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Working Paper

Effective and Sustainable Capacity-Building for Achieving the Paris Agreement: A Special Report on Climate Finance and Digitalization

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Executive Summary

Highlights

- Adequate capacity is needed to enact Nationally Determined Contributions (NDCs) which were adopted by 192 in accordance with the Paris Agreement.
- Climate finance mechanisms and digitalization technologies may be applicable in resolving key shortfalls currently present in capacity building empowerment initiatives.
- This working paper provides recommendations related to empowerment through the lenses of finance and digitalization in response to persistent capacity building challenges.
- The working paper seeks to show where financial and digital toolkits are apt to address shortfalls in the drivers of capacity building, project length, reporting frameworks, participation & inclusion metrics, and clear identification of needs.
- Ultimately, this paper offers a framework for a solution-matching system that is synthesized, centered around prioritizing disadvantaged stakeholders while incorporating modular flexibility to meet the distinct needs of specific communities and countries.

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Introduction

Overview

Addressing the complex global challenge of climate change requires collective action, bringing on board all countries to create a more resilient and decarbonized world. For the first time in history, such a robust collective global commitment was achieved in the 2015 Paris Agreement, which saw 197 countries committing to national adaptation and mitigation efforts. Out of these countries, 192 have already submitted their NDCs, comprising commitments to reduce emissions and adapt to the impacts of climate change. However, many developing countries do not have adequate capacity to achieve their desired climate goals. This, therefore, makes capacity-building a central aspect in the process of achieving NDCs and the Paris Agreement. It is against this backdrop that a number of capacity-building initiatives for developing countries are implemented, both within and outside of the United Nations Framework Convention on Climate Change (UNFCCC). Effective capacity building, however, requires innovative and sustainable approaches and strategies, which are proposed as the central target of this paper.

Problem Overview

As clearly stated in the annual technical progress report of the Paris Committee on Capacity-building (PCCB), there are still institutional, technical and financial capacity gaps with respect to the implementation of the adaptation and mitigation components of developing countries' NDCs (UNFCCC, 2019). These gaps exist despite overall progress in capacity building related to climate action at the national level. Khan et al. (2019) noted that this is due to shortfalls in past initiatives on capacity building under different bilateral and multilateral agencies including bodies of the UNFCCC, which can be largely attributed to their short-term, ad hoc, supply-driven, and project-based nature.

In addition to the general capacity building/empowerment strategies, this paper treats climate finance and digitalization as critical elements that need attention in addressing existing and emerging capacity building gaps in the implementation of NDCs. As Clemencon (2016) argues, financing remains perhaps the most important issue influencing how quickly developing countries will move on to implementing their NDCs, particularly the conditional pledges that most of them contain. Unfortunately, many developing countries still face challenges relating to climate finance mobilization, access, and allocation, hence limiting their progress on NDC implementation.

Regarding digitalization, innovative technologies hold the potential for facilitating climate action and bridging existing and emerging gaps, especially in areas of measurement, reporting and verification (MRV) of GHG emissions, mitigation actions, and support. For example, measurement is needed to identify emissions trends, determine where to focus greenhouse gas (GHG) reduction efforts, track mitigation-related support, assess whether mitigation actions planned under NDCs or otherwise are proving effective, evaluate the impact of support received, and monitor progress achieved in reducing emissions (Singh et al., 2016). With digitalization, such a complex undertaking would be simplified by utilizing specific innovative technologies such as remote sensing, machine learning modeling, and relational database storage. However, the authors of this paper concur with Baloguna et al. (2019) that while a growing body of research has highlighted the significance of digitalization to climate change mitigation such as reducing GHG and CO_2 emissions, comprehensive evaluations of the potentials of digitalization as an enabler of climate change adaptation remain scarce.

Objective

The objective of our paper is to investigate and analyze existing capacity building challenges toward the fulfillment of the Paris Climate Agreement through the lens of financial mechanisms, strategies, and frameworks; to explore digitalization and key digital technologies for climate mitigation and adaptation; and, to synthesize a novel set of recommendations from the interconnection between financial and digital approaches to capacity building.

Research Questions

1. What challenges are present in existing mechanisms under the UNFCCC that restrict developing countries from achieving their Paris Agreement goals?
2. What are the best strategies for mobilizing, allocating, and utilizing climate finance for effective and sustainable capacity building?
3. What are the primary digital technologies that can be used to help countries increase their capacity?

Policy Implications

This policy report has been developed for use by the World Resources Institute Global Climate Change Policy team to support them in answering research questions expanding on the issues we examine here. The policy recommendations and contextualization of the financial and digital mechanisms generated in this document define key challenges facing international development practitioners attempting to build capacity in sustainable and effective ways, while also demonstrating what benefits and optimal paths forward exist. As a literature review with an emphasis on the synthesis of new ideas, potential policy implications include the compilation of a rich body of research for reference and a framework for capacity building following the Paris Agreement.

Methodology

We carried out a review of existing literature related to capacity building for climate action within and outside the Paris Agreement. We reviewed the UNFCCC's capacity building frameworks, the NDCs, country reports to UNFCCC, as well as any other UNFCCC or other policy documents related to digitalization and climate finance. These were supplemented by research and journal articles related to capacity building, digitalization, and climate finance. During the data collection process, the team worked closely with the World Resources Institute to ensure access to some of the crucial documents. We also made use of Cornell University library, as well as the resources of key organizations such as UNFCCC, World Resources Institute, UN Environment, the Green Climate Fund, and the World Bank, among others.

Furthermore, we developed novel capacity building recommendations with attention paid to the flexibility necessitated by implementation challenges in distinct localities. These recommendations were constructed by analyzing existing shortfalls in capacity building efforts and producing relevant solutions compiled from case studies and theory in the literature. Finally, the project was presented at a Cornell Global Climate Change Science and Policy Symposium in December 2020, and a final policy report submitted to the World Resources Institute.

Background: Capacity Building for the Paris Agreement

The Paris Agreement was negotiated based on the need to keep the rise in global temperatures under 2 degrees celsius, with the ultimate goal of limiting global temperatures from reaching 1.5 degrees celsius. Through this agreement, countries developed and submitted their NDCs, to lay out their long term goals for reducing greenhouse gas emissions and adapting to the changing climate. By submitting these NDCs, countries hold themselves accountable for their role in the climate crisis. However, some countries are ill-equipped with the necessary capacity to fully implement their NDCs'. As a result, developing and vulnerable countries need assistance with building capacity in order to meet their NDC goals. Under Article 11 of the Paris Agreement, capacity building is defined as:

> *"[enhancing] the capacity and ability of developing country Parties, in particular countries with the least capacity, such as the least developed countries, and those that are particularly vulnerable to the adverse effects of climate change, such as small island developing States, to take effective climate change action, including, inter alia, to implement adaptation and mitigation actions, and should facilitate technology development, dissemination and deployment, access to climate finance, relevant aspects of education, training and public awareness, and the transparent, timely and accurate communication of information" (United Nations, 2015).*

Capacity building is a necessity for developing and vulnerable countries when it comes to fulfilling their Paris Agreement commitments. Without proper capacity and limited resources, vulnerable countries are unable to meaningfully participate in ensuring that their NDCs are met, thus hindering their ability to take part in tackling global climate change.

Over the years, the UNFCCC has put in place several international arrangements for capacity building, some of which are reflected in the table below.

Year	Occasion	Arrangement
2001	COP7	Two frameworks launched: one for developing countries and the other for economics in transition
2011	COP17	The Durban Forum launched
2012	COP18	The Capacity Building Portal launched
2015	COP21	The Paris Committee on Capacity-building (PCCB) established
2015	COP21	The Capacity Building Initiative for Transparency (CBIT) established

However, despite these initiatives and COP decisions, many developing countries are still lacking the necessary capacity for climate action. Many of the capacity building gaps are a result of shortfalls within existing empowerment initiatives within these countries. In order to build adequate capacity, these shortfalls must be compensated for and addressed appropriately.

Shortfalls Within Past and Current Empowerment Initiatives

The meaning of empowerment can be contextual, however, this paper treats empowerment in line with the UNFCCC's Action for Climate Empowerment (ACE). Action for Climate Empowerment is a term adopted by UNFCCC (based on Article 6 of the convention and Article 12 of the Paris Agreement) with the overarching goal to empower all members of society to engage in climate action, through six priority areas: education, training, public awareness, public participation, public access to information, and international cooperation on these issues (UNFCCC, 2020). The implementation of all six areas has been identified in recent years as the pivotal factor for societies to understand and participate in solving the complex challenges presented by climate change (UNESCO & UNFCCC, 2016).

As noted earlier, despite progress on capacity building efforts, developing countries still report persistent capacity gaps with respect to the implementation of the Paris Agreement. In 2019, a report of the Paris Committee on Capacity Building (PCCB) noted that specific capacity gaps and needs were identified in relation to adaptation in the areas of agriculture, coastal zone management, disaster risk reduction, energy, health, infrastructure and water resources, as well as mitigation in the areas of agriculture, energy, forestry, transport and waste (UNFCCC, 2019). The report further stated that common capacity gaps and needs persist on cross-cutting issues such as standardized data generation, collection and analysis; governance and coordination; development of endogenous capacity; access to climate finance; and gender-responsiveness (Ibid).

