Development Goals' objectives and putting multilateral environmental agreements into practice. From the other side, the emergence of digital technologies may lead to the region facing environmental implications such as increased e-waste production, energy consumption, etc.

In order to shed light on this emerging issue, we are happy to introduce the regional report on "Sustainable Digitalization and the Triple Planetary Crisis in West Asia". This report which is the first of its kind at the regional level, seeks to "help policymakers to better understand the available basic digital infrastructure, and its potential positive and negative impacts on the environment at the regional level".

UNEP hopes that you will find this report on "Sustainable Digitalization and the Triple Planetary Crisis in West Asia" a good stocktaking that could provide decision makers with a forward-looking perspective to address this environmental emerging issue using environment friendly practices and best available technologies before it is too late.

Sami Dimassi
UNEP Representative
Regional Director for West Asia

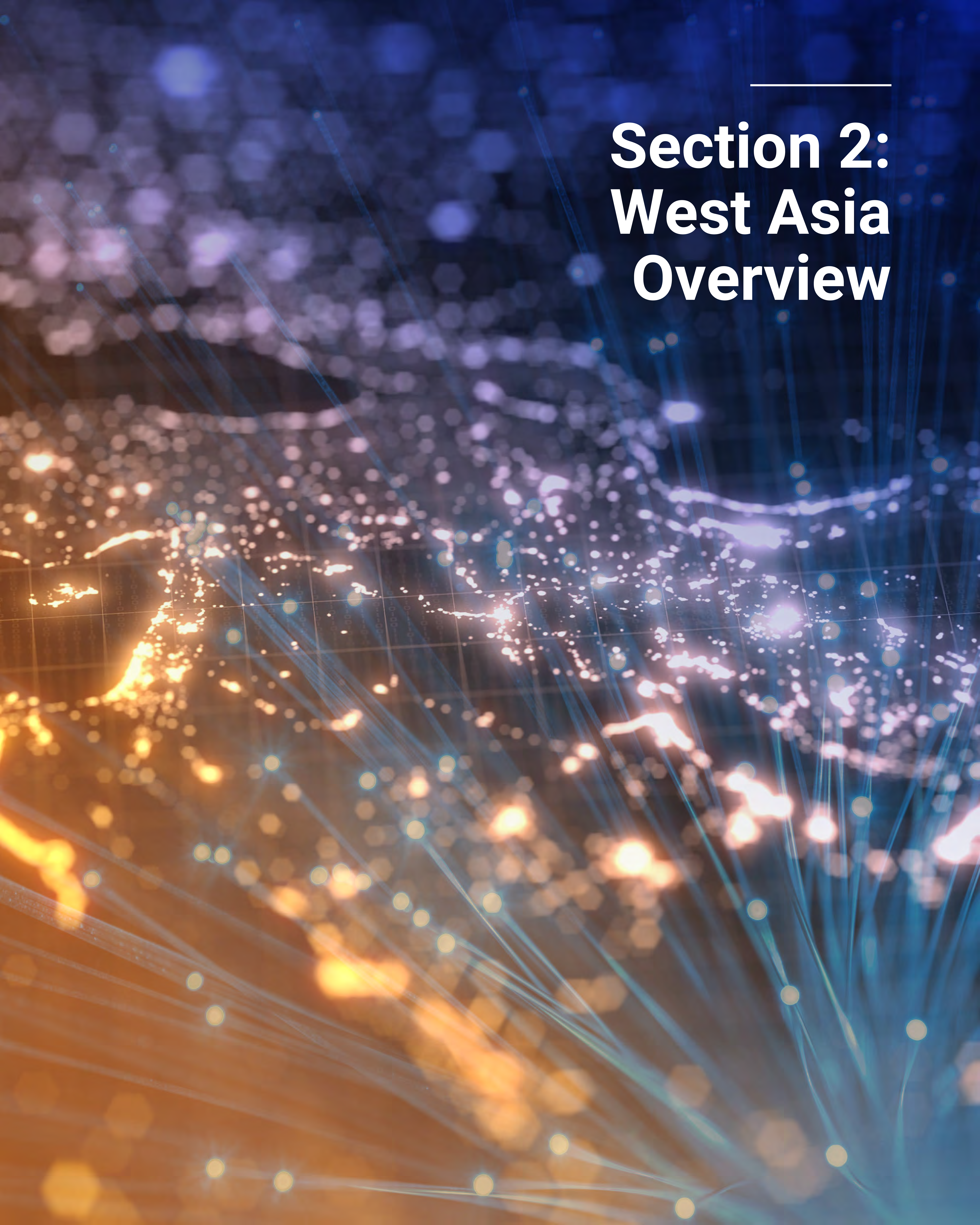
SECTION 1: INTRODUCTION

There are three key environmental crises that are uniquely challenging for the West Asia region, these are the climate change crisis, the pollution, and waste crisis, and the biodiversity loss crisis (United Nations Environment Programme [UNEP] 2020). As home to a significant concentration of the world's oil and gas production, many West Asian countries have built their economies and development plans based on these resources (Al-Hemoud et al. 2019). This has also left an unsustainable legacy where the overexploitation of natural resources induces environmental degradation, pollution, water insecurity, and food insecurity (D Atoufi and Lampert 2020).

Digitalization will be crucial to addressing these crises and in achieving the SDGs by 2030. It is estimated that achievement of 70 percent of the SDG targets can be accelerated through digital technologies (Coalition for Digital Environmental Sustainability [CODES] (2022). Digital technology has the potential to support countries in West Asia to achieve the Sustainable Development Goals (SDGs), specifically SDG 9 - Industry, Innovation, and Infrastructure, SDG 11 – Sustainable Cities and Communities, SDG 13 – Climate Action, SDG 15 - Life on Land (Mondejar et al. 2021) as well as cross-cutting goals such as SDG 5-Gender equality. A key challenge is data and UNEP estimates that around two-thirds of the 93 environmental-related SDG indicators do not have adequate data for West Asia (UNEP 2019). This report draws on multiple sources to create a picture of the regional challenges with regards to the available basic digital infrastructure inside the region, and its potential positive and negative impacts on the environment at the regional level.

This report is a call to action for policymakers in West Asia to lean in and embrace the opportunities of digitalization for sustainability. The report provides a state of digitalization in West Asia and details how technology is being used to address climate change, biodiversity loss, and pollution and the opportunities to scale these technologies. It outlines rapid digitalization's negative impacts on the environment. Finally, the report discusses the opportunities to benefit from sustainable digitalization. Finally, it presents ten "Calls to Action" for West Asia to take the lead globally in digitalization for sustainability.

Section 2: West Asia Overview



SECTION 2: WEST ASIA OVERVIEW

2.1 Anatomy of Digitalization in West Asia

West Asia is highly heterogeneous, with a combination of high-income countries, middle and lower-income countries, and countries in crisis (Map 1), as shown in the disparities in the Human Development Index in Table 1 (United Nations Development Programme [UNDP] 2021).

There are also vast disparities in internet accessibility, as shown in Table 2 below (Datareportal, 2022).

