BUILDING INCLUSIVE AND SUSTAINABLE DIGITAL ECONOMIES

06

This chapter scopes out sustainable and inclusive development in Commonwealth countries and focuses on the impact of digital technologies and changing dynamics of international trade on inclusive development and green growth.

The first section explores the impact of digitalisation on inclusive development in terms of opportunities for small states, youth empowerment and women, respectively. The section will show the gender gaps which exist among the Commonwealth countries and how these gaps could be addressed using digital technologies. The second section focuses on prospects for sustainable development in the digital age, and the implications of rising digitalisation on environmental and social standards.

6.1 Impact of digitalisation on inclusive development in the Commonwealth

The previous chapters highlighted several new opportunities presented by digitalisation and discussed associated challenges and risks. The sub-sections below discuss the scope of inclusive development in the digital economy and how new opportunities for small states, women and youth can be realised by managing digital transformation in a more inclusive manner.

6.1.1 Digitalisation and inclusion of Commonwealth small states

As discussed in Chapter 2, many of the existing debates and discussions on growth and development models do not account for variation in the size of economies. However, small states in the Commonwealth face a range of additional challenges that affect their growth prospects, including in relation to the viability of activities with increasing returns to scale.

Winters and Martins (2004) argue that small states are permanently disadvantaged in agriculture and manufacturing and cannot reap returns to scale in these sectors. Moreover, the remoteness of some Commonwealth member states, particularly in the case of the Pacific island states, raises transport costs and constrains participation in global networks and value chains. The exports of small states are also mostly concentrated in commodities, which increases these countries' exposure to volatile global commodity prices.

Digitalisation may provide new opportunities for Commonwealth small states to address some of these challenges. Knowledge-intensive services and digital trade can support development strategies for small, landlocked and remote Commonwealth member states that cannot rely on economies of scale in agriculture or manufacturing production and lack decent physical access to markets in other countries (Sarwar et al. 2018). IT services (such as data processing and software development) and IT-enabled services (such as tourism, call-services and back-office services for financial firms) are much less constrained by hard borders or remoteness and can be exported as long as the country has strong digital infrastructure and appropriate digital skills.

However, to realise the opportunities of digitalisation at scale, regional co-operation will also be key for Commonwealth small states. Consider for instance, the case of the Caribbean Community (CARICOM). Given the generally small size of Caribbean firms and limited capital base, there is significant potential for e-commerce to reach customers in distant markets, without requiring heavy investment in capital or the use of intermediaries (Broome 2016). However, leveraging e-commerce is constrained by the absence of a coherent regional regulatory framework, the high cost of infrastructure such as postal competence and port logistics, limited financial instruments, a lack of stakeholder buy-in and generally challenging business environments in the Caribbean.

Some regional efforts are underway to digitally transform the Caribbean. For instance, a plan to create a Single ICT Space was approved in February 2017, aimed at strengthening legal and regulatory convergence in telecommunications (UNECLAC 2018). The components of the plan include: a) regional harmonisation of ICT policies, legal and regulatory frameworks; b) strong national and regional broadband infrastructure; c) common frameworks for governments, service providers and consumers; and d) effective and safe technology and management systems.

McClauren (2017) further highlights the scope for a CARICOM e-commerce strategy that addresses issues related to taxing e-commerce and Custom Duty Memorandum (WTO), competition law and policy and consumer protection issues, protecting intellectual property, regulations and enforcement and cyber security. The development of a CARICOM Single Market and Economy has also been given a boost with the launch of four new online platforms aimed at promoting trade and improving the ease of doing business: the CARICOM Online Companies Registries; Labour Market Information System; Community Public Procurement Notice Board; and the CARREX Platform and On-Line Public Portal (Kendol 2017). Such regional initiatives by Commonwealth small states, coupled with knowledge sharing by leading digital Commonwealth small states, can help foster inclusive development. Sharing of lessons and best practices in e-governance can further help the process. For instance, Malta is a champion of e-governance in the Commonwealth (see Box 6.1).

6.1.2 Digitalisation and inclusion of youth

For many developing Commonwealth members, youth unemployment poses another serious and growing challenge. These rates are even higher among young women, who face barriers to receiving

Box 6.1 Malta's e-governance initiatives

In 2010, Malta's Information Technology Agency (MITA) diverted its efforts towards ensuring that all Government services are accessible online and improving the quality and delivery of e-Government services. MITA created a central platform to enable the rapid implementation of services. This encompassed the creation of three important components: eForms, MyBills and eProcurement. **eForms** is a new platform which allows the creation of online forms, enabling the whole process – from the creation of forms by a department to the filling-in and sending process by citizens or businesses – to be done completely online in a secure environment. **myBills** is the Maltese government's online billing solution, supported by the Hosted Payment Page (HPP), which directs users to make electronic payments through a central PCI-certified environment. By the end of 2010, 93 per cent of online transactions were taking place through the HPP. **eProcurement** enables the use of electronic communications and transaction processing by the public sector, in order to purchase supplies and services, or tender public works.

The success attained by the Government of Malta in the context of e-Government can be partly attributed to the pivotal role of the underlying set of service enablers. These services provide the building blocks which enable a common authentication/authorization, mobile messaging, electronic payments, online forms and common data registers throughout all e-Government Services. The e-Government Benchmark 2018 reveals that Malta's e-government services are the best in Europe, on the basis of the number of services available online and on mobile phones. It ranked the highest in four priority areas: user centricity, transparency, accessibility by other EU citizens and technological infrastructure.

Source: MITA (2018).

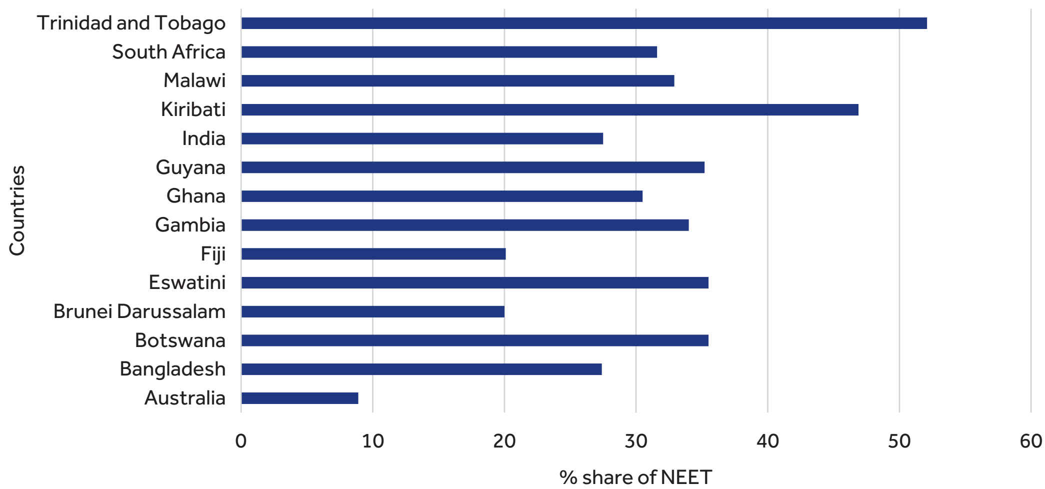
a quality education in the form of cultural norms and practices, poor infrastructure, violence, and fragility. Youths, however, do not comprise a homogenous group – young people's circumstances vary widely by age cohort, gender and education level and geographical location, among other socio-economic factors. Unemployment is also a critical challenge confronting young people in small states, particularly in the Pacific region, where the youth unemployment rate stands at an alarming 23 per cent (ILO 2013). Young people in the Pacific are 4.5 to 6 times less likely to secure decent jobs relative to older people (ILO 2017); and jobs in the formal sector are limited, while the informal sector seldom provides decent jobs (Commonwealth Secretariat 2017).