According to literature, a number of shortfalls exist within past and current empowerment initiatives. Khan et al. (2016) attempted to summarize these shortfalls including inadequate resources; challenges of retaining staff and skills for institutions; lack of ownership and leadership; lack of institutional arrangements and enabling environments; lack of coordination, and fragmentation between capacity building efforts at the sub-national, national and international levels (making monitoring and peer learning difficult). There are also other critical gaps, for example, in education and training strategies. As Dagnet et al. (2016) noted, education, training, public awareness, and access to information are often seen as means to strengthen or build capacity. Unfortunately, as Khan et al. (2019) revealed in another paper, the past mode of capacity building has focused on holding short-term project-based workshops, with dominance of foreign experts during implementation. This approach does not only deny meaningful empowerment for local experts, but also limits long-term capacity retention for developing countries.

Traditionally, empowerment strategies have emphasized the importance of access to information. While this is a vital component, failures in empowerment arise when initiatives apply knowledge, including scientific knowledge, as if it is value-neutral and universally relevant (Ciplet and Robets, 2017). All knowledge sharing in empowerment initiatives is filtered through local political contexts. Thus, there is a need to consider politics in developing environmental development interventions which are sustained. Furthermore, there is a need for the development of a more nuanced notion of "community," in empowerment efforts, as the term can take on many meanings (Taylor Aiken et al., 2017). Without careful understanding of communities and their political dynamics, there is a risk of elite capture of benefits from capacity building, which can widen the gap for poor and marginalized people.

Discussing each of the aforementioned shortfalls in detail is beyond the scope of this paper, but recommendations on general empowerment are provided. As already reflected, the main focus of our paper is on two main gaps: finance and digitalization, and these are discussed at length in the subsequent sections.

Climate Finance for Capacity Building

In order to foster an adequate environment for capacity building, proper climate finance tools must be in place and distributed. While the UNFCCC calls on developed countries to assist developing countries with their capacity building needs, the reality is that many of these developing countries are still reporting the need for capacity building assistance and gaps within institutional infrastructure. There are a variety of funds present in the world of climate finance that have the potential to inadvertently impact and further the realm of capacity building. For the purposes of this report, we will be exploring what funds and grants are set in place that directly target the capacity building efforts and needs in meeting countries' NDC goals.

Financial Entity	Program Name	Date of Program Inception	Description
Adaptation Fund	Readiness Programme for Climate Finance	2014	Provides four* small internal grants that assist with capacity building via financial and non-financial mechanisms
South-South Cooperation Grants		*Allows countries trying to establish National Implementing Entities (NIEs) to work alongside countries with already established NIEs in strengthening capacity*	
Project Formulation Assistance Grants		*Assists countries in their capacity building project formulation*	
Technical Assistance Grants		*Strengthening capacity in environmental and social risk management, and gender issues throughout their project implementation process*	
Project Scale Up Assistance Grants		*Enhancing capacity for projects that are scaling up and advancing their implementation efforts*	
Green Climate Fund	Readiness and Preparatory Support Programme	2015	Provides grants and technical assistance to developing countries to strengthen capacity, governance, and frameworks necessary for their climate action plans
Global Environment Facility	Capacity-building Initiative for Transparency	2016	Provides tools and assistance for countries to uphold Article 13, and improve future transparency efforts

Adaptation Fund

The Adaptation Fund was established under the Kyoto Protocol in 2001 in order to assist countries with their climate change adaptation process. The fund established a *Readiness Programme for*

Climate Finance in 2014. This programme assists countries with their capacity building efforts via financial and non financial mechanisms. On the financial side, the programme has made available four small grant programs (South-South Cooperation Grants, Project Formulation Assistance Grants, Technical Assistance Grants, and Project Scale Up Assistance Grants) to assist with climate finance readiness.

South-South Cooperation Grants

The Adaptation Fund encourages vulnerable developing countries to establish National Implementing Entities (NIEs) that "directly access financing and manage all aspects of climate adaptation and resilience projects" (Adaptation Fund, n.d.). The South-South Cooperation Grant allows countries that are trying to establish these NIE's work with countries that have already accredited NIEs. Through this grant, the Adaptation Fund aims to strengthen these countries' capacity and equip them for establishment of NIEs (Adaptation Fund, n.d.). Countries seeking to participate can contact NIE's that provide South-South cooperation: Morocco, Chile, Senegal, Antigua and Barbuda, Costa Rica, Rwanda, India, Kenya, Peru, Jamaica, and Argentina (Adaptation Fund, n.d.).

In December of 2019, Botswana received peer support from the National Environmental Management Authority of Kenya in order to produce an accredited National Implementing Entity. Through the South-South Cooperation Grant, Botswana received USD 50,000 in order to foster capacity building and mentorship from Kenya via meetings, in-country and training workshops (Adaptation Fund, n.d.). Kenya was able to assist Botswana in developing their accreditation application, analysing any existing gaps, and training the country on different governance tools (such as financial risk management, social safeguards, and anti corruption efforts) (Botswana & National Environment Management Authority, Kenya, 2019).

Project Formulation Assistance Grants

Countries that have accredited NIEs and are in the "concept development stage" are eligible to request a Project Formulation Grant, in which up to USD 30,000 can be distributed (Adaptation Fund, n.d.). This grant assists countries in their capacity building project formulation. Further, the Project Formulation Assistance, up to USD 20,000, can also be granted to these projects, in order to assist with technical assessments throughout the project (Adaptation Fund, n.d.).

Technical Assistance Grants

Technical Assistance grants can be distributed to countries with accredited NIEs. This grant works towards strengthening capacity in environmental and social risk management, and gender issues that might be presented throughout the design, development and implementation process of their adaptation projects (Adaptation Fund, n.d.).

In December of 2018, the Dominican Republic's Implementing Entity (the Dominican Institute of Integral Development) was approved a technical assistance grant amount of USD 22,700 from the Adaptation Fund. Through this grant and project, the Dominican Institute of Integral Development aimed to develop and institution environmental and social management program; implement environmental and social assessments; analyse gender policies of executing institutions; establish a committee tasked with receiving complaints regarding environmental, social and gender risks; and training members of the implementing entity staff regarding the goals of the Adaptation Fund's Environmental and Social Policy and the Gender Policy (Adaptation Fund, n.d.). With financing from the technical assistance grant, the Dominican Republic was able to strengthen its compliance with the Adaptation Fund's Environmental and Social Policy and Gender Policy and foster capacity building through empowerment initiatives.

Project Scale Up Assistance Grants

Project Scale-Up Grants are aimed with assisting Adaptation Fund projects that are undergoing implementation and scaling up. The grant specifically targets planning, assessment, capacity enhancement for projects that have the potential to scale up (Adaptation Fund, n.d.). Further, the grant also understands the importance of context specific programming, and in order to promote effectiveness, it supports projects that best fit the countries needs and priorities (Adaptation Fund, n.d.).

Green Climate Fund

The Green Climate Fund was established by the UNFCCC in 2010 and is tasked with being the operating financial entity of the convention. The fund assists in deciding on climate change policies, programme priorities and eligibility criteria for funding. In promoting and assisting capacity building, the Green Climate Fund has established a program in 2015 entitled the *Readiness and Preparatory Support Programme (the Readiness Programme),* aimed towards supporting developing countries with their capacity building efforts. In doing so, the programme provides grants and technical assistance to these countries, in order to strengthen capacity, governance, and frameworks necessary for their climate action plans. The fund allocates and can distribute up to USD one million per country per year to support these efforts. Further, the fund can distribute up to USD three million for the formulation of National Adaptation Plans, aimed to support countries' adaptation processes. To date, the programme has approved 382 readiness requests, dedicating a total of USD 256.9 million with projects covered in 137 countries (Green Climate Fund, n.d.).

Global Environment Facility

Established in 1992 to help tackle the world's most pressing environmental problems, the Global Environment Facility has emphasized the importance of capacity building and development in order for countries to achieve their NDCs. Under Article 13 of the Paris Agreement, it is evident that transparency, tracking, and reporting frameworks be set in place in order to ensure that countries are on track with their goals. As a result, the Facility has established the *Capacity-building Initiative for Transparency (CBIT)* in 2016 with the goals to strengthen transparency, provide tools and assistance for countries to uphold Article 13, and improve future transparency efforts. Thus far, CBIT has supported 58 projects, 41 national projects, and has contributed $63 million in it's transparency efforts. Of these projects, 78% address NDC transparency and 87% utilize funds to address technical challenges associated with reporting (Global Environment Facility, 2019).

World Bank

While the World Bank provides a variety of financial assistance to governments of developing countries, the Bank does not have a specific internal program aimed towards climate capacity building. Rather, the Bank indirectly promotes capacity building through the funding of projects with capacity building goals on a case by case basis.