Table 1: Human Development Index (HDI) for West Asia (UNDP 2021)

Country	Population	HDI (2021)
Bahrain	1,463,266	0.875
Iraq	43,533,593	0.686
Jordan	11,148,278	0.72
KSA	35,950,396	0.875
Kuwait	4,250,114	0.831
Lebanon	5,592,631	0.706
Oman	4,520,471	0.816
Palestine	5,133,392	0.715
Qatar	2,688,235	0.855
Syria	21,324,367	0.577
UAE	9,365,145	0.911
Yemen	32,981,641	0.455

Table 2: Internet and Social Media Use in West Asia (Datareportal, 2022)

Country	Internet Usage (% of population)	Internet Connection Speed (Mbps)	Social Media Statistics (% of population)	Mobile Connection (% of population)
Syria	49.2	Mobile Data - 11.43 Fixed Internet - 2.90	-	78.3
Qatar	99	Mobile Data - 97.90 Fixed Internet - 64.16	**99.8** Facebook - 71.1 Youtube - 89.7	151.8
Palestine	70.6	Mobile Data - 5.68 Fixed Internet - 14.63	**64.3** Facebook - 50.2 Facebook Messenger - 43.5	82.7
Oman	95.2	Mobile Data - 45.08 Fixed Internet - 44.71	**83.2** Youtube - 83.2 Instagram - 37.0 Tiktok - 37.0	111.3
Yemen	26.7	Mobile Data - 2.76	**11.4** Facebook - 9.2 Instagram - 2.1 Facebook Messenger - 2.7 LinkedIn - 1.0 Twitter - 1.9	62.2
Lebanon	89.3	Mobile Data - 21.30 Fixed Internet - 7.67	**75.2** Facebook - 46.8 Youtube - 75.2	68.4
Kuwait	99	Mobile Data - 83.64 Fixed Internet - 89.36	**93** Youtube - 83.1 Instagram - 55.1	149.5
Jordan	66.8	Mobile Data - 19.37 Fixed Internet - 53.36	**66.6** Facebook - 51.0 Facebook Messenger - 33.1	78.1
Iraq	49.4	Mobile Data - 37.25 Fixed Internet - 19.65	**68** Facebook - 45.2 Facebook Messenger - 38.8	102.1
Bahrain	99	Mobile Data - 46.78 Fixed Internet - 47.08	**87.8** Youtube - 81.5 Instagram - 56.8	101
UAE	99	Mobile Data - 136.42 Fixed Internet - 103.71	**106** Facebook - 71.7 Youtube - 90.3	169
KSA	97.9	Mobile Data - 91.06 Fixed Internet - 80.39	**82.3** Youtube - 82.3 Snapchat - 56.8	115

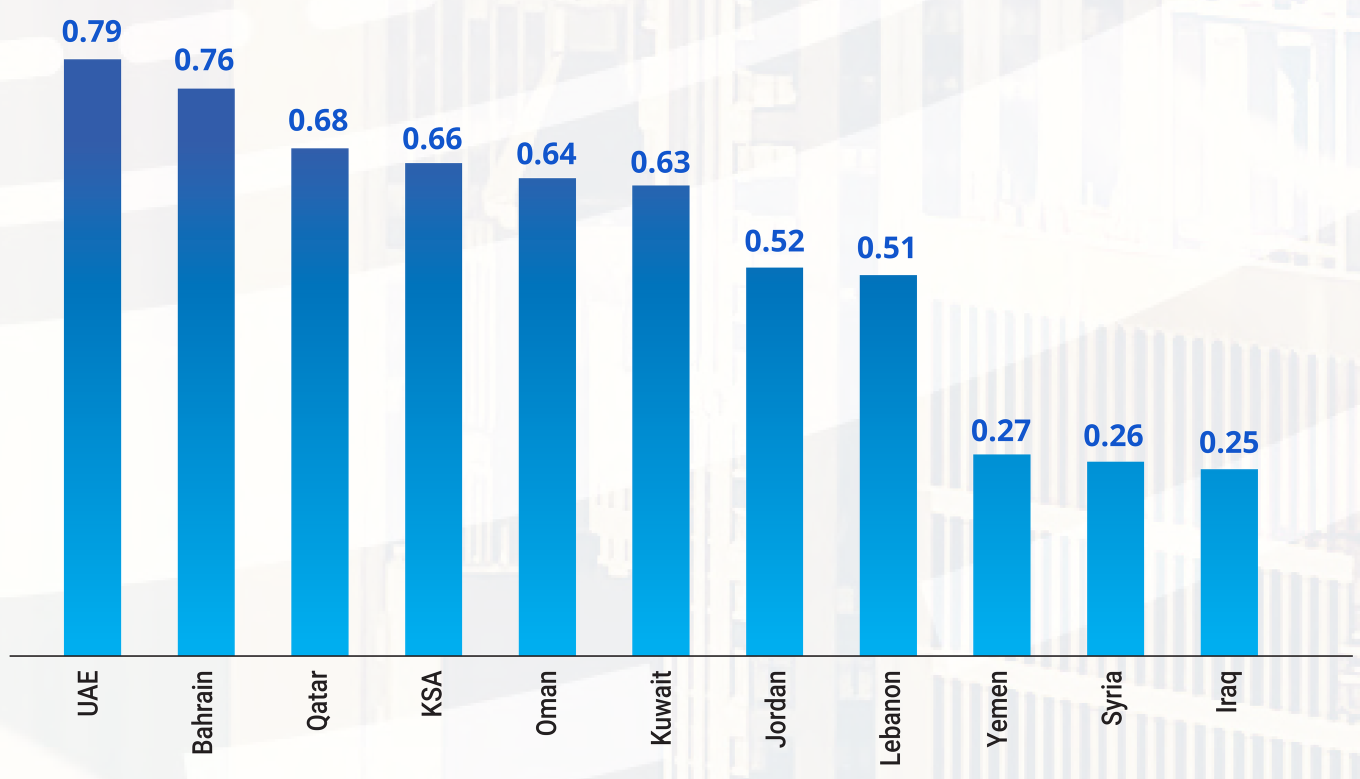
Digital Adoption Index

The DAI is a worldwide index that measures countries' digital adoption across three dimensions of the economy:

1. increasing productivity and accelerating broad-based growth for business,
2. expanding opportunities and improving welfare for people,
3. and increasing the efficiency and accountability of service delivery for government.

The DAI can assist policymakers in designing a digital strategy with tailored policies to promote digital adoption across different user groups. https://www.worldbank.org/en/publication/wdr2016/Digital-Adoption-Index

Digital Adoption Index of West Asia Countries (Data source: World Bank, 2016)



While West Asia has some of the most advanced internet usage globally, many countries lack the basis access and infrastructure required for digital transformation. The development of digital strategies aligned with national development strategies will be essential, to get basis infrastructure in place to support transformation.

2.2 The Climate Landscape in West Asia

West Asia is experiencing severe climate change, such as sea-level rise, temperature change, and desertification (United Nations Environment Programme - World Conservation Monitoring Centre [UNEP-WCMC] 2016). Being largely covered with arid or semi-arid zones, the region faces increasing pressure on water resources, extreme weather, food security, and climate-induced natural risks. Air pollution and dust storms are also persistent and growing problems.

Water scarcity is the predominant issue in West Asia, expecting a 20% decrease in rainfall over the next 50 years (Andersen 2021). UNDESA defines water scarce as 1000 cubic meters per capita per year. Yet, The Hashemite Kingdom of Jordan caps water consumption at 155 cubic meters per person per year (including over 700,000 refugees) (United Nations Department of Economic and Social Affairs [UNDESA] 2014).

With the growing energy consumption in the region, West Asia has witnessed growth in CO_2 emissions, largely as a result of the energy fuel mix and efficiency of water and electrical use. As a response, all countries in West Asia have made their Nationally Determined Contributions (NDC) to the Paris Climate Agreement, with many focusing on emission reduction through renewable energy and clean development.

Technology can support mitigation by reducing harmful greenhouse gas emissions, geoengineering techniques to stabilize or reduce global temperatures, and adaptation by developing people's capacity and resilience to the adverse effects of climate change.