Figure 6.1 highlights the untapped potential of youth in Commonwealth countries, reflected in the share of youths not in employment, education or training (the NEET rate). The NEET rate varies across Commonwealth members, with small states having more untapped potential for youths. Trinidad and Tobago has a NEET rate of 52.1 per cent, followed by Kiribati (46.9%), Botswana and Eswatini (25.5%) and The Gambia (34%).

In the fast-changing landscape of the digital economy, both digital and soft skills are going to be increasingly demanded. In such a scenario, the problem of youth unemployment will be compounded by a lack of job-relevant digital skills among Commonwealth youths. On the one hand, young people are "early adopters" of ICT-based technologies and can drive growth and innovation in the sector, but on the other hand, the majority of young people do not possess job-relevant digital skills (ITU 2018). Chapter 3 confirmed that youth (15–24 years) are also at the forefront of internet adoption in the Commonwealth: on average (unweighted), 66.77 per cent of the population in the 15–25 age group in Commonwealth countries has access to the internet. However, compared to the Commonwealth average, internet adoption by youth in Asian economies such as Bangladesh and Pakistan is significantly lower – at just 11.8 per cent and 18.5 per cent, respectively. Similarly, in Nigeria, only 4 per cent of the population in the 15–24 age group has access to the internet. These economies are also found to score lower in terms of digital skills (see Chapter 3).

To boost the inclusion of youth in the future workforce, Commonwealth governments can design national strategies to develop young people's digital skills and build an enabling environment for innovation, entrepreneurship and job creation in the digital economy. Beyond increasing access

Figure 6.1 Share of youths not in employment, education and training in selected Commonwealth countries



Source: ILO Database and authors' own depiction.

The gender digital divide in the Commonwealth presents a significant challenge.

to secondary and tertiary education as well as STEM-focused TVET, this will require changes in the curricula, effective and quality provision of digital and soft skills training, continuous professional development of TVET trainers, investment into digital infrastructure and linkages with a dynamic private sector to align skills taught with industry needs. As the major employer of digitally skilled young people, the private sector can provide workplace learning opportunities to enhance the long-term employment prospects of young women and men.

For out-of-school youth, marginalised sections of society and adult learners in Commonwealth countries, access to digital and soft skills training can be expanded through non-formal TVET. However, training capacity needs to be leveraged through better co-ordination across existing players and linkages with national accreditation systems, which continue to present key challenges in many Asian and African countries. An excellent example of non-formal TVET delivering future-relevant skills is the Digital Ambassadors Programme (DAP), a joint initiative by the WEF's Internet for All, Digital Opportunity Trust and Rwanda's Ministry of Youth and ICT, which is mounting a three-pronged push for boosting internet access, skills training and jobs in Rwanda. DAP aims to employ 5,000 young Rwandans, with 50 per cent participation of young women and girls, as digital skills trainers. These Young Digital Ambassadors will receive training in essential digital skills and soft skills, which they will then draw on to provide hands-on training across the country (WEF 2017).

Boosting opportunities for youth entrepreneurship will require addressing key challenges related to the limited regulatory environment in small states; poor co-ordination between national and sector-based policies promoting youth entrepreneurship; data gaps on youth unemployment and youth entrepreneurship; insufficient and ineffective business services for young entrepreneurs, including the lack of financial access and services such as e-commerce platforms; limited incentives and investment opportunities for young entrepreneurs; inadequate ICT infrastructure and capacity including high costs, low coverage and connectivity; and the absence of entrepreneurship education and training for young people in formal and non-formal education, including as a result of insufficient funds to support educational development in this area (Commonwealth Secretariat 2017).

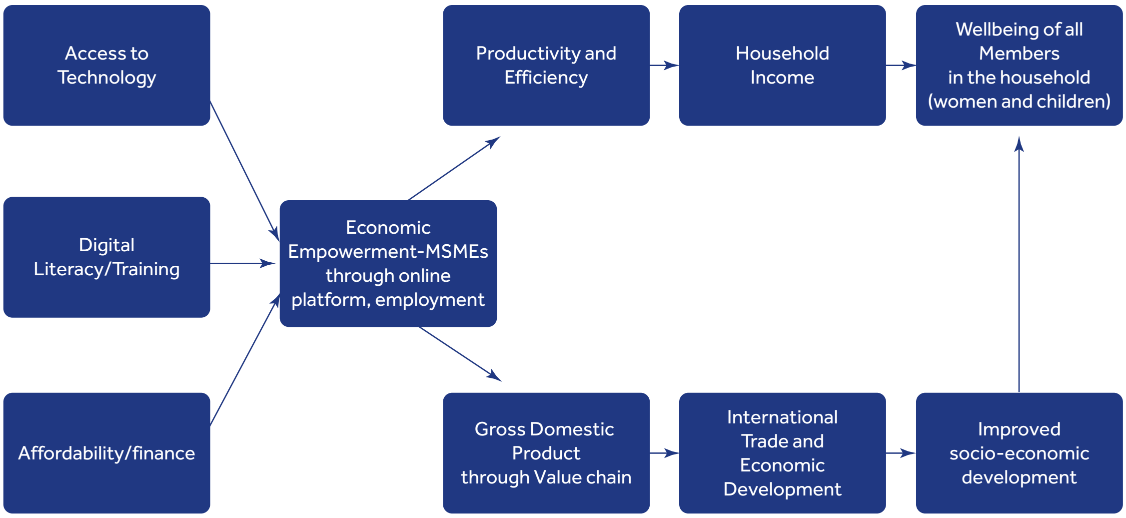
6.1.3 Digitalisation and inclusion of women

Digital technologies can help reduce gender gaps in labour force participation in the Commonwealth through a number of channels (Herbert 2017), including by creating new opportunities in services sectors; lowering barriers for MSMEs to enter markets; creating new opportunities in online work, e-commerce and the gig economy; and making work arrangements more flexible (World Bank 2016, 134; UNCTAD 2017). Figure 6.2 provides an illustration of the link between digitalisation and women's economic empowerment.

The on-demand economy for domestic work, for instance, is growing rapidly in developing countries, and is largely dominated by women (making up 80 per cent of the 67 million domestic workers globally). On-demand platforms offer some benefits to domestic workers, such as choice over working times, tracking of hours worked and wages earnt, and potentially better remuneration compared with other forms of domestic work (Hunt and Machingura 2016, 6).

While digitalisation does hold potential for inclusion of women in economic activities, a much more nuanced view is needed to understand whether these opportunities are being realised. For instance, Chapter 3 discussed how automation is: a) displacing mid-level jobs, which are routine and cognitive; b) creating more jobs for low-skilled workers, performing non-routine non-cognitive work such as nursing and caring; and c) creating more jobs for high-skilled workers, preforming non-routine, cognitive tasks such as ICT professionals and managers. Evidence suggests that, on the one hand, women tend to dominate mid-level jobs, while,

Figure 6.2 The link between digitalisation and women's economic empowerment



Source: Authors own depiction.

on the other, they form a very low share of those employed in advanced technology jobs. The latter require advanced digital skills, and employment and wages in these jobs are increasing at a rapid rate (IT for Change n.d.). Therefore, the occupational re-structuring that is currently happening as a result of the digital economy may not be beneficial for the employment of women.