One example of which relates to a 2017 project funded in Bhutan, with the objective of supporting Bhutan's capacity in developing a multisector and climate resilient investment plan (World Bank, 2017). Through this project, a USD 1.50 million loan was distributed to Bhutan to be put towards the preparation of a strategic program for climate resilience. On the capacity building front, the loan has already funded two government planning officials Masters programs in Environmental Management and Development, and is currently funding Masters programs for two more government officials. These programs are furthering climate change and sustainable development understanding, and assisting in building "practical skills towards environmental management and socio-economic development" (World Bank, 2017). The loan has also allowed for a variety of assessments to be conducted mapping out climate

hazards, risks, resource availability. The World Bank gives this project a "satisfactory" rating in overall implementation progress, and plans on bringing the project to a close in 2021. Through financing projects similar to this, the World Bank takes part in the movement towards capacity building, and equipping countries with the means to meaningfully build capacity.

It is worthwhile to note at the 2019 UNSG Climate Action Summit, a group of multilateral development banks, including the World Bank Group, identified 5 courses of action to be adopted in order to enhance support for their client's climate action goals. These actions include: committing to support increased climate finance levels over time; mobilizing USD 40 billion annually in private sector climate investments by 2025; helping their client's fulfill goals outlined in the Paris Agreement; developing transparency frameworks; and pushing client's to move away from fossil fuels (European Investment Bank, 2019). These new adopted actions can help align the World Bank, and other multilateral development banks, in further strengthening and equipping their clients with the capacity and financial resources to achieve their climate goals.

Private Sector Financing

While the above grants can assist in financing capacity building efforts, gaps in financing still persist. There is a need for the private sector to get involved in providing funding for climate change capacity building projects in developing countries. Private financiers have the potential to assist in capacity building via direct investments that go towards funding projects directly. These investments can help grant communities the resources needed to foster capacity building and empower these communities in reaching NDC implementation. However, it is worthwhile to note that the private sector might be more hesitant to distribute monetary resources to these areas due to the fact that, because countries lack the capacity in the first place, they are not seen as ideal investments (Rai, 2017). Further, these agencies might also be hesitant to invest due to capacity gaps and lack of understanding within the private sector regarding climate data and information (National Adaptation Plan Global Network, n.d.).

One example of private sector involvement is in the case of Jordan's solar photovoltaic program. The International FInance Corporation (IFC), a member of the World Bank Group, helped assist Jordan with the capacity to revamp its energy sector towards a renewable one by gearing the country with necessary financial resources to construct seven solar photovoltaic projects. In 2015, the IFC invested USD 79.66 million and another USD 107 million was mobilized towards these projects, making it the "...largest fully commercial private sector-led solar initiative in the Middle East and North Africa" (World Bank Group, 2015). Projects like this one have potential to spark conversation related to capacity building, and inspire private sector involvement and assistance. Private sector financing has the potential to bring about broader impacts associated with capacity building, equipping communities with the capacity to promote empowerment and facilitate education.

Challenges with Climate Finance for Capacity Building

Effective and sustainable capacity building for meeting the requirements of the Paris Agreement requires sustainable financial resources. Unfortunately, there are still numerous financial barriers constraining capacity building efforts in developing countries.

Inadequate finance

A significant investment of funds in capacity building initiatives is required to help developing countries achieve a desired level of capacity to sustainably address climate change. However, inadequate finance is a major obstacle constraining capacity building efforts in developing countries. The emergence

of Covid-19 has added salt to injury as countries have been forced to re-allocate climate action funds to addressing the pandemic. Although the Adaptation Fund (AF) and Green Climate Fund (GCF) have made considerable investments towards building capacity for climate action in developing countries, the released funds are still below the levels needed because these entities themselves are not well financed. Developed countries are yet to fulfill their $100 billion pledge for climate action per year. For example, after the withdrawal of the United States from the Paris Agreement, "a total of 27 countries raised $9.8 billion at a pledging conference in Paris to fund green projects for the 2020-2023 period – including 4% in zero-interest loans. That was less than the $10.3bn donors promised for the first period to 2020 and not enough to fund the $15bn pipeline of projects identified by the GCF as of December 2018" (Farand, 2019). There are hefty costs associated with capacity building, and with these inadequate investments and financing, challenges are bound to be presented.

Finance allocation

Capacity building funds do not necessarily go to countries where they are most needed. Although the United Nations Paris Agreement (2015) prioritizes capacity-building and financial support to "the least developed countries, and those that are particularly vulnerable to the adverse effects of climate change" (especially under article 9 and 11), this has not practically been the case. Research shows that the distribution of capacity-building assistance depends not only on perceived levels of vulnerability but also on donor priorities and profitability, and on the capacities of recipient countries to access, manage, and implement this support (Doshi and Garschagen, 2020). Ferreira (2017) noted that in practice, significant funds are being invested in developing countries with higher income levels, which often have comparatively lower levels of geographical vulnerability, lower levels of socio-economic vulnerability, and greater capacity to mobilize domestic financial resources and private finance for climate adaptation. Sennan et al. (2019), also found out that in 2015, just 18% of funds from GCF went to projects in the poorest countries, while 65% went to projects in middle-income countries like Mexico or India. This kind of finance allocation leaves the most vulnerable countries with very limited resources for building sustainable capacity for climate action.

Short-term funding

Equipping developing countries with the necessary capacity to address climate change requires long-term financing as opposed to short term funding cycles which do not facilitate sustainable capacity building. Short-term funding often compromises the quality of capacity building projects, as there is no adequate timeline for meaningful planning and substantial capacity building. In addition, short-term funding also means that projects end once the international funding dries up.

Relevance

Unfortunately when climate funds are received, capacity building finance is sometimes not spent on pertinent issues relevant to enhancing capacity in specific country contexts. Broad financing programs do not take into account country specific circumstances, and how different policies and regulations might impact initial goals (Nakhooda & Norman, 2014). Further, these programs sometimes also tend to reflect the goals of the financing entity rather than what is in the best interest of the nation (Ibid). This often results from inadequate involvement of relevant stakeholders in identifying capacity gaps and defining priorities. While facilitating capacity building, some external actors fall into the trap of 'one-size-fits-all model,' rendering their interventions futile. This misallocation of capacity building finance results in persistent capacity gaps among developing countries and their inability to achieve their commitments to the Paris Agreement.

Navigating access modalities

Although the existing wide range of climate finance mechanisms seem to increase the options and possibilities for capacity building among developing countries, the reality is that some developing countries find it difficult to access these funds due to the varied structures, complicated processes, and criteria involved. These long and complex application processes that are intended to foster fair programming actually end up producing high barriers for countries to participate (Nakhooda & Norman, 2014). Access requires adequate skills, on the side of government officials and other relevant stakeholders to, for example, identify appropriate climate finance sources, develop winning project proposals, and negotiate with donors.

Corruption and lack of transparency

Corruption and lack of transparency at national and international levels is a huge challenge to capacity building efforts. For example, as Transparency International (2017) noted, decision making around the allocation of climate finance and selection of climate finance projects may involve bribery, nepotism and clientelism, favoring specific interest groups, rather than prioritizing areas of greatest need. At a national level, capacity building (which often involves activities such as training courses) presents very distinct corruption risks when compared to a more tangible project like the construction of a hydropower dam or floodgate (Ibid). This is possibly due to the nature of capacity building finance distribution being more vague, open-ended, and less transparent than those of tangible projects. Further, similar to any financial distribution, there is opportunity for corrupt officials to divert funds away from their intended purposes (United Nations Development Programme, 2010). It is common to see financial figures attached to a capacity building training which actually never took place, or a lot of money allocated to government officials' per diem at the expense of the intended outcomes. Amidst limited funding for capacity building, a lot of money is lost to corruption tendencies, crippling progress and sustainability of capacity building initiatives.

Digitalization for Capacity Building & Key Digital Technologies

In the era immediately preceded by the personal computing and Internet revolutions, investigating the application, cost, and deployment of key digital technologies is essential to ensure the optimal introduction or expansion of such disruptive technologies. Optimal, in this context, refers to minimizing negative externalities and the measured treatment of inherent social challenges so that the primary benefits of utilizing digital technologies for capacity building can be achieved. There are a number of ways that digitalization can help countries increase their capacity both generally and to meet their NDCs and GHG reporting requirements under the Paris Agreement. Furthermore, digital tools have the potential to allow communities to help mitigate and adapt to climate change, while also not hindering their development. It is this potential that motivates the exploration of digitalization, with a keen focus on what positive benefits can be achieved and what challenges or barriers would prevent a successful digital transition.

Foundational Digitalization Methods

Industrial marketing and strategic positioning are critical when determining a country's or community's place in global markets. As it relates to climate change adaptation and mitigation solutions produced using digital technologies, this matters because the ability to build digital capacity for climate action is contingent upon the ability of a community to market the economic value of the services they can provide. Servitization is a useful tool for creating a dynamic and lasting economic role for an organization,

and while its positive offering on sales growth may be non-linear or diminishing in returns after a certain point, enhanced service offering is considered a strategic alternative to product innovation (Kohtamäki et al., 2013; Coreynen et al., 2017). Many of the digital technologies described later in this section help to enhance network capabilities, which positively impact the effect of service offering on sales growth (Kohtamäki et al., 2013). Leveraging digital capabilities is a way by which a country can transition from being strictly a supplier of commodities to a more dynamic management, distribution, and financial service provider. That being said, while digital technologies are key to unlocking service-based industrial diversification, mere acquisition of the technologies is not sufficient for developing sustainable systems for smart growth.