A powerful tool in use in West Asia, is satellite data, which has the immense power to help decision-making processes around nature protection, restoration, and sustainable management. Spatial data identifies the areas where natural solutions can effectively reduce greenhouse gas emissions, encourage green economic growth, and preserve a global safety net. In its fight against pollution and climate change and confirmation of its commitment to the terms of the Paris Climate Agreement, UAE launched DMSat-1. This is a nanometric environmental satellite, which will compile and provide analytics on environmental data, air pollutants and greenhouse gases. This will enable the development of maps of the concentration and distribution of greenhouse gases, and seasonal changes. It has been developed by the Dubai Municipality in collaboration with the Mohammed Bin Rashid Space Centre. (Dubai Air Environment 2021).

The Regional Initiative for the Assessment of Climate Change Impacts on Water Resources and Socio-Economic Vulnerability in the Arab Region (RICCAR) is a joint knowledge base for providing access to information on water resources and water-dependent sectors vulnerable to climate change in the Arab region. These are informed by regional climate and hydrological modeling and generate baseline assessments for impact analysis and capacity building on a regional level. The Data Portal allows interactive visualization of RICCAR maps and serves to strengthen coordination between member countries.

Renewable Energy Labs in University of Bahrain (University of Bahrain 2022)

The renewable energy initiatives at the University of Bahrain are multifaceted collection of projects and partnerships that work together to provide a cohesive eco-system for sustainability research, data, and learning. At the core of this ecosystem is the Renewable Energy Labs whose goals for the are to:

1. Encourage research and innovation in sustainable energy and water technologies through capacity building.
2. Designing integrated energy and water systems with independent technical guidance.
3. Invest in renewable energy (solar, wind and biomass) as alternatives to oil and gas.
4. Establish Bahrain as a reference for low carbon sustainable economy.

2.2 Urbanization and Pollution

West Asia countries are dealing with the effects of desert dust combined with anthropogenic emissions, primarily from historical and present waste practices as well as from the energy industry and transport sectors. Over the past 20 years, the rising amount of air pollutants in this area has led to an increase in early fatalities, threatening the health and future lives of their citizens (United Nations University [UNU] 2016). The effects of air pollution disproportionately affect women and young children from poor households who use dirty fuels and are exposed to high levels of indoor air pollution. Pregnant women are also at increased risk of adverse pregnancy outcomes following exposure to high pollution levels (World Health Organization [WHO] 2022).

Rapid and growing urbanization is a critical environmental issue for West Asia, with two-thirds of the population already living in cities as shown in Map 2 (Statista 2022).

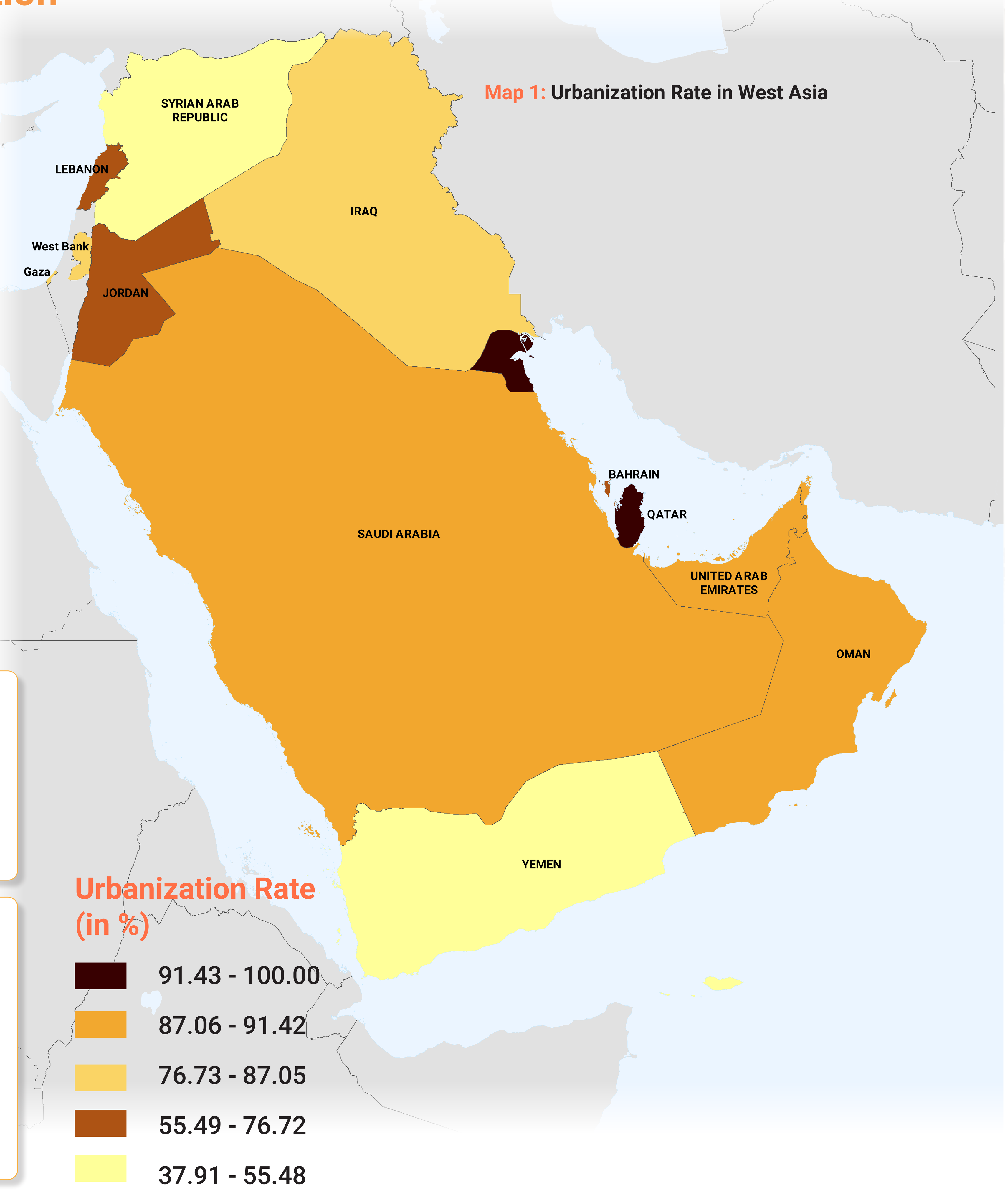
Urbanization Facts and Figures

Over 2/3
of the world population are expected to live in cities by 2050. The majority of this urban expansion will take place in emerging economies. (UNDESA 2018; United Nations 2022)

2/3
of the population of the Middle East live in cities, well above the global total of just over half

Globally, cities
75%
of energy consumption and carbon emissions. (United Nations Convention to Combat Desertification [UNCCD] 2020).