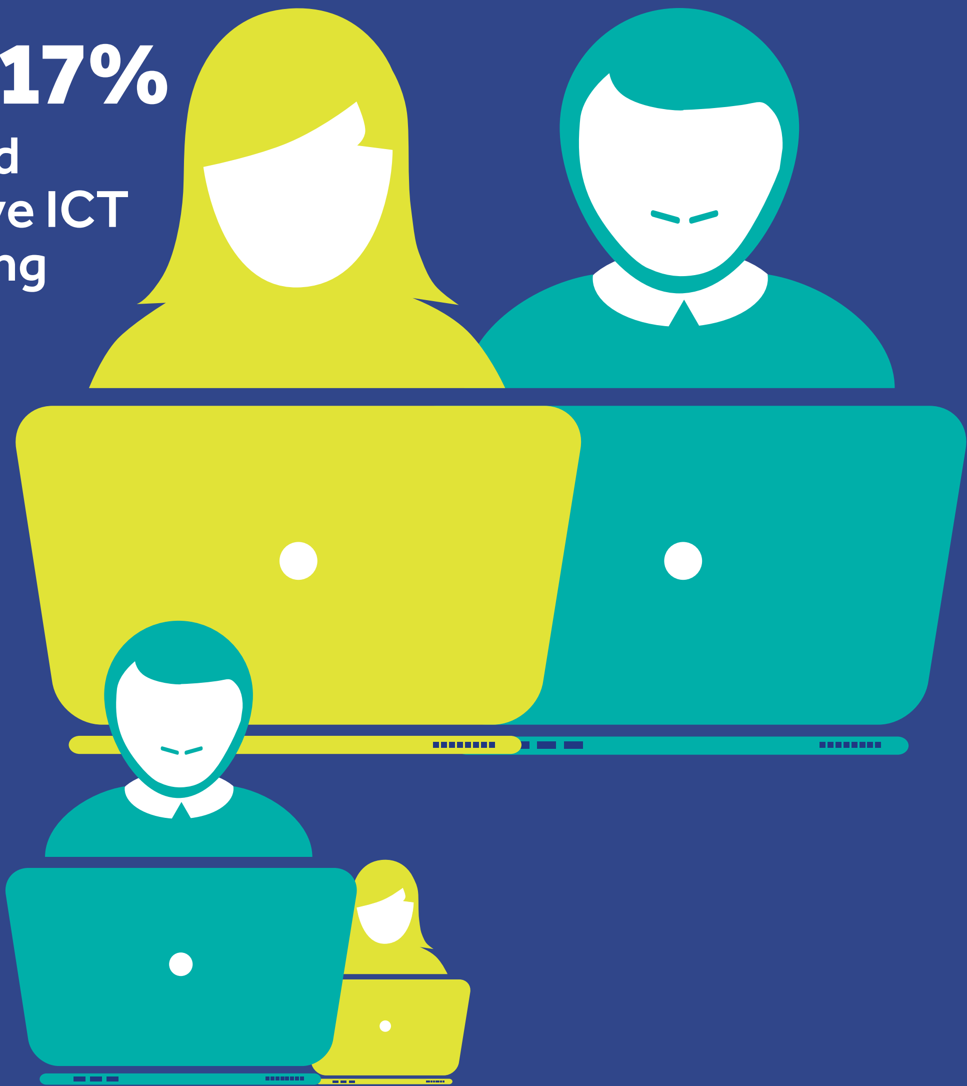
Secondly, the 'gig' economy has been growing rapidly, with ICT companies developing digital platforms to link clients (service purchasers) with work (service providers) (Hunt and Sarwar 2017, 13). Evidence suggests there is a high degree of occupational segregation on gig platforms (Hunt and Samman 2019). For example, in the UK, on the Hassle platform, which provides cleaning services, 86.5 per cent of workers are women, while on the food delivery platform Deliveroo and private transport platform, Uber, 94 per cent and 95 per cent of workers, respectively, are men (Balaram et al. 2017). While overall the gig economy has improved flexibility for both workers and employers, this work is often low paid, insecure and ad hoc, especially for less-skilled workers and marginalised/discriminated groups (Hunt and Sarwar 2017, 13).

Digitalisation has also seen to disproportionately impact the informal sector, which historically is highly feminised (IT for Change n.d.). 'For every new job that digitalisation has opened up, ... (we) may not realise what job opportunities are being taken away, because in the first place, the majority are in the informal sector and may not be easily visible. A squeeze on the informal sector will not really take the form of outright 'job' losses; indeed, in most cases there are not 'jobs' as such, to be lost, but livelihoods. What would happen is a steady compression of incomes, making survival precarious' (Pratap and Bose 2017 in IT for Change and DAWN 2018).

Persistent gendered digital divides are further compounding digital exclusion of women and keeping them from realising the full benefits that the digital economy has to offer. Compared to men, women entrepreneurs in developing economies tend to be disadvantaged in accessing finance, and in terms of time constraints, mobility, and access to skills and training. Figure 6.3 provides an illustration of the time required to start a business (in female days) across Commonwealth countries. For countries such as Fiji, Malawi and Eswatini, the time for females to

In some Commonwealth countries there are significant gender disparities in ICT programming skills

Brunei 17%
of males and females have ICT programming skills

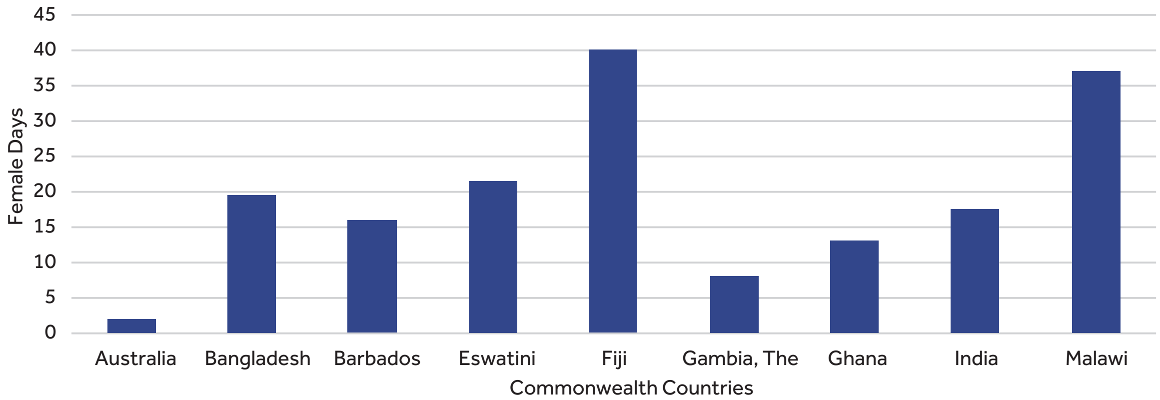


UK
10.6%
vs **5.2%**

Singapore 8.9% vs 3.9%
Malta 7.7% vs 3.4%
Botswana 5.9% vs 3.9%

Pakistan 2% vs 0.9%

Figure 6.3 Time required to start a business (female) days in selected Commonwealth countries

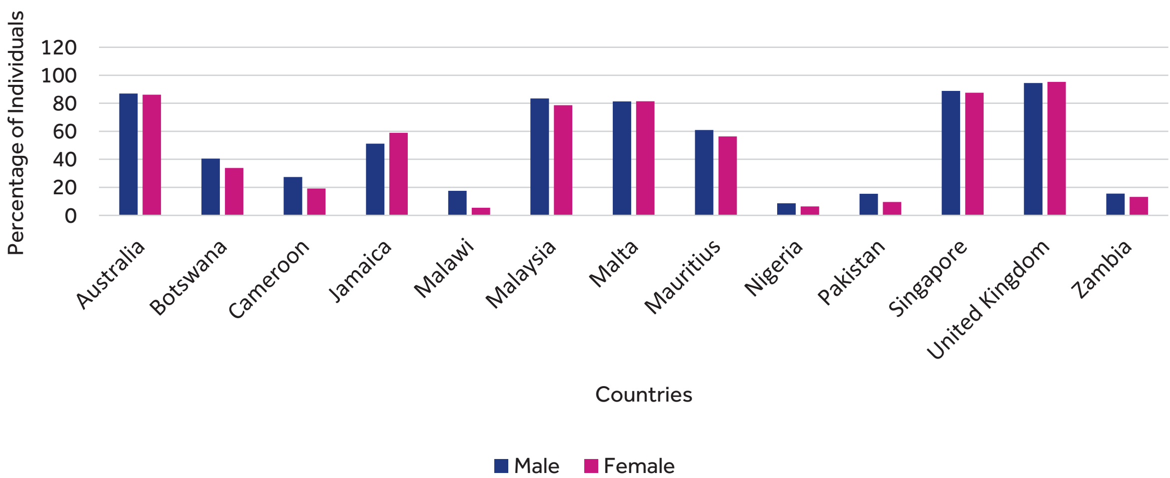


Source: World Bank Database.

start a business is high in comparison to countries such as Australia and The Gambia. The difference in the time required to start a business reflects the trade facilitation constraints faced by women.