In addition to transforming jobs with the servitization of industry, digitalization is also an enabler of socio-economic dynamics related to fostering climate friendly urban environments and societies (Balogun et al., 2020). Beyond triggering positive lifestyle changes, Balogun et al. (2020) note how digitalization impacts cities' resilience and adaptation capacities from reducing CO_2 and other GHG emissions to enabling climate adaptation. Although urban populations are of ever-increasing importance, it is also worth noting that digital technologies have usefulness in rural regions with respect to agricultural, mineral, and other natural resource management schemes as well as connectivity to broader information networks. It is this same connectivity that allows for more advanced, decentrally accessible data recording and storage technologies useful for organizational management of countries interested in building capacity, as well as for participation in reporting system frameworks demonstrative of how digital technologies can help support collaborative compliance to international environmental law (Bürgin, 2019).

Reporting to a global governing body increases the chance for success in achieving NDCs at the cost of subjection to international non-compliance pressures. However, digital technologies such as internet connectivity, remote sensing, advanced modeling & machine learning, and data storage do open up new opportunities to promote sustainable capacity building efforts. Of note here, these are not the only key technologies for digitalization as a tool in capacity building, but in order to provide useful specificity these technologies were the extent of the scope in this report. When determining how to implement these technologies, the individual needs of a country must be met on a case-by-case basis, catering to the specific geographic and socioeconomic requirements present. Because a tradeoff of economic destitution for the sake of sustainability is unacceptable, methods using digital technologies to optimize economic growth without compromising the Paris Agreement is a critical component in combating both climate change and poverty simultaneously.

Applications, Implementation, and Cost of Digital Technologies

Internet Connectivity

Before any advanced digital technology can be utilized for the purposes of increasing mitigation and adaptation efforts for the Paris Agreement, connection to a network must be established. In order to accomplish this for a community that does not have pre-existing technology, a significant and geographically distinct infrastructure development project must be conducted to allow for Internet access. For a country, community, or organization to become an Internet Service Provider (ISP) or Wireless Internet Service Provider (WISP), there is a requirement for a series of towers at high elevations to transmit signal and fiber-optic/Internet cables to be installed. Alternatively, an already established ISP may be expanded to meet the needs of a new region via such cables and the associated cost therein. Furthermore, an Internet exchange point, linked data centers, and end users must be set up with requisite hardware such as routers, modems, relay sites, and computer access points. All of these infrastructural requirements have associated costs that are estimated in the following paragraph, but it is worth noting

the components of a community-scale Internet connection project because it is valuable information when considering the feasibility of digital technologies for capacity building solutions - digitalization may be an obvious choice for some communities and an unnecessary economic sink for others.

One estimate given by places the total upfront cost of starting an ISP at approximately 24,500 USD with a monthly cost of 2,730 USD for a singular ISP system (Graham, 2020). In order to connect additional houses in a community - depending on the geography and population distribution - the cost will increase significantly due to the need for more Internet towers at an additional 400 USD monthly rental and greater lengths of fiber optic cable at approximately 6,000 USD upfront (Graham, 2020; Mercer, 2013). Greater costs are incurred if existing towers do not already exist for rental. Building a new tower can cost anywhere from 20,000 to 600,000 USD depending on the size and placement of the tower. This range is related to the size of the community served and the height of the tower. Furthermore, maintenance costs for salaried workers and replacement parts must be included in the overall price determination, which will also vary based on where the project is being developed. The one-time cost data are described in *Fig. 1*, however, the monthly fees are not included.

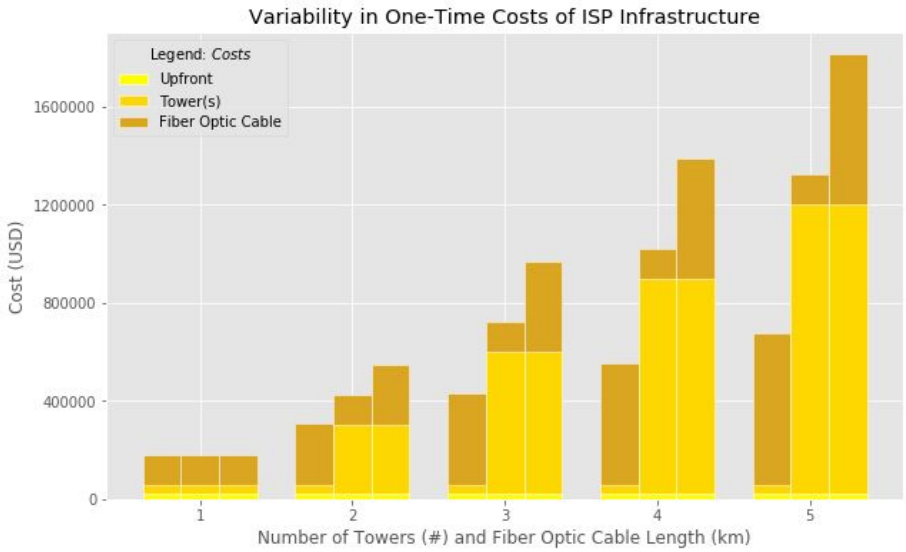


Fig. 1: the plot shows three different infrastructural cost scenarios; 1) increasing fiber optic cable length, 2) increasing number of towers, and 3) increasing both fiber optic cable length & number of towers. The price for the construction of a new tower was estimated at 60,000 USD given approximate sizes of community scale ISP projects. This plot was created for this report.

While this aspect of digitalization has the highest costs, it is also unfortunately the most necessary, as having an Internet connection is foundational for proper usage of each digital technology discussed in this report. Without Internet access, the effectiveness or even basic functioning of such technologies comes into question, with mobile access as the primary (and arguably exclusive) alternative to broadband internet access. The argument for mobile Internet adoption has arisen primarily to bridge the digital divide caused by the high prices of wired broadband outlined above. As a result, there are developing countries currently weighing the price, service, and application attributes of both types of Internet access (Srinuan et al., 2012), which again should be considered on a case-by-case basis related to the specific needs and available resources of a community.

Remote Sensing

A relatively new and exciting advancement in digital technology applications to climate-related problems is the utilization of drones, satellites, high-flying aircraft, and any other distant data collection

systems known collectively as "remote sensing." Remote sensors are designed to collect data either passively (i.e. such as detecting incoming radiation from the sun) or actively (i.e. shooting a laser beam off of the Earth's surface and calculating the time it takes to return) from the environment (NOAA, 2020).

Although these technologies have their own associated costs and challenges, the potential benefits are as numerous as they are novel. Examples include collecting agricultural data, locating new potable water resources (such as geophysical groundwater assessments), assessing land-use/land cover change, and much more. It would be impossible to list all the uses as new applications are continually being explored. Furthermore, many development practitioners and natural resource researchers are looking to remote sensing solutions to help determine environmental connections to socio-economic issues such as poverty, as well as providing a methodology for enacting better ecosystem accounting using the United Nations Environmental-Economic Accounting framework as a global standard (Holloway & Mengersen, 2018). As a means to enhance transparency within resource management, remote sensing serves as a primary data collection tool for everything from crop identification/yield, tracking shoreline progression, assessing impacts of hazardous natural disasters, and managing ecosystems, which can then be quantitatively analyzed for relevance to national planning and reporting to global organizations, such as in compliance with the NDCs.

The Climate TRACE coalition hopes to expand upon transparency, specifically pertaining to GHG emissions, by utilizing cutting-edge artificial intelligence and machine learning in combination with remote sensing. The coalition of tech companies and climate NGOs plans to employ existing satellites to conduct comprehensive global pollution monitoring in partnership with numerous NGOs and several tech-firms. Climate TRACE's goal is to provide strategic insights for creating stronger climate policy and action, and to provide the necessary tools for mitigation, adaptation, and decision making to any organization or community in the world. The latter point is especially exciting for its implications toward capacity building efforts; although the Climate TRACE tool is not yet available, a first version release is set loosely for Summer 2021. With a scope ranging from emissions tracking for individual factories, ships, and power plants up to aggregate country emissions, the project has received significant media attention for its potential implications with respect to transparency (Worland, 2020). Although undoubtedly beneficial for validated emissions reports for NDCs, the privacy implications are still debated. However, in addition to strict data security, the project team has the option of signing non-disclosure agreements to ensure the data is not released without the provider's explicit consent. Despite these considerations, such a service could be an excellent solution for developing nations who do not want to take on the costs of installing their own remote sensing systems.

These costs are largely contingent on what specific types of sensors are required. If the country plans to conduct remote agricultural, geophysical, and hydrological assessments of their natural resources costs may include drone(s) at 300 to 10,000 USD as the general range for camera drones with additional costs incorporated with the attachment of relevant sensors. Air quality sensors can range from 200 to 50,000 USD as an example of price variability here. For certain tasks, drones are not capable of handling the scope of the project, and instead low Earth orbit or Landsat Satellites are utilized, costing around 2,000 to 7,000 USD per kilogram for renting space for launch. This can mean sending up independent sensors, or partnering with research institutes/national actors/industrial interests to reduce costs.