Map 1: Urbanization Rate in West Asia



2.3 Biodiversity in West Asia

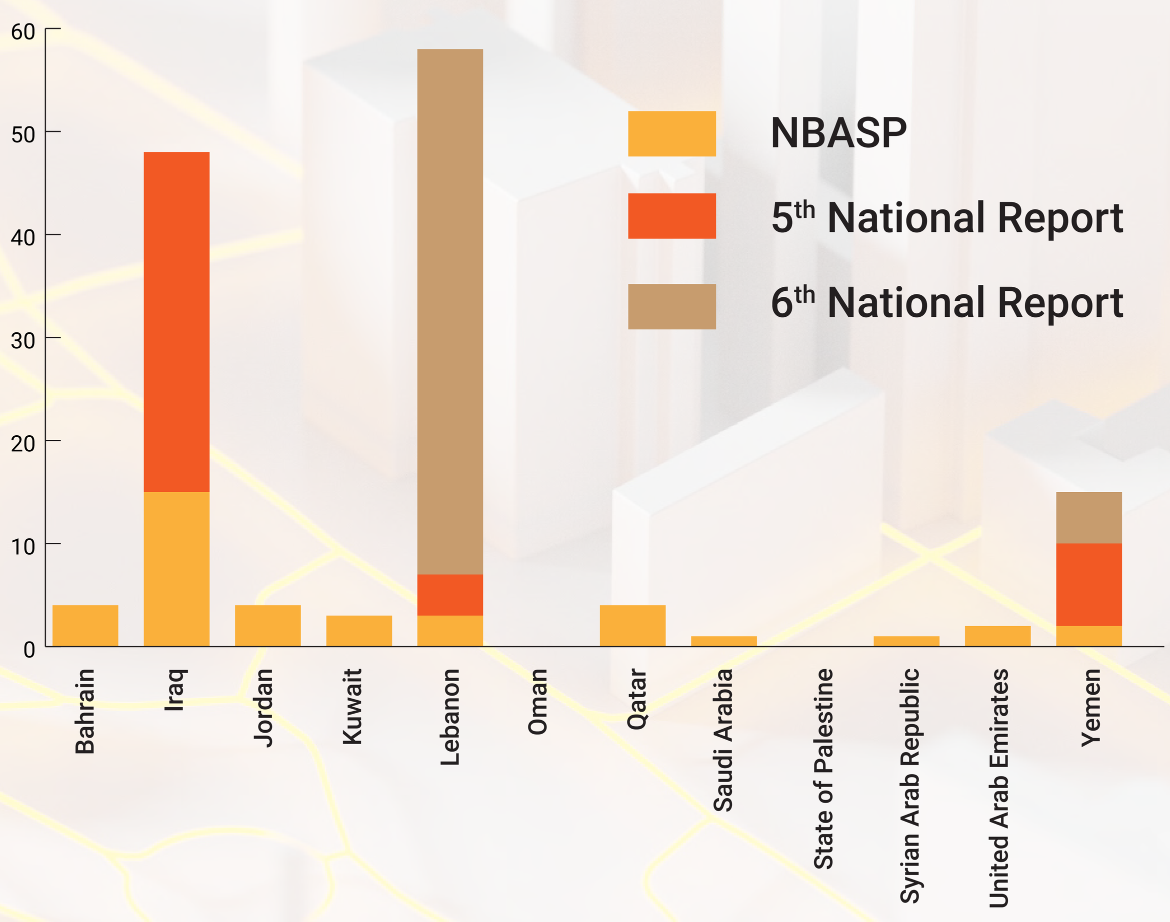
The environment in West Asia, is impacted by urban expansion, pollution, and diminishing bio-capacity of ecosystems, and modification of habitats. This threatens biodiversity and causes further biodiversity degradation (United Nations Educational, Scientific and Cultural Organization [UNESCO], Asia-Pacific Centre of Education for International Understanding [APCEIU] 2021).

Protected areas often offer one way to conserve essential biodiversity and safeguard ecosystem services. However, West Asia's protected area networks are limited in coverage and management effectiveness.

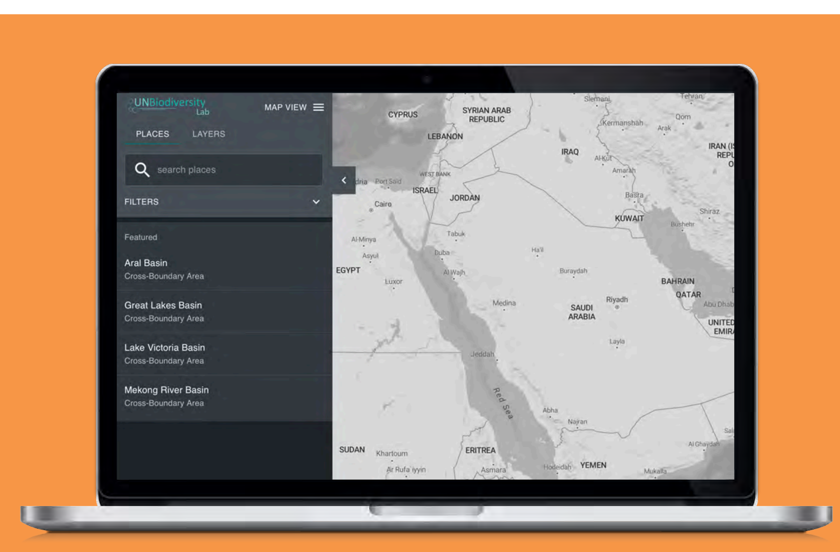
The region's last biodiversity state report also highlighted the lack of information and data available for biodiversity and ecosystem services. This factor limits robust evaluation of the region's status and effective decision-making (UNEP-WCMC 2016).

Countries in West Asia have invested considerable effort in building capacity to support biodiversity conservation. The Global Biodiversity Outlook 4 Report shows urban expansion, intensive agriculture, and marginal land cultivation contribute to biodiversity decline. Wildlife crimes, including illegal hunting, are a continuing problem. At the same time, conservation work was hindered by the unstable political situation in the region (UNEP-WCMC 2016). Increasing access to spatial data and tools, and improving capacity to use them, have been proven to help support nations to make more informed decisions on how and where to halt or reverse biodiversity loss around the world while also addressing climate and development issues (Supples et al. 2022; Hansen et al. 2021; Maxwell et al. 2020; Runting et al. 2020). Although progress has been made to make spatial data from the West Asia region available, there is still much to gather and make available historical data and generate current information (Secretariat of the CBD, 2014).

Figure 2: Number of spatial analyses during NBSAP, 5NR and 6NR in West Asia (Supples et al. 2022).



As of 2021, only 6 out of 12 countries have established protected area systems. Only Qatar and the United Arab Emirates have a protected area coverage that exceeds 10% (UNEP-WCMC 2016).



The UN Biodiversity Lab (UNBL), a free, open-source platform that was jointly created by the United Nations Development Programme (UNDP), the United Nations Environment Programme World Conservation Monitoring Centre (UNEP-WCMC), and the Secretariat of the UN Biodiversity Convention, enables governments and other organizations to access maps and data on biodiversity, climate change, and human development in new ways to generate insight for nature and sustainable development.

A recent study shows that the region's use of spatial data is below average compared to other regions around the world. The study by UNDP, analyzed how nations party to the Convention on Biological Diversity used spatial data to support their pledges. The amount of maps on the national biodiversity and ecosystem status is used as indices of data sufficiency. The study reviewed the post-2020 National Biodiversity Strategies and Action Plans (NBSAPs) and the Fifth and Sixth National Reports (5NR, 6NR) submitted to the CBD by June 2020 (Supples et al. 2022).

In conclusion, climate change, war, and migration are just a few of the many elements causing serious environmental problems in West Asia. When it comes to addressing these risks, digital transformation (DT) can have a significant impact on innovation, knowledge and decision-making. Many West Asian nations will find that digital technologies play a significant role in facilitating the conduct of science-based analyses of environmental trends in climate, nature, and health as well as tracking the progress toward the achievement of the Sustainable Development Goals and the implementation of multilateral environmental agreements. In the next section, the report summarizes a forward-looking perspective to address environmental issues using environment friendly practices and best available technologies.

Section 3: Opportunities for Digitalization and Environment

SECTION 3: OPPORTUNITIES FOR DIGITALIZATION AND ENVIRONMENT

The ubiquity of mobile phones, the availability of technologies that enhance sustainability, and the growing young population who care about sustainability, make West Asia well-placed to take advantage of digitalization. In this section, the report summarises the main ways that digital technologies are being deployed to address environmental issues and provide a resource for the region to utilize.