While e-commerce and digital solutions can help overcome some of these barriers – e.g. via cloud services and crowd financing on online platforms (UNCTAD 2017, 45), women are less likely to access the internet. Figure 6.4 shows the percentage shares of males and females using the internet across a selection of Commonwealth member countries. There is greater parity in the use of the internet across developed Commonwealth countries such as Australia and the UK. On the contrary, the use of internet is biased toward males in developing countries such as Botswana, Cameroon, Malawi, Nigeria and Zambia. This disparity indicates how women are further marginalised in the digital age. Women are also less likely to access financial services, and

Figure 6.4 Percentage share of males and females using the internet in selected Commonwealth countries



Source: ITU Database.

particularly less via mobile technology (Hunt and Samman 2016, 19). Women on average are 14 per cent less likely to own a mobile phone than men, which translates into 200 million fewer women than men owning mobile phones in low- and middle-income countries; and this gender gap in mobile phone ownership is most pronounced in South Asia (GSMA Connected Women 2015). While cost remains the greatest barrier overall to owning and using a mobile phone, security and harassment also emerged as one of the top five barriers, and a key concern for women (Herbert 2017).

Figure 6.4 shows the percentage shares of males and females using the internet across a selection of Commonwealth member countries. There is greater parity in the use of the internet across developed Commonwealth countries such as Australia and the UK. On the contrary, the use of internet is biased toward males in developing countries such as Botswana, Cameroon, Malawi, Nigeria and Zambia. This disparity indicates how women are further marginalised in the digital age.

Women and girls also tend to have lower levels of literacy, education and digital skills, which can be key in enhancing the ability of women to access technology and engage in digital trade. Table 6.1 shows the percentage of the population with different ICT skills, by country and gender. It is observed that the proportion of the male population with basic information management skills – for copying or moving a file or folder and using basic arithmetic formulae in a spreadsheet – is higher than that of the female population in the majority of the Commonwealth countries examined. The same is true for more advanced digital skills associated with finding and downloading software or writing a computer programme using a specialised language (ICT programming). In Jamaica, the share of the female population with information management skills, and with advanced digital skills for finding, downloading and configuring software, is higher than the equivalent share of the male population. Across the Commonwealth, the available data suggests there are disparities that exist among males and females in relation to ICT programming skills. Table 6.1 shows that apart from Brunei Darussalam,

Table 6.1 Individuals by ICT skills, by gender

		Copying or moving a file or folder		Using basic arithmetic formula in a spreadsheet		Finding, downloading, installing and configuring software		Writing a computer program using a specialized programming language	
		Male	Female	Male	Female	Male	Female	Male	Female
Botswana	2014	37.1	31.6	21.1	18.5			5.9	3.9
Brunei Darussalam	2016	89	89	25	25	57	57	17	17
Jamaica	2016	13.2	17.6	4.6	6	6.9	7.2		
Malaysia	2017	59.9	50.7	25.7	23.8	36.5	30.7	7.9	7.1
Malta	2017	54.5	52.1	41.4	35.8	53.4	43.9	7.7	3.4
Pakistan	2016	8.1	2.9	2.9	1.3	4.9	2.1	2	0.9
Singapore	2017	57.1	51.3	37.8	36.5	46.8	38.9	8.9	3.9
United Kingdom	2016	66.4	59.4	48.5	45.6	63.8	57.5	10.6	5.2

Source: ITU data.

other Commonwealth countries such as the UK, Singapore, Malta, Malaysia and Botswana have gender disparities in ICT programming skills in favour of males.

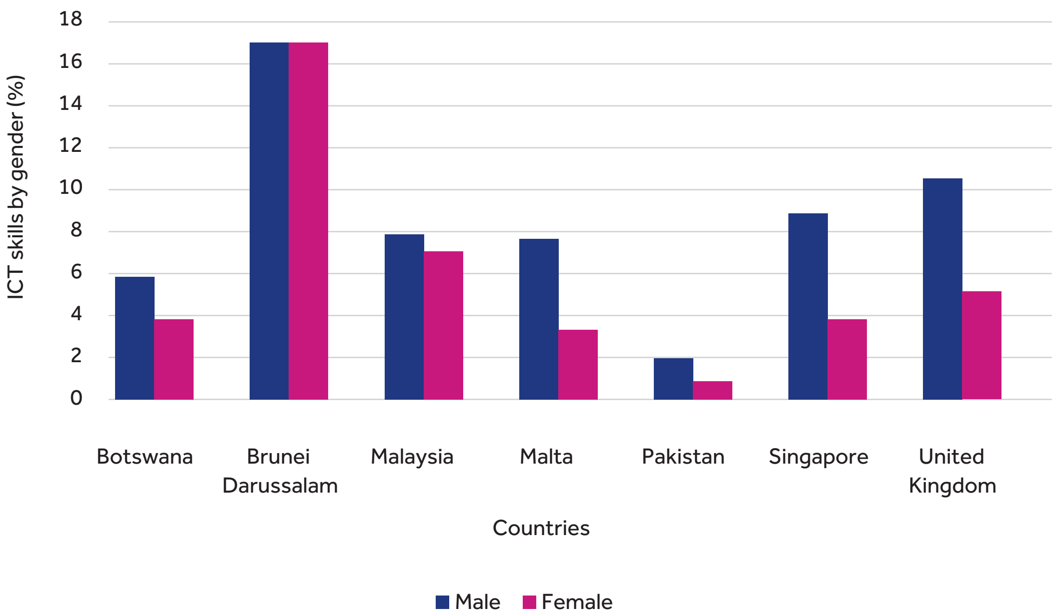
Furthermore, ICT skills are critical in enhancing the ability of women to access technology and engage in digital trade. Across the Commonwealth, the available data suggests there are disparities that exist among males and females in relation to ICT programming skills. Figure 6.5 shows that apart from Brunei Darussalam, other Commonwealth countries such as the UK, Singapore, Malta, Malaysia and Botswana have gender disparities in ICT programming skills in favour of males.

For technology to be truly transformative, it is imperative to bridge the gender gap in mobile phone access and usage, digital connectivity and employment in ICT sectors in low- and middle-income Commonwealth countries. Some of the more digitally connected Commonwealth member countries, such as Australia and the UK, have experience in developing inclusive digital strategies. There is an opportunity for greater knowledge sharing within the Commonwealth, to enable fellow Commonwealth members to draw on these experiences to foster and accelerate inclusive and sustainable development by closing the digital gender gap and harnessing the transformative potential of ICTs for women's empowerment (Commonwealth Secretariat 2018).