In addition to having Internet access as mentioned in the previous section, Geographic Information System (GIS) mapping software (at around 100 USD annually) or other softwares will be required to produce usable data for analysis of trends, actionable insights, and report submission. The additional software can range from several hundred to thousands USD depending on the services required. Furthermore, this software requires trained computer science professionals to operate, rounding out the costs with salaries for software engineers as well as drone pilots, terminal managers, and other administrative staff. While this is positive from a job generation aspect, providing the training and sustainable infrastructure for this workforce is a particularly difficult challenge.

Advanced Modeling & Machine Learning

Machine learning is oftentimes made out to be unnecessarily complicated, when in reality it is simply utilizing a computer's ability to handle large quantities of data by applying human intuition at scale. The purpose is to analyze big data in a way that determines the relative correlation between numerous different factors called "features", changing the weight and node strength of each feature with subsequent iterations in order to construct a model indicative of a 'training set' of data. The 'training set' from which the model is constructed is a known set of inputs and outputs, from which a machine learning model can verify if it has successfully predicted or classified the correct output for a given set of inputs. Then, the model is set loose on a 'test set' with known inputs but obscured outputs, such that the model must create its own outputs based on its previous "experiences" in modeling data with the same input features. In this way, the model is able to be trained and tested such that it functionally learns over time - or at the very least iteratively improves with continued tweaking and adjustment.

As it relates to climate change data, machine learning and other advanced modeling techniques can be useful in the data analysis portion of a project. Where remote sensing would be utilized to compile a large dataset of crop yields over a decadal cycle, the machine learning model would use the data to predict the present or following year's crop yields based on the environmental features correlated to yield such as precipitation, solar irradiance, average humidity, etc. Statistical machine learning (SML) is versatile because it can be applied to data of many different sources, not only from remote sensing. The covariate analysis provided by SML is useful for determining relationships between non-causal patterns for the purposes of classification, clustering, regression (predictive), or reduction based modeling, and best of all does not necessarily require specific software. Among the costs required include Internet access, a computer, computer programming training in an applicable programming language, and salaried workers. The costs for salaried workers have not been included in this report, as the suitable cost for such purposes vary too dramatically based on geography to make valuable assessments.

APSIM Applications
Investigating soil sustainability
Modeling horticultural cropping & agroforestry systems
Evaluating resource use and efficiency
Environmental characterization
Providing farmer advice
Informing plant breeding programs
Climate change adaptation analyses
Understanding drivers of production
Interactions between livestock and mixed crop-livestock enterprises
Whole-farm modeling
Biotic & abiotic system constraints
Continental and sub-continental studies

One example of advanced modeling being used to combat the effects of climate change in line with the Paris Agreement and capacity building in tandem is APSIM or the Agricultural Production Systems Simulator. Developed in the 1990s as a field-focused farming systems framework with a small user base, the suite has grown into a large collection of models with thousands of international modellers involved in further development (Holzworth et al., 2018). It has the capability of simulating over 80 models of soil and crop processes with numerous applications (Holzworth et al., 2018). The implications of a globally integrated tool like APSIM is the ability for contributors from around the world to contribute to a growing body of code that offers real-time farming solutions. With the expected changes to regional precipitation

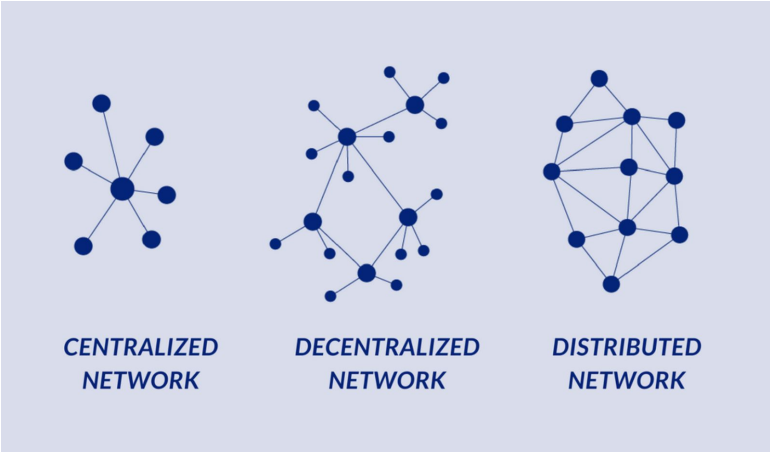
as a result of climate change, accurate simulations of farming partners will be critical to the food security of developing nations.

Data Storage

The manner by which data is handled and managed in a system was selected as a digitalization technology because, like remote sensing and advanced modeling, it fulfills a unique aspect of the digital toolkit required to make a digital transition function in a capacity building context. In fact, with respect to actual capacity, the ability to store data in a neat and organized fashion is arguably the most critical for reporting, institutionalizing, and democratizing data. Among examples of e-records are recorded information, documents, and evidence of policies, transactions, & activities carried out in government and commerce environments (Wamukoya, J., & Mutula, S. M., 2005). These e-records are being adopted as the primary method for confirming pensions, entitlements, registering births & deaths, verifying citizenship, certifying rights (voting, etc.), enabling tax collection, supporting financial management, and litigation (Wamukoya, J., & Mutula, S. M., 2005). Online Database management of e-records could play an important role in making GHG emissions reporting and access to data more efficient and accurate. Two primary methods of data storage will be discussed here; relational databases and blockchain, otherwise known as distributed ledger technology (DLT).

IBM defines a relational database as one which organizes data into a series of linked tables on the principle of relating common data to each other, allowing the user to retrieve new tables from data in a single query. This allows any organization, government, or business entity to make better decisions and identify new opportunities such as maintaining a history of transactions, clients, and customer information (IBM, 2020). As it relates to capacity building efforts, data storage methods are being applied to commerce interactions in developing nations, like DigiCAP - a multidisciplinary toolkit that supplies expertise in manufacturing, human resources, and business to female entrepreneurs in Sub-Saharan Africa with the goal of enable women to increase productivity in the handicraft industry (Marzano et al., 2020). However, this project, like many others, has failed to address many of the key implementation difficulties associated with phasing in a technology to a pre-existing workflow. In this sense, drawing in iterative project management strategy such as systems development life cycle (SDLC) analysis or the Agile approach might help to clarify some of the ambiguous lapses present in many development projects.

Similarly, blockchain technology allows for the management of large sets of data, but it does so in a novel, counterintuitive way - the blockchain consists of a DLT that stores data so that it is decentralized among the users of the data management system. Although primarily known for its use in cryptocurrency to largely negative effect on perception of the technology, blockchain is simply a unique configuration of Peer-to-Peer or in this case Country-to-Country cryptographic and distributed computing technology (Adams et al., 2018). As a method for detailing climate reports and compiling data for use on the global stage, a permissioned blockchain could significantly allow for national interests to upload sensitive information to a decentralized database where it could be accessed by any member of the network *only*



if they have been granted certain authorization. This offers maximum within-group transparency, privacy, and actor control over their own degree of privacy (Adams et al., 2018). Furthermore, blockchain serves to eliminate information asymmetry or heterogeneity in datasets, while simultaneously automating GHG emissions accounting through a bottom-up, decentralized reporting systems approach (Schletz et al., 2020). Beyond mere decentralization, the image shows how blockchain promises to employ a distributed data structure as outlined by the 2020 article "UN Supports Blockchain Technology for Climate Action," which would allow for greater transparency, trust, and mutual collaboration among users (UNFCCC, 2020). Because blockchain offers a framework that could be electively joined, it may be more useful for developing countries who don't want to design their own reporting methodologies.

Relational database management requires trained computer science professionals with a background in standard query language (SQL). SQL is the language used to create relational databases, including the joining together of different pieces of data based on their relevance. Although not specifically requiring SQL, blockchain also requires specialized computer science practitioners who understand the concepts and principles necessary to address problems using the respective digital tool. Every new digital technology requires more technical training and adequate compensation for salaried workers.

This arrives at the heart of digitalization for capacity building; the costs and training structures required to achieve a complete digital transformation may be unattainable financially, or unrealistic from the standpoint of human resources - how many people can spend their valuable time learning computer skills when there are more immediate challenges to address? For individuals already working full-time to provide for their family in strenuous labor roles, asking them to take an additional coding class before returning home might seem laughable or even impossible. As such, it may be better to develop a modular framework for digitalization. Here modular means a system in which technologies can be selected on the basis of how serviceable they are to the community or neglected if the cost is deemed too great, but should be structured in a 'menu' of options with value-benefits and costs clearly outlined. The option to input preliminary geographical, socioeconomic, or governmental parameters into a modular system to produce catered recommendations is critical for addressing community variability in climate solutions.