Table 3: **Emerging Technologies that can Facilitate Sustainability**

Technology	Opportunities for the Environment	
Artificial Intelligence Machine Learning Big Data	**Data analytics**	Emissions, air quality, and pollution levels data collection, monitoring, cleaning, integration, analysis, visualization, and prediction (Davis 2021)
	Automation	Control and navigation of monitoring robots (Sky News 2021).
	Digital Twin technologies	Weather and environment monitoring and prediction
	Machine learning algorithms	Supply of low-carbon power technologies forecasting (wind, solar) less harmful than high-carbon power technologies that rely on fossil fuels. • Predicting supply and demand for cheaper and cleaner fuels to power the base-load and react to unforeseen events that require a spike in demand.
	Efficient Energy Use	Forecasting renewable power and demand for renewable energy. • Used to improve the scheduling and the forecasting of supply of low-carbon power.
	Optimizing Systems Control	Reducing energy usage.
	Forecasting	Absorbing and analyzing historical data, and producing more accurate forecasts • Renewable energy in grids requires more accurate forecasts for renewable power and demand. Examples include solar and wind power on the grid and optimizing forecasts for agricultural yields. • AI forecasting increases the efficiency and optimization of climate models.
Blockchain	**Smart Grid Management**	Increases the speed of exchange, minimizing transacting backlog and costs. • Improves availability and reliability of data. • Ameliorates auditability by verifying records in near real time. • Conveys titles of physical commodities between market participants.
	Peer to Peer Energy Markets	Improves and manages smart grids in decentralized energy markets. • Allows for reliable and transparent peer-to-peer trade of power. • Connecting blockchains and solar panels enabling consumers to benefit from distributed generation.
	Market platform for renewable energy certificates	• Creates an alternative revenue stream for renewable energy via an open-source tool to build digital platforms which can register users and devices, track renewable energy, and issue corresponding energy attribute certificates.
	Micro-leasing marketplace	Enables the distribution, receiving and transparency of funds digitally between investors and recipients
	Digital Measurement Reporting and Verification	Structured data collected via Internet of Things (IoT) and secured on a blockchain • Measurement Reporting and Verification increases the data utility to support decision-making for climate and sustainability.
	Non-Fungible Tokens (NFT)s	Used for climate change through awareness-raising/ fundraising and as an immutable record for carbon credits.
GIS and Satellite Imaging	**Geographic Information System**	Geospatial data collection of habitat information and accurate measurements of forest borders to support preservation efforts (Sky News 2021). • Geospatial sensing and monitoring of emissions and air quality (Acton *et al* 2022a)
	Remote Sensing Technologies	Guides policymakers to make data-driven decisions when identifying, planning, implementing, and measuring the effectiveness of nature-based solutions (Supples *et al.* 2022). • Landscape-level characterizations of biodiversity and the surrounding environment in a spatially exhaustive, systematic, repeatable manner (Duro *et al.* 2007).
Smart Infrastructure	**Smart Grids**	Reducing energy loss through household energy efficiency, monitoring energy consumption, and maintaining efficient use of energy (Sky News 2021).
	Smart Transportation	Autonomous vehicles and smart transportation systems change road network use, reducing the stop-start nature of traffic. • Smart and interconnected transportation system reduces pollution and optimizes driving effort, time, and emissions. A range of studies has estimated that smart transportation systems can improve fuel efficiency by 15-40%, reducing emissions of air pollutants and greenhouse gases, not to mention the benefits of safety and congestion (Shaheen and
	Smart Buildings and Cities	• Mitigating building inefficiencies through sensors and analytics (Acton *et al* 2022a) The Government of Abu Dhabi, UAE, has launched the 2030 Masdar City project, a pioneer in sustainability and a research hub for clean energy and technology. Their master plan provides the "highest quality of life within the lowest environmental footprint" by encouraging cleantech innovation and investments and achieving sustainable urban and energy management.
Spatial Mapping	**Earth Observation (EO)**	The project Mapping Nature for People and Planet shows a concrete application of the benefits of digitalization and spatial mapping. This project, currently piloted by UNDP in 13 countries, aims to support nations using the latest advances in GIS, AI, and Data Analytics, to create their own national 'Map of Hope'. Local stakeholders use national and global spatial data to identify Essential Life Support Areas. The result is an interactive map that governments can use to develop policies and prioritize areas for protection, management, and restoration. • Drives the creation of rigorous targets for the post-2020 global biodiversity framework • Supports countries in monitoring progress towards the Rio Conventions and the 2030 Agenda. • Derives indicators on key biodiversity changes, land cover, productivity, topography, biophysical and structural parameters of vegetation such as forests and mangroves (including biomass and carbon stocks) with faster speed, lower cost, and broader scale. (Yang *et al.* 2013; Zhao *et al.* 2022).
	Data Access	Development of cloud computing environments, data management and analysis platforms to address the storage and processing capacities of personal servers, allowing users (nations, researchers, and civil society) to directly access these datasets, with leaders including Amazon Web Services (AWS), Microsoft Azure Cloud Services, Google Earth Engine (GEE), and the Joint Research Center Big Data Platform (Gorelick *et al.* 2017; Soille *et al.* 2018). • Monitoring the state of the planet. • Provides policymakers with easier access to spatial data to support countries' adoption of nature-based solutions for development. • Using systematic conservation planning approaches and tools also enables users to bring together diverse datasets to support countries in prioritizing actions to protect, restore, and sustainably manage biodiversity to achieve their nature, climate, and sustainable development commitments. • Increasing number of online tools with user-friendly interfaces that enable access to spatial data such as the UN Biodiversity Lab (CBD Secretariat, UNDP, UNEP, and UNEP World Conservation Monitoring Centre), Resource Watch (the World Resources Institute), Global Forest Watch (the World Resources Institute), Trends. Earth (Conservation International) and Integrated Biodiversity Assessment Tool (IBAT Alliance).
Digital Twins	Energy, water, and telecoms networks allow climate projections, hydrological models, and flood forecasting. • Allow the forecasting of where a flood would occur, but also if an electricity substation floods and what would be the knock-on effects on the network. • Benefits include bringing together, connecting, and leveraging different models to evaluate their impact considering multiple variables at a larger scale. • Combining with Augmented Reality simulates natural disaster impacts on the networks through real-time interaction and accurate 3D registration.	
Information & Communication Technology (ICT)	Remote working: reducing transportation, heating, and cooling emissions (Sky News 2021). • Crowdsourced monitoring using smartphone apps (Acton *et al* 2021; Davis 2021) • Repurposed smartphones create early warning systems (Acton *et al* 2022a)	
IoT and Sensors	Monitor habitat changes and prevent animal poaching • Remote monitoring of emissions, air quality, and climate indicators (Smith 2021; Acton *et al* 2021). • Early warning networks to detect signs of critical climate phenomena, or unwanted human presence in protected areas (Acton *et al* 2022b) • IoT-based air and water quality monitoring systems are used to monitor air and water quality in cities by installing several data-collection sensors. This data is then calculated according to the Air Quality Index (AQI). • Inform policymakers and stakeholders about air quality and predict air quality measures (Toma *et al.* 2019; Moursi *et al.* 2021).	
Robotics	Solar-powered monitoring robots, autonomous robots and drones create early warning systems to detect unusual environment indicators or climate patterns (Acton *et al* 2022a)	

Section 4: Risks of Sustainability and Digitalization

SECTION 4: RISKS OF SUSTAINABILITY AND DIGITALIZATION

4.1 E-Waste – A Growing Problem

Digitalization requires an increasing element for computers, data centers, mobile phones, crypto mining nodes, batteries, and networks. In 2019, ICT produced a record 53.6 million metric tons of e-waste globally (Bogdan-Martin 2022). These numbers suggest that e-waste is the fastest-growing domestic waste stream, with 17.4 percent of e-waste being collected and recycled (International Telecommunication Union [ITU] 2020), and only 78 countries having legislation for e-waste management (Forti, Balde, Kuehr, and Bel 2020). As such, digitalization and circular economy must be interlinked to enable tracking, recovering, and recirculating of minerals used in tech production.