6.2 Sustainable development in the digital age

Digital technologies have significant potential in boosting sustainable development for Commonwealth countries. The discussions on sustainable development are discussed in relation to the 'green' and 'blue' economies. For the green economy, the focus of the Commonwealth Connectivity Agenda (CCA) is in the area of smart agriculture and the use of such technologies to leverage inclusive and sustainable development across the Commonwealth. For the blue economy,

Figure 6.5 Share of individuals with ICT programming skills, by gender, in selected Commonwealth countries



Source: ITU Database.

the CCA's focus is on smart fisheries and the use of technology in the sector to leverage sustainable development.

6.2.1 Digitalisation and the green economy in the Commonwealth

Given the growth impediments typically encountered in the agriculture sector, to leverage growth and development and equitable welfare gains for countries, including Commonwealth small states and LDCs, the application of technology and its integration into agriculture would greatly benefit the sector. The technology involved in smart agriculture ranges from sensing technologies, software applications, communications systems (e.g. cellular, telematics), positioning technologies, hardware and software systems, data analytics solutions and sensing technologies. Smart agriculture (see Figure 6.5) can be applied to a number of areas including fleet management, arable farming, livestock monitoring, indoor farming, fishing, forestry and storage.

The use of different technologies will assist in the improvement of farming systems and ultimately boost agricultural production. With the use of new digital services such as Global Satellite Systems machine guidance, sensors and cloud portals, traditional suppliers will be able to create value and market advantage for their products. The use of new digital solutions through the internet or via smart phones allows access to services which was previously not possible. For example, e-payments using mobile systems in agriculture.

Technology also enables farmers in rural remote areas to access agricultural extension services and provides access to market information on inputs and production prices, connecting to suppliers and receiving online training on farming techniques to boost agricultural productivity and the quality of production. For smallholder farmers, including MSMEs, which operate in unorganised farming sectors, the integration of technology will enable them to organise the sector and solve issues in relation to supply-side constraints. For instance, the use of virtual market places to co-ordinate and bring together traders and farmers in one place is a promising way for isolated farmers in remote areas to connect to markets. This positive spillover also increases farmers' livelihood opportunities and benefits in accessing untapped trade markets.

In agriculture, the control of pests and diseases is a major concern and an issue that also impedes trade in agricultural products. The 'behind the border' sanitary and phytosanitary (biosecurity) measures are extremely important in agriculture. Meeting biosecurity standards is critical in order to export agricultural products to importing member countries. Machine learning technology can support the identification of pests by simply using an application and smart phone camera. It uses farm-specific data to provide insights which farmers can act upon, for example, information on the pace of water in an irrigation system and variable application rate of pesticides.

The utilisation of digital technology can also aid farmers in addressing technical barriers to trade and information asymmetries. The use of digital technology can facilitate traceability, food integrity and assist in certification. Digital technology enables the capacity to transfer data from 'farm to fork' in secure and trusted ways and makes it possible for consumers to access information and act on their preferences. Digital technology can also provide data and information to non-food downstream sectors to which the agriculture sector supplies primary products, including textiles and leather. Such technology also provides tools to enable those sectors to perform life cycle assistance. In other words, it aides in GVC additions in agriculture. Box 6.2 presents some examples from Commonwealth African countries which are leveraging the benefits of digital technologies to boost the green economy.

Use of technology in agriculture in Commonwealth countries

Commonwealth members are at different levels of development. For Commonwealth developing

Box 6.2 Digitalisation and green economy in Tanzania, Kenya and Uganda

In relation to the green economy, Flying Labs, an organisation by We Robots prevalent in Tanzania, Kenya and Uganda, uses robots and drones to collect data on regional servers. These data are then used to improve efficiency and provide access to information across several industries. They work across the agriculture and agro-processing sectors and monitor forest coverage. Kenya is also a hotspot for agricultural apps and the use of digital technologies to support agricultural activity. For instance, Precision Agriculture for Development (PAD), a global non-governmental organisation, is focused on integrating greater precision into digital smallholder advisory extensions with the support of remote sensing data, other data such as weather patterns and soil types, behavioural science techniques (for solution design and testing), and rigorous evaluations (i.e., randomised control trials (RCTs) of resulting advisory outcomes). Satellite imagery analytics are the cornerstone of PAD's precision advisory solutions in Africa. The information is frequently transmitted to farmers through SMS, thereby allowing for greater penetration.

In Uganda, the Ministry of Agriculture and ICT supported E-voucher and Akello Banker apps provide packages of inputs (fertilizers, chemicals and seed) to farmers. E-voucher uses a subsidy system that partially covers the cost of inputs for the growing season. Akello Banker provides discounts to farmers via its dashboard if farmers purchase inputs from its partners, while also getting working capital loans to do so.

Source: https://flyinglabs.org/kenya/ and https://precisionag.org/

countries, the use of technology in the agricultural sector is slowly evolving. It is evident that there are different levels of use of technology in agriculture across the Commonwealth. A number of different applications are used by countries depending on their varied needs and also the stage of development of their agricultural sector. Table 6.2 provides some examples of the technology used by developing Commonwealth members in agriculture.

Challenges in the use of smart agriculture

There still remain major challenges in the adoption of technology in agriculture for Commonwealth members. The agriculture sector in most Commonwealth members depends on traditional methods of farming and most of the farms operate as MSMEs. The adoption of high-end technologies requires capital investment: such technologies could be affordable to large-scale farmers, but MSMEs may face significant financial costs for business remodelling to acquire such technologies.

Furthermore, a lack of capacity – including in relation to human capital and know-how – among farmers to utilise agricultural technology is an impediment. The absence of other key enablers for the use of agricultural technologies, such as access to the internet and broadband connectivity or physical infrastructure such as energy (electricity) in rural areas, can also derail the use of SMART agriculture technology. In addition, the use of data and the lack of regulations on data co-operation and sharing among the various stakeholders can also be an impediment. Most Commonwealth countries do not have regulations for businesses related to digital data sharing and use.

Table 6.2 Examples of the use of technology in agriculture in Commonwealth countries

Country	Application	Description
India	Agropedia	This is a wiki type of website developed as a collaborative project by seven consortium partners. It offers a crop-specific library, blog and chat.
Pakistan	Pakissan	Pakissan.com is the largest agricultural web portal in Pakistan, providing a platform where the entire agri-community can connect with one another, sharing ideas, experiences and information.
Bangladesh	Jigyasha	This is a mobile-based ago-information service in Bangladesh.
India	Kisan Call Centre	The purpose of these call centres is to respond to agricultural and related issues by farmers.
Kenya	Kenya Farmers' Helpline-m Kilimo	Call centre provides agricultural and horticultural information, advice and support. The service primarily targets individual farmers and is accessible to agriculture extension facilities.
India	IFFCO Kisan Sanchar Limited (IKSL)	This is provided by a mobile operator in India partnered with the Indian Farmer Fertilizer Cooperative Ltd. The company provides information on market prices, farming techniques (including dairy and husbandry), weather forecasts and fertiliser availability. It also answers farmers' queries.
Kenya	Corn Variety SMS Service	Kenyan farmers can get an SMS for the recommended corn verities in their division by sending text messages with key word 'MAIZE'.
Uganda	Farmers Friend	Farmers can search for agricultural tips through an SMS-based database covering crop and livestock, pest and disease control information, planting, storage and harvesting tips and weather forecasts.
India	Digital Green	Information is disseminated to small-scale farmers through digital videos. It provides structure to traditional, informal peer-peer training and improves the efficiency of extension programmes.
West Africa	SIBWA – Seeing is Believing West Africa	This project is intended to demonstrate the value of high-resolution imagery (VHRI). The SIBWA team provides farmers with very high-level imagery of their land. The information gives farmers an understanding on soil fertility and accurate land size to plan and manage their crops for the coming growing season.