Challenges of Digitalization for Capacity Building

Though digitalization can provide incredible opportunities for capacity building, the introduction of digital tools does not inherently empower people. If implemented poorly, digitalization in developing countries can amplify new societal vulnerabilities, and a unilateral perspective on technology can exacerbate existing inequalities. The proper ruse of Information and Communication Technologies for combating climate change and building capacity is quite a challenge, as the internet was not originally designed for such widespread automation of major sectors like energy, the economy, healthcare systems, and transportation (Niels Nagelhus, 2018). To make matters worse, most climate change ICT interventions are emergent and the lack of thorough planning allows for unintended impacts (Pant and Heeks, 2011.). The challenges of digitalization for capacity building are characterized by gaps: between developed and developing countries, between rural and urban communities, between men and women, and between introduction of digital technologies and the ability of people to utilize those technologies (Wong, 2012).

In considering the potential of digitalization for capacity building, it is vital to consider that climate change is inseparable from all other development issues. Thus, like other development issues, adapting ICTs for capacity building to meet NDCs demands adaptive, multi-stakeholder approaches. One of the most significant uses of ICTs for capacity building is the transformation of knowledge systems to be more holistic and equitable (Pant and Heeks, 2011). The most notable limitations on digital capacity are

questions of access and "hollowness." Hollowness is defined as the lag between technology development and the societal capacity and management of this technology. Access to ICT services are shaped by several factors including awareness, physical barriers, political influences, gender differences, financial considerations, and technological components (Schia, 2018). These in turn shape questions of coverage, uptake, and use of ICTs. Internet connectivity is considered to be the major foundation of digitalization. This causes distinct challenges in the Global South, where digital infrastructures are often based on mobile rather than fixed broadband, which makes them unreliable and sometimes slow (Schia, 2018). As it stands, approximately 4.4 billion people worldwide are offline or disconnected from the internet. Of those people, 64% live in rural communities, 50% live in poverty, and 52% are women (Pinto, 2018). When developing strategies for capacity building through digitalization, the challenge is developing a strategy which is human-centered, with a focus on human rights, equity and justice, and inclusion (Reuter, 2020). This can be done by paying special attention to four digitalization challenges: the rural-urban divide, differences in use and access across gender, disruptions in employment and bottlenecks in ICT implementation, and concerns about human rights.

The Rural Urban Divide

ICTs can be strategically employed to build capacity by combating rural and urban poverty and by uplifting the livelihoods of urban farmers, if implemented correctly. Connecting rural communities to the outside world can be a key necessity for economic development. However, one of the most notable challenges of digitalization is ensuring that it does not widen the rural urban divide. There is a serious need to consider the distinction of needs for urban versus rural peoples when designing digitalization strategies (Kumar, 2017). Historically, there is a trend of cities being "super-served," i.e., very well connected, while the rest of the country is underserved (Niels Nagelhus, 2018). There are many reasons for the lack of digital development in the rural sector, but some major factors include poor ICT infrastructure, poor ICT awareness, and language barriers. Thus, successful digitalization projects call for three foundational elements: digital infrastructure, digital services, and digital literacy (Vironen and Kah, n.d.). The rural-urban divide also amplifies existing gender gaps, as women often are expected to take on roles in domestic careers, which keeps them from moving to larger cities and towns. This exacerbates their lack of access to ICTs (Wong, 2017). If done correctly, rural digitalization can have many benefits for users allowing them more agency and representation. Proper digital tools allow communities and rural farmers to set processes, strengthen land claims, and legitimize resource rights and infrastructure projects. ICT also allows for greater networks of communication, which reduces rural social isolation. Furthermore, it expands the worldview of local communities and offers an understanding of national and international trends and policies (Kumar, 2017). Paying close attention to the rural-urban divide in the context of capacity building for climate change of critical importance, as potential climate impacts, and their corresponding adaptation and mitigation responses, will differ between these two settings, as a result vastly different livelihoods, demographic make-ups, and value systems.

Gender

Digitalization can widen gender gaps as well. This is largely due to the fact that women typically have less access to technology, information, and financial resources, as well as land rights than men. Digitalization can be a major tool for changing gender relations, as the gendered outcomes of ICT climate change interactions can reveal a great deal about existing gender relationships and aid women and men in renegotiating their roles. However, when digitalization is introduced without precise policies and stakeholder engagement, it works to uphold gender stereotypes. It is more readily accessible to men. As it stands globally, adult males are more likely to own a phone than their female counterparts, particularly in poorer households which can only afford one device. The greatest disparity in mobile phone ownership

exists in South Asia, with a 37% gender gap. This pattern imposes a significant limitation of women's access to technology (Kaur et al., 2017). Gender influences digitalization by means of the process of gendered negotiation, gendered outcomes, and indirect influences.

There are many reasons to embrace a gendered consideration of ICT projects, but four prevailing motivations include efficiency, effectiveness, equity, and rights-based empowerment. Efficiency focuses on the cost-effectiveness of including both men and women in climate change mitigation and adaptation projects. Critics believe this value is potentially damaging because it frames poor citizens as cheap laborers. Effectiveness considers the differences in the impacts of climate change and willingness and skill sets for the adoption of ICTs for men and women. It does not, however, consider the burdens which demanding action places on women who are already commonly marginalized. Approaches which emphasize equity, a crucial value for empowering digitalization for capacity building, frame digital divides and climate change as social justice issues. In an approach for equity, there is a focus on challenging and reconstructing long-standing power differentials. Finally, approaches which incorporate rights-based empowerment acknowledge that the right to information is a basic human right. Therefore, under this framework a lack of access to resources, skills, information, and decision-making in ICT interventions is a human-rights concern (Wong, 2017). All forms of digitalization must consider pre-existing gender inequity and work to minimize them, as the effectiveness of ICT tools is dependent on such considerations. For instance, in e-agriculture, one of the most popular uses of digitalization, it intersects with gender divides when considering land ownership. In some places, women in rural farm systems are traditionally barred from legal land-ownership, which lowers decision-making power in ICT implementation and lowers their ability to receive loans and credits. Conditions such as this must be considered and accounted for so that ICTs increase the engagement and agency of women rather than reinforcing existing conditions (Wong, 2017). Applying a gendered lens to capacity building efforts for climate change is essential, as climate change impacts will disproportionately affect women.

Information, Education, and Disruptions to Labor and Capital

The introduction of digitalization for capacity building also has the potential to disrupt labor and pose challenges in access to information and applicable skill sets. Disruptions in the labor market can contribute to increased inequality, especially because digital tools are adopted at different rates by different sectors. The disparity between the introduction of digital technologies and an ill-equipped labor force creates serious disruptions to livelihoods, especially in less developed countries where capacity-building efforts are focused. In the Global South, the growth of IT jobs is typically slower than the growth of internet connectivity. Thus, the demand for ICT professionals increases, while the demand for unskilled labor decreases. This phenomenon contributes to a widening gap, as technological advances benefit workers who have skills and disadvantage people who lack digital competencies, while simultaneously contributing to a negative redistribution of capital. The redistribution is determined by the percentage of capital and labor in the essential productive factors. The application of new technologies typically increases the percentage of capital more than the percentage of labor, which leads to fewer redistributions to workers. Therefore, biased and directed technology innovations will exacerbate inequalities in income distribution. It follows that the introduction of ICT is not naturally empowering to the general workforce of less developed countries (Niels Nagelhus, 2018).

There are also possible pitfalls which are rooted in the intersection of labor with gender and age. The gender gap remains in terms of access to, adoption of, and use of technologies, as well as in representation in ICT-related industries and opportunities to build digital competencies. Thus women are being more negatively impacted by changes in employment sectors caused by ICTs. Young people also face possible negative impacts in a digital workforce due to competition caused by increasing automation. The key strategy to shortcoming in emerging technologies is to enhance people's digital skills and competencies and to equip them with unique skill sets to work and live in the future information society

(UN, n.d.). ICTs may also amplify inequalities in education and access to information. Certain gaps in education can limit the usefulness of ICT technology, most notably low rates of literacy.

Low literacy rates reduce the impact of ICT services, even if they are available. Though voice recognition and audio-to-text technology have helped, illiterate users still can't access the full capacity of most digital technologies. This complicates the process of guaranteeing the right to information. ICTs can undoubtedly build capacity in employment and education in several significant ways, by enhancing collection and categorization of local knowledge and offering external information to rural and/or less developed communities. Digitalization which is empowering incorporates certain precautions and transformations in education. It is critical to build digital literacy, situational awareness in the digital environment, and cultural competence. Furthermore, for proper use of technology there must be the capacity to find, create, and spread information in different contexts, and the capacity to evaluate the reliability, credibility, and legality of online content, also known as critical media literacy (UN). The introduction of these skill sets will require a shift from formal ICT education to more practical approaches. Comprehensive education programs to smooth ICT bottlenecks will require learning communities, skilled teachers, and ICT regulation policies (Pinto, 2018). As climate change adaptation and mitigation introduces new livelihoods and skillsets, considerations of information, education, and disruptions to labor and capital are crucial to ensure that digitalization does not exacerbate existing inequalities in these areas.