Production of computer hardware makes up 75 to 85% of the environmental impact of the digital world.

Regulatory frameworks to raise awareness of circular economy, product lifecycle, and sustainable purchasing behavior must be encouraged.

E-waste poses a significant challenge in the region, where there is little capacity to handle the recycling challenge. In West Asia, e-waste is commonly disposed of using general waste, open dumps, and open burning. The disposal, dismantling, and recycling of e-waste through illegal methods or methods that are informal and fall below the international standards for e-waste management are primary drivers of the negative impact of e-waste on the environment.

Egypt, Jordan, Lebanon, and the United Arab Emirates have all adopted legislation or regulations governing ESM for e-waste. However, e-waste legislation on management of the waste remains inadequate in the region. Nevertheless, e-waste should be considered in well-developed legal and regulatory frameworks on hazardous waste. Yet, in countries without legal and regulatory frameworks, e-waste is treated as municipal waste, which in most cases is dumped in landfills (Iattoni et al. 2021).

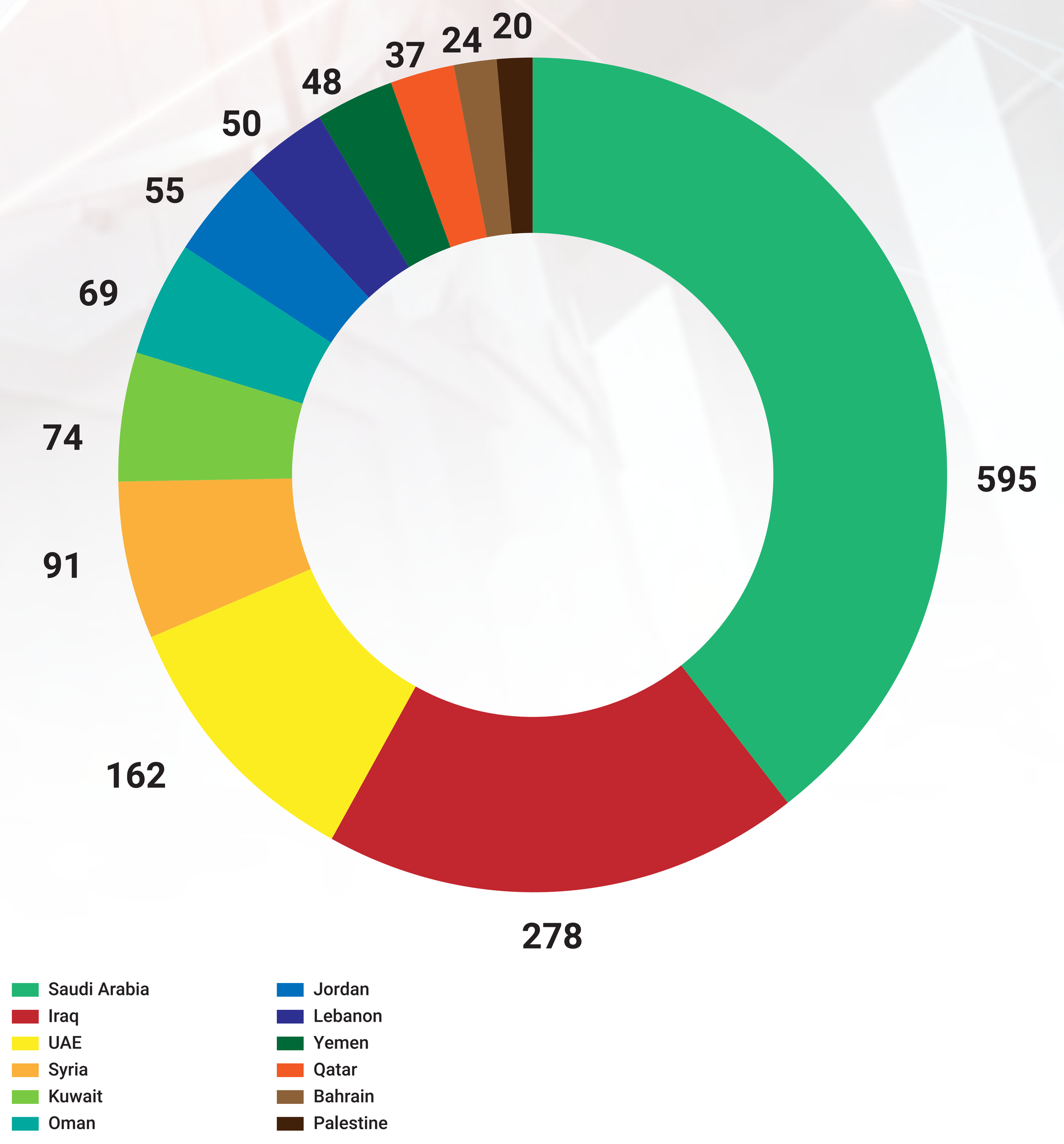
The Regional E-Waste Monitor for the Arab States 2021 report found an overwhelming lack in e-waste collection information. This is due to absence of official data and inconsistency in the collection infrastructure. Of the 12 West Asian countries with e-waste generation data presented in Figure 1, only four countries provided data on e-waste collection: the State of Qatar, the Hashemite Kingdom of Jordan, the United Arab Emirates, and the State of Palestine. Jordan collected the highest amount of e-waste for ESM, amounting to 1.3 kt, followed by the United Arab Emirates at 0.7 kt, then Qatar at 0.2 kt and finally the State of Palestine at 0.08 kt (Iattoni et al. 2021).