(*Continued*)

Table 6.2 Examples of the use of technology in agriculture in Commonwealth countries (*Continued*)

Country	Application	Description
Uganda	Community Knowledge Worker	The community knowledge workers can help experts identify disease and pest outbreaks. The system uses both mobile phones and Geographic Information Systems (GIS) technology to link local community knowledge workers networks to scientists, in order to enable them to identify, map, monitor and control banana diseases within farming communities.
Senegal	Xam Marse	This provides information on the prices and availability of fruits, vegetables, meat and poultry at all the country's markets.
Benin	Info Prix	This provides market prices of the 25 most important staple foods via SMS.
Ghana, Benin, Burkina Faso, Cameroon, Ivory Coast, Madagascar, Mali, Togo and Afghanistan	Esoko/Trade Net	This initiative is similar to eBay for agricultural products. With Esoko, market information can be delivered automatically to mobile phones, specified by days, markets and commodities for which to receive prices, or commodities and locations from which one would like to receive offers.
Kenya	Kenya Plant Health Inspectorate (KEPHIS)	The Kenya Plant Health Inspectorate has established a simple SMS service that allows farmers to check whether the seed seller is duly licensed. The farmer texts the dealer's license number to the KEPHIS short code and gets the SMS confirmation on the seed seller's status.
Kenya	Agri Managr	This is a mobile solution for the Kenyan tea industry. It is used to accurately record growers green leaf weights from the buying centre through to the factory. It is useful for small-scale farmers.

Source: Syngenta Foundation (2011).

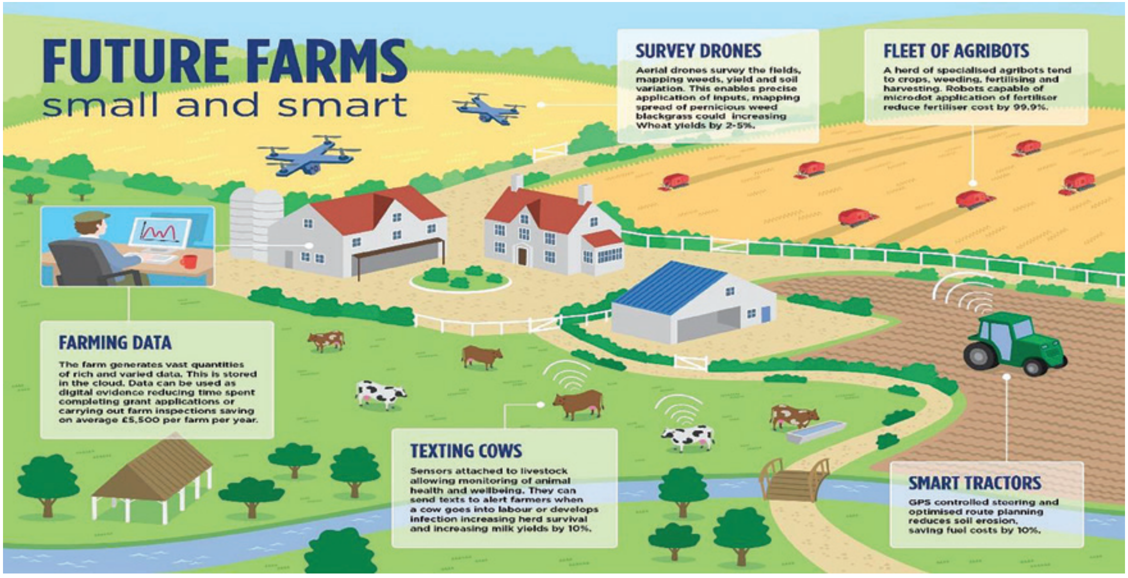
6.2.2 Digitalisation and the blue economy in the Commonwealth

The fisheries sector is of particular importance to the blue economy. 'Fish is a major source of protein for a large portion of the world's population. Fish is a renewable resource however it can perish if not managed properly. For developing and least developed countries, fish is not just for human consumption, it similarly creates jobs and value addition by producing processed products.' (Kumar et al. 2019). The integration of technology in the fisheries sector will enable the sustainable management of fisheries resources for Commonwealth members, while ensuring maximum returns. Smart fisheries are, therefore, an important component of the blue economy which, in turn, is a focus of the CCA. Figure 6.6 provides an example of how satellite technology is used to monitor vessels.

Smart fisheries technology

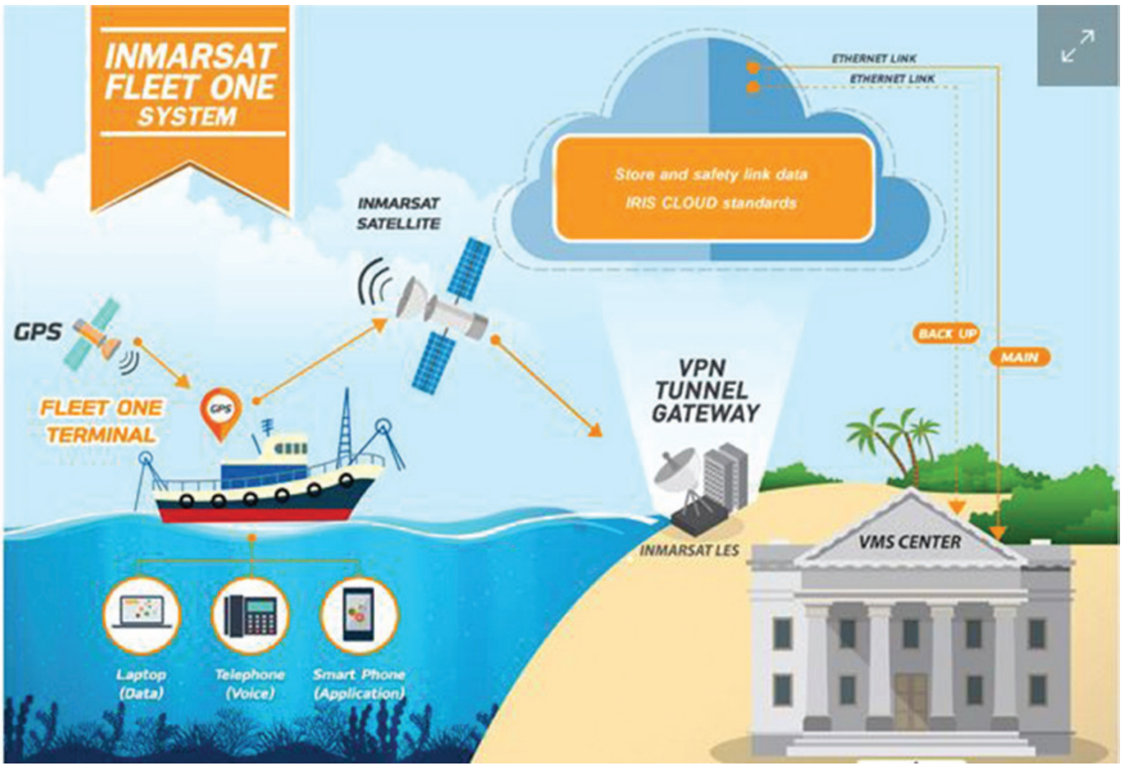
The following are some examples of smart technologies used in the fisheries sector (see Figure 6.7):

Figure 6.6 Illustration of smart agriculture



Source: NESTA (2015).