Human Rights

Digitalization presents another significant potential challenge for human rights. At face value, digitalization and human rights may seem to be incompatible. Digitalization is driven by quantification and monetization, while questions of human rights are costly, time-consuming, and demanding of long-term modeling and investment. Digitalization also involves different types of professionals, primarily computer and data scientists as well as engineers (Pūraitė, 2020). The technologies themselves have also been criticized for placing too much emphasis on the technical solutions to climate change rather than the complex set of climatic responses and vulnerabilities (Wong, 2017). It is important that efforts to use digitalization for capacity-building take a humanist perspective in order to be empowering and sustained. Often, the technical perspective is ahistorical and nonspecific. Digitalization without context may be ineffective for building capacity. Inappropriate digital strategies are technocratic and top-down, excluding citizen input. If utilized improperly, they may reinforce divides and inequity and pose threats of surveillance and privacy violations.

Proper digital technology for climate change capacity building must be designed with the users in mind. Therefore, digital technologies must be carefully modified to serve each community in which they are introduced. Oftentimes, digitalization is also associated with corporatization and privatization, i.e., handing over public functions to private actors (Pinto, 2018). There is a significant risk of "digital colonization" in the introduction of ICTs, and projects which appropriately build capacity must take preventative measures to promote digital sovereignty. Private actors have assumed a lot of power in digitalization, and those actors are also centralized in just a few developed (and rapidly developing) countries, foremost the United States and China. The presence of ICT professionals and the ability to deploy this infrastructure is controlled by these powerful nations. These countries enjoy capital and intellectual resources, legal architecture, and capital for experimentation with different technologies, which leads to innovation. There are many developing nations in the process of digital transformation without these foundations, which causes them to be dependent on the infrastructure, hardware, and software of just a few companies (Pinto, 2018). Human rights must always be a consideration in development issues, but it is especially important to maintain a human rights approach in capacity building for climate change, because climate change raises many human rights concerns.

As a whole, the rural-urban divide, gender, information, education, and disruptions to labor and capital, and human rights must be explicitly integrated into the use of digital technologies for capacity building. Climate change impacts will be felt in the context of existing social systems. In other words, the negative consequences of climate change manifest unevenly in rural versus urban areas, for men versus women, for different groupings of livelihoods, incomes, and education levels, and across different power structures. As such, holistic solutions must consider these disparities in capacity building strategies.

Recommendations

In order to enhance capacity building for climate action among developing countries, we propose the following recommendations on general empowerment, finance, and digitalization.

Recommendations for General Empowerment toward Capacity Building

Engage Institutions of Learning
- Strengthen research capacity for climate change adaptation and mitigation.
- Establish universities in developing countries as central hubs for a sustainable, institution-based capacity building system.

Promote Long-Term Institutionalized Capacity Building
- Replace consultancy and project-based approaches with long-term, sustainable systems.
- Support the competence of individuals, the functions of organizations and the informal rules of institutions.

Embrace the "Country-Driven and Context-Specific" Approach to Capacity Building
- Limit external actors to facilitation and support roles.
- Acknowledge the complex history, institutional settings, and social fabric of each country.

Promote Participation of All Levels of Government and All Groups of People
- Encourage locals to assess their adaptation capacity gaps and figuring out possible adaptation strategies.
- Ensure that local priorities are integrated into management, decision-making, and leadership.

Prioritize Gender Equity in Capacity Building
- Target the participation of women in capacity building initiatives.
- Encourage the intersection of research on climate change and gender.

Promote Cooperation, Networking, and Peer Learning for Information Sharing
- Facilitate communication and sharing of power between multiple, diverse agencies.

Engage Institutions of Learning

Efforts to build capacity for climate action can focus on engaging institutions of learning such as universities and research institutions in capacity building for climate action. Strengthening research capacity relating to climate change adaptation and mitigation in developing countries is one of the most effective and sustainable ways of advancing capacity to address climate change. The authors of this paper concur with Khan et al (2019) that universities in developing countries should serve as central hubs for a sustainable, institution-based capacity building system, supported by strengthened partnerships and long-term financing. Universities have the potential to foster new competencies and skills to trigger climate change responses. One way to build research capacity is to encourage Memorandum of Understanding agreements for climate action between universities in developing countries and developed countries, and provide international funding to support this cooperation.

Promote Long-Term Institutionalized Capacity Building

Capacity building programs should be long enough to allow the required impact in bridging capacity gaps. Based on empirical evidence from multiple settings, concern has been expressed over the ability of short-term training to effectively build capacity for adaptation (Mataya, 2019). In their recent research on the impact of a one-day capacity building workshop, Alpízar et al.'s (2019) findings suggested weaknesses in the common practice of using workshops for delivering capacity building and climate science. They noted that simply holding one-day workshops to disseminate climate science and build capacity will not have substantial impacts on actual behavioral outcomes needed to address climate change. Therefore, as suggested by the European Capacity Building Initiative (2018), long-term, sustainable systems will have to replace the current consultancy and project-driven approach where any gains dissipate due to a lack of retention systems. According to Shakya et al. (2018), strengthening institutional capabilities involves supporting the competence of individuals, the functions of organizations and the informal rules of institutions and engaging the wider constituency to build long term capacity.

Embrace the "Country-Driven and Context-Specific" Approach to Capacity Building

It is critically important that countries lead the process of their own capacity building, as opposed to being externally driven. In any case, external actors should stick to playing a facilitation and support role to allow proper diagnosis of capacity gaps and learning-by-doing among local stakeholders. Climate change affects different areas differently, and so, local leaders should be given a chance to lead the identification of capacity gaps, needs and opportunities for climate action relevant to their context. Capacity building interventions should be country-specific since a country's approach to a particular problem, such as climate change, is embedded in its complex history, institutional setting and social fabric (OECD, 2003).

Promote Participation of All Levels of Government and All Groups of People

Joint effort, more participation, making use of synergies of actions, expanding partnerships and reaching out to sectors and geographical regions are the key to reaching the goals of the Paris Agreement (UNFCCC, 2018). This concept pointing to participation, inclusion and collective action should be embraced in capacity building initiatives in developing countries. There should be clear intentions and strategies to empower different levels of government and different groups of people, including women and rural smallholder farmers, to address climate challenges impacting their lives. As Takao (2012) argued, climate change impacts are manifested locally, and adaptive capacity is determined by local conditions. For example, engaging rural smallholder farmers in assessing their adaptation capacity gaps and figuring out possible adaptation strategies is essential for effective and sustainable climate action. Therefore, engaging smallholder farmers in capacity building initiatives will improve their capacity to learn (to access and comprehend information), capacity to decide (to be actively engaged in the planning and decision-making process) and capacity to act (manifested in leadership and increased practical involvement) (Phuong, 2018).

Prioritize Gender Equity in Capacity Building

Article 11 of the Paris Agreement states that capacity-building must be an effective, iterative process that is participatory, cross-cutting and gender-responsive (Shakya et al, 2018). UNDP recognizes women as strong agents of change. Unfortunately,there are still many factors constraining the capacity of women to fully participate in addressing climate change which negatively impacts their lives. Therefore, targeting the participation of women in capacity building initiatives will ensure their contribution to needs assessment and to the prioritization of pertinent areas of focus for capacity building and climate action. Drawing on women's experiences, knowledge and skills and supporting their empowerment will

make climate change responses more effective (UNDP, 2013). A recent report commissioned by UNDP on countries' progress on gender and NDCs noted the need to build capacity on climate change amongst gender specialists and those in ministries of gender or women's affairs and the demand to build capacities on gender equality amongst those in climate change directorates or ministries of environment (Murray, 2019).

Promote Cooperation, Networking, and Peer Learning for Information Sharing

Cooperation and networking is an important catalyst of capacity building which should be promoted. This includes active collaboration between agencies involved in climate action as well as the wider constituency – trusted, influential external partners who legitimize climate action (Shakya et al, 2018). Such cooperation will improve coordination of capacity building efforts, lessen duplication, and strengthen information sharing among facilitators and beneficiaries of capacity building.

Recommendations for Financing Capacity Building

Revise Global Climate Finance Allocation

- Increase funding allocation to capacity building within existing climate change finance.
- Revise strategies to ensure the distribution of climate finance to countries where it is most needed.

Support the Formulation of Public Policies that Foster Investment in Climate Capacity Enhancement Ventures

- Create policies which acknowledge the need for climate finance and specify the expected benefits of both investors and beneficiaries.

Support Mainstreaming of Capacity Building in National and Sub-national Development Plans

- Pay particular attention to institutional coordination and cooperation at different levels of development planning.
- Establish a national financing arrangement which allows sub-national agencies to harness climate finance.

Encourage Allocation of Capacity Building Finance to Disadvantaged Groups to Maximize Financial Benefits

- Direct climate finance towards neglected groups such as women and smallholder farmers.

Support Relevant Stakeholders to Navigate Access Modalities for Capacity Building Finance

- Train government officials and other leaders to identify sources for capacity building finance, to develop winning project proposals, and to negotiate with donors.

Focus on Enhancing Capacity for Efficient and Effective Utilization of Finance

- Train stakeholders in financial and project management skills.
- Introduce infrastructure and technology to manage, report and sustain capacity building projects.