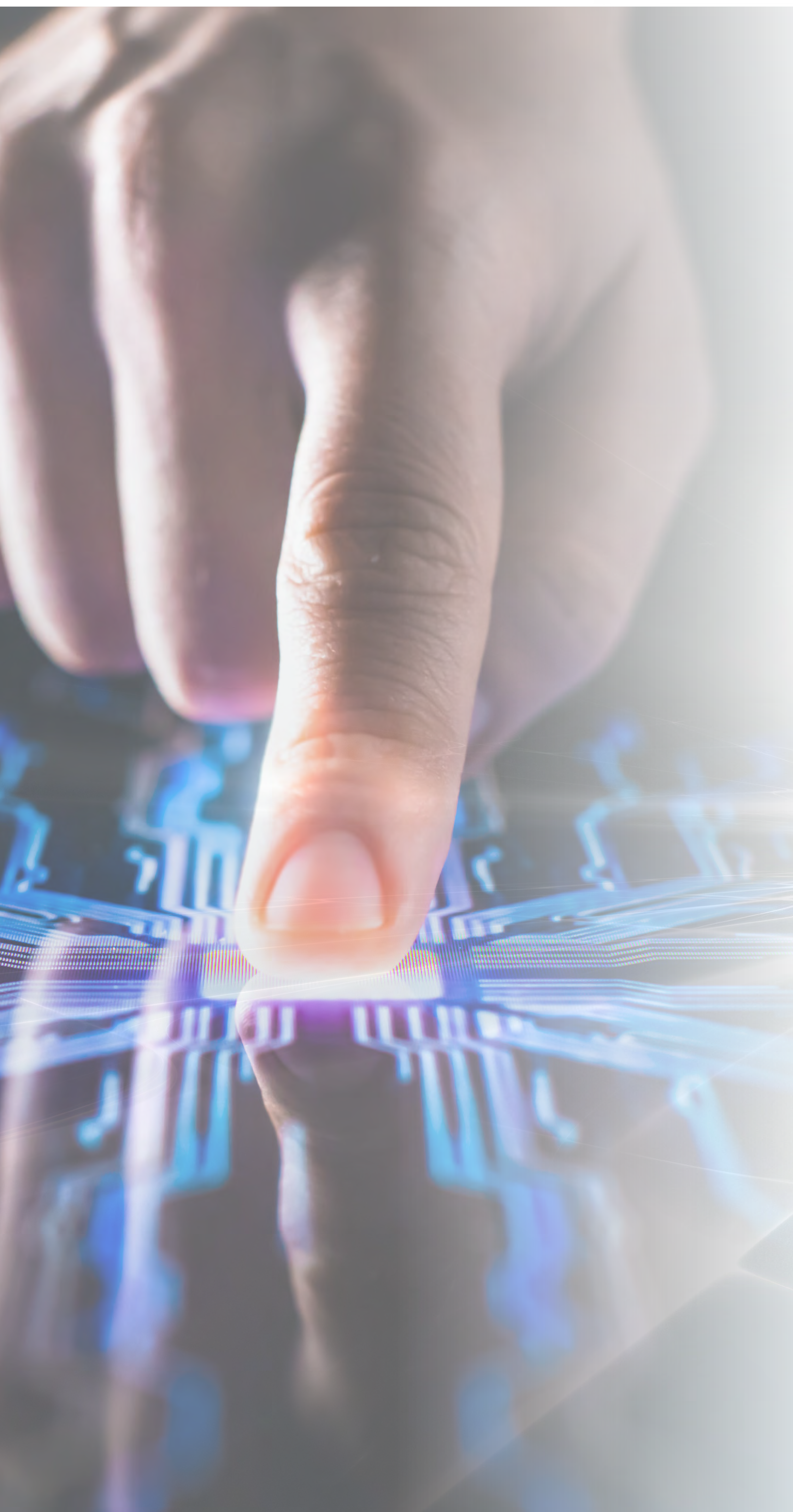
A preventative approach to reduce the impact of e-waste is the Extended Producer Responsibility (EPR) strategy. It is a policy approach encouraging EEE producers to shoulder financial and physical responsibility for the disposal, recycling, and treatment of post-consumer products (Iattoni et al. 2021). It encourages producers to reduce the environmental impact of products and their packaging throughout all product life cycles. According to the Regional E-Waste Monitor for the Arab States 2021, several West-Asian countries aim to further combat the impacts of the informal handling of e-waste through the EPR principle. The West-Asian United Arab Emirates introduced the principle of EPR for e-waste and battery waste through the legislative Cabinet Decree No. 39 of 2021. Following in UAE's footsteps, Jordan's Ministry of Environment is establishing an EPR system, as well as Lebanon, whose 2019 national strategy foresighted the adoption of EPR (Iattoni et al. 2021).

It is recommended that countries work on preventing e-waste generation, adopting necessary legislation and policies such as EPR and E-waste specific ESM strategies, also making collection and treatment plants available and improved. Policymakers should consider institutional support and recognize women waste workers in policymaking.

A study in the UAE estimated that 85% of respondents purchased one to three e-devices every year. The e-waste generation rate is also 17.3 kg/capita/year, most of which is disposed of in household trash. The rest is donated, repaired, or sold.

Figure 3:
Kilotons of E-waste Generated in West Asia in 2019 (Iattoni et al. 2021).





4.2 Digital Technologies and Carbon Footprint

GHG emissions from the ICT industry, include energy consumption from ICT manufacturing processes, emissions from the mining and extraction of essential earth metals used in ICT production, the operation of ICT devices, and the disposal and recycling of them. According to United Nations Information Portal on Multilateral Environmental Agreements (InforMea), countries in West Asia have witnessed dramatic increases in the number of users per 100 inhabitants between 2010 and 2021. In terms of growth over the years, West-Asian Iraq is in the lead among the region with an increase of 2900% percent from 2.5 internet users per 100 inhabitants in 2010 to 75 users in 2021. Regarding 2021 estimates, Bahrain, Qatar, Kuwait, Emirates, Saudi Arabia, and Oman have all come close to full integration of the internet among their population, with an average of 98.16 users per 100 inhabitants (InforMea 2022).

Digital assets, especially Bitcoin which use computers to mine digital assets, have an estimated yearly use of 58 Terawatt-hour (TWh) electricity. This number represents 0.21% of global energy consumption. Electricity use from crypto mining amounts to the same energy consumption as Switzerland (Baraniuk 2019). The issue with the forecasted emissions of cryptocurrency mining and its expected contribution to global warming by 2040 lies in its potential violation of the Paris Agreement COP21, UNFCCC (Mora et al. 2018). According to Cambridge Bitcoin Electricity Consumption Index' (CBECI) latest monthly average estimates, Arab countries have significant rankings among global countries for global mining. Kuwait and Libya accounted for 0.13% and 0.10% of the global bitcoin mining hash rate, Oman had 0.06% of the global hash rate share (CBECI 2021). However, the industry is responding to develop alternative validation methods to create a token that use less energy, including the recent Ethereum Fork, Algorand, Cardano Stellar Nano and Hedera Hashgraph (Bogna 2022).

4.3 The Digital Divide

The Global Risk Report 2021 indicates that growing dependency on digital systems, especially during the COVID-19 pandemic, drastically sharpened societal inequalities (World Economic Forum [WEF] 2021). Digitalization will also continue broadening this digital divide: the WEF's report marks digital inequality in the top ten of the most concerning short-term threats (0-2 years) (WEF 2022). These inequalities will likely harm the already most vulnerable, with long-term consequences that policy makers should not ignore.

The digital divide is a result of structural injustices and power disparities that need to be addressed, among other things, by implementing agile governance frameworks, making public investments in digital infrastructure, and promoting digital literacy. It goes beyond inequalities in access to the internet. It includes different levels of access to the tools, technologies, information, skills, and agencies in driving digitalization. The digital divide also exists along gender lines, with fewer women compared to men having access to and engaging with digital platforms.

Section 5: A Sustainable Digital Future for West Asia

SECTION 5: A SUSTAINABLE DIGITAL FUTURE FOR WEST ASIA

The Coalition for Digital Environmental Sustainability (CODES) defines four fundamental shifts that are required for a sustainable digital future: Align digital capabilities' values with those of sustainable development; Ensure inherently sustainable digitalization; Direct and incentivize innovations towards digitalization for sustainability; and remove behavioral barriers to digitalization

This will require a purposeful commitment by governments and a widespread collaboration across the ecosystem between innovators, industry, academia, policymakers, and governments. The mobilization of capital for new technologies for sustainability startups should be a regional priority, using digital technologies to align capital with sustainability.

In the digital age, consumers also have the power to influence choices, demand sustainable products, and advocate for sustainable actions.

Finally, across the spectrum, it must be remembered that there are wide disparities across West Asia; improving internet access for vulnerable groups, including women and the illiterate, and closing the gap in wealth, gender, and education with the help of digitalization remains a priority.

Sustainable digitalization is attainable, and West Asia can set the pace. This report makes ten calls to action.