Figure 6.7 Smart fisheries technology



Source: https://ec.europa.eu/fisheries/sites/fisheries/files/img/body/vessel_monitoring_system_en.jpg.

a. **Vessel monitoring device**: The device collects data on the movement of vessels. This is used to improve management and compliance with government fisheries policies and enables them to collect near real-time observations of fishing vessel positions.

b. **Automatic Identification System (AIS)**: This is a device which was initially developed to prevent vessel collision by Vessel Traffic Services. However, the communication system can be used to detect the speed and location of the vessel and also alert the authorities whether a vessel is operating in a specific area or is in transit.

c. **Electronic log books**: This keeps track of catches (origin and volume) and the type of gear used. It also collects information on species, volume and the area of catches. The system makes it possible to trace catches back to the individual fishing operation, improves knowledge of fisheries and, thus, enhances the efficiency of the sector.

d. **Smartphone for monitoring**: Global Systems Mobile Communication smart phones with vessel monitoring system transceivers can be used to collect data from fishing vessels and transmit this data to satellite operators. The data can be used for monitoring information. Some satellite operators also use software which shows a vessel's location, the estimated time of arrival and its course over 24 hours.

e. **Big Data technologies for monitoring of fisheries**: Big Data can assist in sorting information on vessel traffic intensity and also detect suspicious fishing activity in Marine Protected Areas around the globe.

f. **Blockchain technologies**: These can be used in the seafood industry by combining collaborative technologies to increase the traceability of fish products, targeting illegal, unreported and unregulated (IUU) fishing products mixed within the value chain of legal products. The technology can be used in both marine capture and in aquaculture. However, the issue of data sharing among competitors has been contentious.

g. **Smart weighing system at sea**: This system is used by large fishing vessels at sea. The system monitors the movement of boats at sea and calculates the weight of catches. The data is then sent to fish markets and ports by satellite support to update landing forecasts. Some of these weighing systems also integrate tagging systems on fish boxes to have traceability features.

h. **Drones**: These can be used for surveillance and locating illegal fishing and may be deployed in Marine Protected Areas.

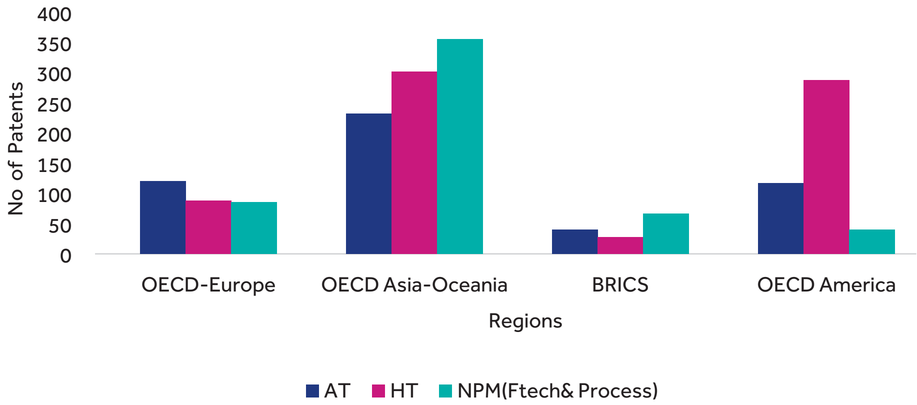
i. **On board survey cameras and electronic monitoring**: Electronic monitoring consists of a closed video or photographic system, integrated with a sensor system that can be used to view changes in fishing activity and to trigger or co-ordinate detailed viewing. The camera and sensor systems do not allow external or manual inputs or manipulation of data. The cameras may identify interactions with bycatch species and are useful when recording bycatches of protected species. The viewed data can also provide a secondary source of information, for example, to validate catch and bycatch log sheets.

Use of technology in fisheries in Commonwealth countries

Figure 6.8 shows the development of fisheries technologies by region, including OECD and BRICS (Brazil, Russia, India, China, South Africa) countries in aquaculture technology (AT), harvesting technology (HT) and new products and markets technology, which includes food technology and processing (NPM & Processing). The OECD Asia–Oceania countries are the top developers of fisheries technology in all three categories. This is followed by OECD America, OECD Europe and the BRICS countries, which include two Commonwealth members (India and South Africa).

It is evident that the development of fisheries technology is available to an extent and countries are utilising such technology and moving towards digitalisation. For example, New Zealand has

Figure 6.8 Fisheries technology development by region



Source: OECD fisheries database.

launched a digital monitoring system which includes electronic catch and reporting, electronic positioning to verify fishing and on-board cameras. The Western Central Pacific Fishing Commission has adopted standards specification procedures for fishing vessel monitoring systems (Kumar 2017). These have become effective in New Zealand, Australia, Tuvalu, Samoa, Tonga, Nauru and Solomon Islands. Some of these countries are small states and members of the Commonwealth. The Indian Ocean Tuna Commission has also adopted the vessel monitoring system programme.

There are already some excellent examples within the Commonwealth of how digital technologies are being successfully used by countries to move towards more sustainable use of ocean resources for economic growth, improved livelihoods and jobs, and a healthier ocean ecosystem, i.e. a blue economy. These developments include formulation of a Blue Lab in the Caribbean (Box 6.3), electronic monitoring of fisheries in Australia (Box 6.4), digitalisation of tourism and fishing in Mauritius (Box 6.5) and the use of digital technologies for disaster management in small states (Box 6.6).

Box 6.3 Caribbean – Blue Lab/IADB Blue-Tech Challenge

A new Accelerator Lab is being hosted within the UN Development Programme (UNDP) Sub-Regional Office for Barbados and the Organisation of Eastern Caribbean States focusing on the blue economy through the construction of a Blue Lab. This Blue Lab is critical to countries like Antigua and Barbuda, Barbados and Dominica, which have maritime space between 200 and 400 times larger than their land space and are heavily reliant on ocean resources to support the tourism and fishing industries, as well as access to imported products through seaport activity.

TEN Habitat, a company from Barbados began implementation of a 'Totally Traceable Tuna' blockchain product in 2019 under the Inter-American Development Bank (IADB) Blue-Tech Challenge accelerator, an element of the Blue Lab. The aim is to use blockchain technology to enhance the tuna supply chain which could, in turn, support the expansion of the fisheries sector by reducing imports and increasing exports.

Sources: Simpson and Small (2019); IDB (2019); FOMIN (2018).

Box 6.4 Electronic monitoring of fisheries in Australia

Australia is another Commonwealth member state investing heavily in digital technologies. Fishing is an important sector within Australia – approximately 3.4 million Australians are regular fishers. Over the last two decades, there has been heavy investment in data collection, and electronic monitoring to provide timely, reliable and independent data that equips fisheries managers and other parties with improved capacity to make well-informed management decisions. Electronic monitoring consists of a sensor system linked to a closed video or photographic system that can be used to view fishing activity (AFMA 2016). The EM system generally consists of a control centre connected to an array of peripheral components including CCTV cameras, a GPS or AIS receiver, gear activity sensors, and a communications transceiver. The sensors transmit real-time positions and record when a change in fishing behaviour occurs, while the camera and sensor system do not allow external or manual inputs, or manipulation of data. The footage is transmitted to the Cloud, where the Australian Fisheries Management Authority (AFMA) collects, stores and analyses the data to provide real time support. This is done within the Tuna and Billfish Fishery and Scalefish and Shark Fishery.

Source: Australian Government Department of Agriculture (2017).

Box 6.5 Mauritius: Digitalisation of tourism and fishing

Digitalisation, both in terms of hardware and software is also pervasive in Mauritius. For instance, there has been significant uptake of ICT, which has permeated into tourism and fishing among small-scale farmers. Mauritius has been an early adopter of mobile technology, including by launching 3G mobile services in 2007 and 4G services in 2012, well ahead of most other African countries (WDR 2016). The use of ICT has allowed for online booking and payment of hotel stays in coastal regions, and the use of GPS navigation by mariners and RFID/barcode tracking of catches by fisheries has allowed for improvement in catchment. Furthermore, the Mauritian government, has extended mobile coverage offshore, which is particularly useful for casual or leisure mariners, as well as for fisheries operating in coastal waters. This could also supplement existing maritime safety services (ibid). Mauritius already has a high level of mobile phone subscribers, with 1.76 million subscribers at the start of 2016, equivalent to a 140 per cent penetration rate (World Bank 2017). The Mauritius Ocean Authority has been pushing for the creation of an Integrated Ocean Database and to set up the Mauritius Ocean Observatory for detailed analysis to support decision-making. The ocean database for Mauritius and the Indian Ocean can be used for modelling the movement of fish, and improving the overall productivity of fishing, while maintaining ocean biodiversity.