Revise Global Climate Finance Allocation

A key priority should be a deliberate move to increase finance allocation to capacity building within existing climate finance mechanisms. This is critical to overcoming financial constraints experienced by capacity building initiatives. Second, there is a need for revising strategies for deciding where climate finance goes, to enable capacity building in countries where it is most needed. Vulnerability, for example, needs to be clearly and objectively re-defined under the UNFCCC. Doshi and Garschagen (2020) noted that looking at climate policy negotiations over time, from the Convention in 1992 to this date, there has been no agreed methodology on how to prioritize the "particularly vulnerable" for the allocation of climate finance. This lack of clarity needs to be corrected. In addition, countries with

very limited capacity to access and manage climate finance need to be given special assistance and special capacity building arrangements to enable them to proceed with the implementation of their NDCs.

Support the Formulation of Public Policies that Foster Investment in Climate Capacity Enhancement Ventures

To boost capacity building finance, developing countries should be supported to enact policies that create a supportive environment for private investment in initiatives that enhance climate action. For example, many developing countries still have gaps in weather and climate information services, which not only constrain institutions' capacity to make climate projections and manage risks, but also undermine capacity building efforts towards adaptation and mitigation. These existing gaps present opportunities for private investment in weather and climate information services thereby enhancing capacity for climate action. However, this calls for policies that clearly spell out the need for climate capacity building, as well as the direct benefits to both the investors and the beneficiaries.

Support Mainstreaming of Capacity Building in National and Sub-national Development Plans

Another way of securing and sustaining finance for climate change capacity building is by mainstreaming capacity building in national and sub-national development plans. Such an integrated approach will ensure that capacity gaps are explicitly identified, and that capacity building interventions are prioritized and considered during national and sub-national budget allocations. Fatemi et al (2020) supported this same argument while advocating for mainstreaming of capacity building for climate action. Although some donors are still skeptical about investing in decentralized projects, the benefits are enormous. Rai (2020), for example, argues that delivering climate finance to decentralized, small-scale projects gives communities a greater say in how climate finance is spent, ensures accountability, efficiency, sustainability of investments that are identified and delivered by local actors, and addresses local concerns and priorities. However, to enhance mainstreaming at different levels, there is a need to build institutional coordination and cooperation at different levels of development planning as well as a need to establish a national financing arrangement that allows sub-national agencies to harness climate finance (Fatemi et al, 2020).

Encourage Allocation of Capacity Building Finance to Disadvantaged Groups to Maximize Financial Benefits

It is important that the usually neglected segments of society, including women and rural smallholder farmers, become targets for capacity building finance. Women in rural areas, for example, present an opportunity for implementing climate actions relating to improved agricultural and land use management practices, due to their involvement in local community agricultural activities. Women, just like men, have important insights to contribute to designing and implementing effective climate responses and should, therefore, be explicitly targeted for capacity building finance projects. Targeting such groups of people ensures efficiency and effectiveness as finance is directly spent on people who matter in local communities.

Support Relevant Stakeholders to Navigate Access Modalities for Capacity Building Finance

Although the existing wide range of climate finance mechanisms seem to increase the options and possibilities for developing countries, the reality is that some developing countries find it difficult to access these funds due to the varied structures, complicated processes and criteria involved. Access requires adequate skills, on the side of government officials and other relevant stakeholders to, for example, to identify sources for capacity building finance, develop winning project proposals, and

negotiate with donors. Application requirements and processes need to be streamlined and made more consistent across funding mechanisms to reduce burdens and duplication of efforts. Any efforts to equip these officials with such knowledge and skills will be a move in the right direction.

Focus on Enhancing Capacity for Efficient and Effective Utilization of Finance

Adequate capacity for effective and efficient utilization of climate finance is a huge determinant for accessing it. This also entails the capacity to plan, manage and report on capacity building projects. As Nakhooda and others (2012) pointed out in their discussion paper on climate finance, planning for climate change is no easy task, and programming and using climate finance well is often a complex undertaking. As such, and as earlier stated above, a number of vulnerable developing countries still have limited access to climate finance simply because donors are reluctant to invest in such countries that seem to have inadequate capacity to manage funds or sustainably implement projects. It is also important to note that besides equipping stakeholders with financial and project management skills, efficient utilization of finance also requires having the necessary infrastructure and technology to manage, report and sustain capacity building projects. This makes digitalization (also a key element of this paper) an important aspect in facilitating readiness for capacity building finance in particular and climate action in general.

Recommendations for Digital Capacity Building

Develop Local Digital Technologies and Competencies

- Promote local digital developers and service providers.
- Create policy to protect open-source technology and oversight, decentralization, and net neutrality.

Consider Gender in Digitalization

- Collect gender-sensitive data on local power-structures, economic distribution, and community responses to digital technology..
- Mainstream gender in capacity building frameworks and national frameworks

Introduce Practical ICT Education

- Prioritize localized learning centers equipped with appropriate technology for education and development of digital skills.
- Strive for affordable public internet access.

Develop Local Digital Technologies and Competencies

It is critical to develop frameworks to translate external knowledge into local contexts (Pant and Heeks, n.d.). In the context of digitalization, this requires an approach which starts with the people rather than the technology. The complex social, political, and economic issues of each country must be addressed when considering digital solutions. In the same vein, the technology should not dictate the objectives. In order to promote digital sovereignty, it is important to develop local digital providers, such as internet providers, whenever possible. Preventative measures to guarantee agency include open source technology and oversight, decentralization, and net neutrality. As a whole, capacity building digitization projects will be more effective if they are rooted in the local, decentralized, and compatible with the digital commons logic (Pinto, 2018).

Consider Gender in Digitalization

As with any development project, digitalization programs have considerable implications for gender relations, which can be both positive and negative. In broad terms, there is an urgent need to mainstream gender in capacity building frameworks and national frameworks. Historically, many ICT projects do not properly address gender and social considerations, and can be described as "gender blind," which essentially means that they are applied indiscriminately across all genders. Accounting for gender in ICTs is undoubtedly challenging, primarily due to a lack of gender-sensitive data. For the sake of all sustainable development, there is a need to collect data on the 'contested, changed and reinforced,' dynamics of gender inequity (Wong, 2017). Qualitative data on local power-structures, economic distributions, and the difference in climate impacts and responses between men and women. In a similar vein, there is an essential need to develop an understanding of agency-structure dynamics to anticipate community response to digital interventions (Wong, 2017). Gender cognizant solutions are needed in order to design and implement digitization which is embraced by both male and female users and which recognizes the need to empower women as they face disproportionate climate impacts.

Introduce Practical ICT Education

Access to university programs can improve digital competencies and offer skills training which minimizes digitalization bottlenecks. It is important, however, to avoid placing all emphasis on formal academic institutions. Smaller, more localized learning centers can play a significant role as well. Digital telecenters or learning hubs which are built and equipped with appropriate technology can strengthen local capacities by offering internet classes and training to grant access to information and opportunities to build digital skills. Ideally these hubs will offer a fixed broadband connection. To be truly inclusive, there must be educational opportunities for affordable, public internet access (Pinto, 2018).

Conclusion

The interconnectedness of finance and digitalization with climate change lies primarily in their respective roles as tools for capacity building. Financial mechanisms are the tools that allow capacity building efforts of all kinds to be enacted, as funding promotes opportunities otherwise restricted. Digital technologies are among the opportunities that grant autonomous ownership, institutional strength, resource use efficiency, and enhanced transparency. As was identified throughout the report, the direct benefits to capacity offered by digitalization can only be realized if the physical infrastructure and technical training - provided to ensure a system of continued training into the future - are supplied, both of which require a considerable financial backing.

In order to accomplish this in line with the Paris Agreement, a number of challenges regarding the deployment and mobilization of climate finance toward capacity building were analyzed with a focus on empowering the particularly vulnerable or otherwise disadvantaged groups who currently face the greatest threats from climate change and lack of prioritization through funding pathways. Included as important issues facing relevant stakeholders are the lack of access to funding sources, knowledge, and skills related to developing project proposals and negotiating with donors. This has a synergized overlap with digitalization because the successful implementation of digital technologies share identical issues regarding sustained funding and training systems. Among the barriers to utilizing digital toolkits to build capacity is the significant financial requirement necessary to meet the infrastructural and labor project demands associated with related hardware and software use.

A key takeaway from this report is that the distinct nature of national and local community challenges with climate change requires an adaptive intellectual framework for identifying the needs of specific communities. This should be a widely accessible toolkit where user inputs reveal best-fit solutions

corresponding to the socio-economic, environmental background of the user. Ultimately, the variability of projects requires a modular process for selecting solutions, which is best determined by members of the communities or countries seeking solutions. The framework must be able to transform in order to address the needs of any community, acknowledging that an offering of general solutions would require the recipient of such recommendations to parse through the information to determine what is relevant to their community. More effective would be a framework that takes into account community uniqueness from the onset before providing potential solutions. More questions still exist regarding the methodologies for constructing such a framework, just as further investigation of the individual components of finance and digitalization could be conducted to draw out more insights specific to the individual approaches. However, an appropriate synthesis from the analysis of both approaches has directed attention to the importance of engaging with disadvantaged stakeholders and utilizing modular flexibility within capacity building strategies.

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