1. Link Environmental Sustainability Strategy to National Digital Strategy

Digitalization and sustainability should be linked to national digital strategies to maximize potential and benefits and promote pathways to channel digital transformation towards sustainability. Policymakers need to steer digitalization towards fostering environmental sustainability, taking the urgent challenge of climate adaptation into an opportunity to make West Asia more resilient and lead in sustainability innovation. Environmental sustainability evaluation and monitoring should be part of any significant digitalization project design.

2. Nurture a Regional Entrepreneurial Tech for Sustainability Ecosystem

The region needs a vibrant technology ecosystem that supports growth of technology for sustainability. The ecosystem can pool unique capabilities, data, consumers, research centers and industry knowledge to bring together many collaborators to join forces to create digital innovation across the region. It can also foster the Arab entrepreneurial spirit and create employment opportunities for the youth interested in tech for sustainability. Innovation ecosystems foster entrepreneurship, capital, research and education, and corporate innovation.

A regional network of collaborative Innovation Hubs could help accelerate the development, deployment, and scaling of digital technologies to build sustainability and solve environmental challenges. These hubs would help build urban and rural environmental action and opportunities to support sustainable livelihoods, resilience, and human well-being. To offer the funding and incentives necessary to promote green digital solutions and transformative innovations for sustainability, capital mobilization must act as a catalyst. The ecosystem should attract the best companies, startups, investors, researchers, policymakers, and future shapers, with a vision to create the future in tech for sustainability.

The area must encourage transparent co-creation and open collaboration between the public sector, the private sector, and civil society in order to support crucial digital innovation ecosystems. This ecosystem can be built around the sustainable industries of the future, helping navigate shifts and prepare for sustainable digital opportunities.

3. Develop Enabling Regulations and Incentives

The ecosystem will need a supportive regulatory environment, including legal, regulation, incentives, innovation, and intellectual property laws. The regulations should also ensure that they involve and support those at risk of being left behind, especially the indigenous people, women and girls in terms of access to knowledge, incentives and other resources for sustainable digital infrastructure.

4. Invest in Skills Development on Tech for Sustainability

Digital skills and literacy will be the key to digitalization for sustainability. The Public sector and policy makers need to understand the environmental opportunities and risks of digital transformation. Computer scientists, entrepreneurs, and software engineers should also account for their products and services' impacts on sustainability to consider in the design process. They need to understand sustainability challenges, especially decarbonization, dematerialization, detoxification, and economic circularity.

The green economy will require new skills. Academic curricula, trainings, and professional organizations must be upgraded to reflect the demands and outcomes of digital sustainability. A skills pipeline of those with domain experience is required, as well as computer scientists and engineers, and those who can manipulate energy data and understand environmental models. Digitalization for environmental sustainability will create new job categories, ranging from algorithm bias auditors to content creators to meme designers to drone fleet managers.

Mapping the available training programs both in institutions in the region, on the internet, and by private industry is required, especially with a focus on Arabic speakers. Creating partnerships among institutions across the region and with existing tech hubs will be fundamental to success. In a digital world, knowledge, and education can be gleaned from many sources.

Young people own the future and preparing them for a digital future, mobilizing them as influencers for sustainability should be part of the regional DNA. Building entrepreneurship is an essential pillar and finding ways to stimulate nascent entrepreneurs and give them access to innovative settings where they can share ideas with other innovators.

5. Align Capital with Sustainability

Appropriate structures and mechanisms for green finance can help bring great opportunities to the region, expected to reach $2 trillion in economic growth and over 1 million jobs by 2030. Green finance can accelerate the region's goals of economic diversification and job creation, and attract foreign investment if properly structured. This requires adoption of sustainability guidelines. Establish new green investment institutions, strengthen capital markets, and establish or participate in standardized and transparent environmental performance reporting mechanisms. The endgame is to increase capital available for the development of sustainable solutions, products, and services to improve the environment (CODES 2022).

6. Demand Sustainable Technology

There are two aspects to this, sustainability in technology development, and sustainability in technology digital transformation's implementation. Designing, for example, involves deciding which energy efficient programming language is used, whereas implementing has to do with how the technology is used. Technology can help map the sustainability of supply chains and risks to economies. Accurate and real-time data on carbon emissions, carbon assets, and carbon footprint can enable planning and accountability for the private sector. Using digital technology to align capital towards sustainability, integrate environmental and climate considerations into costing models, and conduct risk assessments and due diligence reviews to improve the environmental, social and governance (ESG) enables transparent measurement of performance.

Finally, influencing consumer choices on sustainability using algorithms and digital platforms to help make sustainability the preferred choice for online customers. The ecosystem will also help develop a platform of regional efforts to deliberately curate and design digital influence strategies as a technology powerhouse for sustainability that key influencers can have a say in. The ecosystem platform can also run entrepreneurial contests and hackathons, which may help entrepreneurs get seed capital that can help them in financing their startups and inventions.

Users under the age of 18 make up one-third of all Internet users, and young people between the ages of 15 and 24 are the main cohort of Internet users. (ITU 2022). They can lead the consumer demand for sustainability. The power of social influence and engagement is a vital complement to sustainability actions. Algorithms and digital platforms can help make sustainability the preferred choice for online customers. New digital technologies can enable companies and consumers to track the environmental and social impacts of their products. Storytelling through captivating videos across all channels is key to getting a message across to today's young people.

7. Use Data to Drive the Circular Economy

AI, machine learning, robotics, and Internet of Things (IoT) allow the quantification of circular business models which is key to increasing resource efficiencies and reducing waste. Through efficient resource utilization, manufactured commercial and industrial products are more economic and environmentally friendly (Chauhan, Parida and Dhir 2022). Countries work on preventing e-waste generation, adopting necessary legislation and policies such as EPR and E-waste specific ESM strategies, improving e-waste treatment facilities, and raising awareness on the issue.

8. Make Access to Digital Infrastructure a Basic Human Right

The wide disparities across the region highlight the need for investment in basic digital infrastructure like access to electricity, and communications (mobile and internet). In remote areas, solar panels and off-grid energy production make access possible. Utilizing digital services and data platforms to enhance collection, production, and management of data, mobilize research to fill knowledge gaps and improve the consistency and transparency of data used in countries' nature status, land-use, and development planning. The use of voice activation for reach is essential, and its rapid expansion for digital interaction provides substantial opportunities. Voice activation could have a significant influence on people who are affected by digital exclusion, have low literacy levels, and/or disabilities.

9. Plan for Smart Cities in an Urbanizing Region

As the West Asia region urbanizes, it will need smart and sustainable cities. By integrating technology into city services, smart cities can improve energy efficiency, urban infrastructure operations and transparency, road network resilience, water distribution system efficiency, wastewater management, and security of digital transformation increase (International Telecommunications Union – Telecommunications [ITU-T] 2019).

10. Promote Open Data Accessibility

Open access to data can help promote environmental sustainability through i) data timeliness: helping governments leverage data from open platforms like social media to act on the most up-to-date information (e.g., images of floods or disasters) ii) accountable data governance: allowing people to have access to government data helps enhance transparency and involve the population in monitoring the governments' actions towards sustainability, and iii) data inclusiveness: ensuring that data is available to all and that no one is left behind in taking action and responsibility for sustainability. Open data policies would help governments make better decisions, encourage wider use of society data, and find the right partners to drive positive change.

CONCLUSION

This UNEP Regional report on “Sustainable Digitalization and the Triple Planetary Crisis in West Asia” is the first of its kind at the regional level. It seeks to “help policymakers to better understand the available basic digital infrastructure inside the region, and its potential positive and negative impacts on the environment at the regional level”. It has many gaps, but it provides a forward-looking perspective to address environmental emerging issues using environment friendly practices and best available technologies before it is too late.

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