Source: World Bank Group (2017); Kenna et al. (2018).

Box 6.6 Blue economy and disaster management in small states

Ocean acidification is occurring at a fast pace. Coral reefs are estimated to be worth approximately US$9.9 trillion and provide circa US$325,000/ha/year to local communities through tourism/recreation, fish habitats and the protection of coastal regions against storm damage, especially in small island states. The Natural Environment Research Council of the UK, through the National Oceanographic Centre, worked with the governments of Belize and Dominica, Papua New Guinea and Fiji in 2017 to install a self-contained, autonomous monitoring system capable of measuring pH (climate level quality), dissolved oxygen, salinity, temperature and nitrate levels. The system includes a satellite telemetry unit for relaying data offshore to a shared server, enabling the measurements to contribute to global observational systems. The autonomous digital systems aim to reduce complexity, as they can be attached to the seabed or other permanent structures and need very little maintenance, while also operating with rechargeable batteries (ibid).

For instance, in Vanuatu, Oxfam International just spent a month testing MakerDAO's stablecoin DAI as a vehicle for helping disaster victims. The pilot was conducted in partnership with Australian technology firm Sempo and ConsenSys, a startup providing Ethereum blockchain solutions to real-world problems. Vanuatu routinely faces a high risk of tsunamis, cyclones and volcanic eruptions, while poverty levels in the country are high. In the pilot, named the UnBlocked Cash, 200 residents in the villages of Pango and Mele Maat on the island of Efate were given tap-and-pay cards, each loaded with about 4,000 vatu ($50) in DAI. The cards could be used for payments across a network of local stores and schools, with 32 vendors in total.

Source: National Oceanography Centre n.d.; CoinDesk 2019.

Challenges to smart fisheries technology

The integration of technology in both agriculture and fisheries is essential for improving productivity and efficiency in these sectors. Both sectors are important for food security, livelihoods and socio-economic development of Commonwealth member countries. The technology applied in both these sectors is similar in nature but varies in its application. The adoption of technology varies across the Commonwealth countries depending on the nature of production and the capacity of countries. The most commonly used technology is mobile phones, which depend on access to high-speed internet. In the fisheries sector, vessel monitoring systems and electronic logbooks are some of the ways in which information is captured. Some of the new technologies can also act as a barrier for fisheries and countries that lack the capacity and the financial resources to fully adopt them. Additionally, barriers to access to new technologies by fishers and fish farmers also have to be addressed. The lack of capacity and know-how for fishers and the industry as a whole to utilise disruptive technologies is a challenge. For MSMEs in aquaculture, the adoption of such technologies comes with a high cost. Most of these sectors employ women who are further marginalised with poor access to technology.

6.2.3 Digitalisation and outcomes for the green and blue economy in the Commonwealth

Maintaining and mitigating are key outcomes for the green and blue economies. Maintaining

Table 6.3 Digital technologies supporting the blue and green economies in the Commonwealth

Digitalisation product name	Sector	Country/ countries	Type of tech	About the product	Expected outcomes	Key actors
Totally Traceable Tuna	Blue economy – tuna value chains	Barbados	Blockchains	Improve traceability, payments and quality of the tuna supply chain in Barbados	Maintain: improving productivity, reducing wastage Mitigate: improving eco-design	IADB, UNDP, Ten Habitat Barbados
Electronic Monitoring	Blue economy – tuna, scale fish and shark	Australia and New Zealand	Big Data, GPS, electronic monitoring with IoT, automatic identification systems	Improve the decision-making of fishery managers and maximise yield without disturbing habitat	Maintain: increasing productivity, de-materialisation of resources, increasing energy efficiency Mitigate: investment in technology; improving eco-design	Tuna and Billfish Fishery and Scalefish and Shark Fishery, Australian Fisheries Management Authority
ICT uptake and Ocean Observatory	Blue economy – fishing	Mauritius	Radio frequency identification, GPS, barcode tracking, internet	Traceability of standards, green communication of best practices via mobile, data collection and dissemination of wave patterns	Maintain: improving productivity, reducing wastage Mitigate: improving eco-design	Mauritius government, World Bank, Ocean Observatory

Autonomous ocean acidification sensor kit	Blue economy – ocean acidification	Belize, Dominica, Papua New Guinea, Fiji	Self-contained, autonomous monitoring system, rechargeable batteries, data servers	Monitor and maintain ocean pH levels, monitor fish activity	Mitigate: improving eco-design and increasing use of green chemistry; improving resource recovery	National Oceanography Centre, UK and Governments of Belize, Dominica, Papua New Guinea and Fiji
UnBlocked Cash	Disaster management	Vanuatu	Blockchains through Ethereum stable coin	Payment of cash for relief during disasters	Mitigate: climate change and risk to livelihoods	Sempo and Ethereum start-up ConsenSys
Flying Labs	Green economy – aerial mapping, decision analysis	Kenya, Uganda, Tanzania	Drones, AI and data analytics	Land mapping, remote sensing	Maintain: improving productivity, reducing wastage Mitigate: improving eco-design	Flying Labs, We Robotics, regional companies
E-Voucher and Akello Banker apps	Green economy – apps	Uganda	Smart phone-based apps, agri- and fin-tech support	Tech support for crop production and sale	Maintain: improving productivity, reducing wastage	Ministry of ICT, Ministry of Agriculture Uganda, Standard Bank, Akello
Precision Agriculture for Development (PAD)	Green economy – farming app	Kenya	SMS-based crop information, fin-tech support	Tech support for good practices, weather information	Maintain: improving productivity, reducing wastage, increasing efficiency	PAD, J-PAL, Acre, World Bank

Source: Authors, compiled from various sources.

means improving resource efficiency and productivity of natural capital; while mitigation involves larger asset-specific investments for prevention or reduction of emissions, wastage and promotion of circularity within the green and blue economies.

Technological advancement has been identified as a key process for maintenance and mitigation in the context of the green and blue economies, especially as it relates to digitalisation through ICT, Big Data analysis, the use of blockchains, IoT and 3D-printing (Halkos 2018). While much research suggests that digitalisation has positive implications on industry and growth (Niehoff and Beier 2018), some question the net effect of increased pollution caused by intensive use of mobile phones, laptops and servers, which contributed almost 3 per cent of total emissions in 2017 (Halkos 2018). This sub-section unpacks the role of digitalisation in mitigation and maintenance of the green and blue economies in Commonwealth countries. The impacts of different digital technologies on the green and blue economies are discussed below and summarised in Table 6.3.

There are also major challenges to the adoption of digital technologies for both the blue and green economies. These include a lack of internet infrastructure, inadequacies in energy supply, limited capacity and industry knowledge, and the high cost of some of these technologies, which creates a barrier to access for MSMEs. For instance, even though new technologies offer the fisheries sector the opportunity to improve fishing practices and, thereby, increase efficiency and income, if these technologies are not used properly, they can further exacerbate illegal, unreported and unregulated fishing or, if mismanaged, increase the overexploitation of resources. Despite these challenges, some Commonwealth member countries are utilising smart technologies in both the agriculture and the fisheries sector. Further exchange of experiences and knowledge between Commonwealth member states in smart agriculture and fisheries is therefore imperative.

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