ACCELERATING THE SDGS THROUGH

Digital Public Infrastructure

A COMPENDIUM OF THE POTENTIAL OF DIGITAL PUBLIC INFRASTRUCTURE

FOREWORDS

Digital public infrastructure (DPI) comprises open and interoperable digital platforms that can unlock innovation and solve problems at population scale.

DPI offers solutions that can deliver progress on achieving the Sustainable Development Goals (SDGs). This compendium presents DPI success stories from around the world and maps them to corresponding SDGs.

We hope this compendium inspires the readers to further explore the possibilities and benefits that DPI can offer.

Ashwini Vaishnaw
Minister for Railways, Communications, and Electronics and Information Technology
Government of India

As new technologies advance at a rapid rate, they risk benefiting a select few if countries do not invest in the underlying network of digital systems -- or DPI -- that allow life-changing digital solutions like digital cash transfers, online education, or e-health to benefit every corner of every community.

Composed of open, interoperable technology within transparent and accountable governance frameworks, DPI can unlock innovation and value at scale. Indeed, it also offers the speed, scale and reach that can create exponential societal outcomes to deliver progress on the SDGs.

This compendium identifies and analyses DPI successes from around the world and maps them to corresponding SDGs. It shows how DPI can move the needle on achieving the SDGs and quantifies its potential impact. This data-driven guide can sharpen decision-making by all practitioners to promote safe, inclusive and resilient digital public infrastructure.

For many parts of the world, the future is already here with a range of new digital solutions now easily accessible. By assisting countries to build their DPI, we can help to ensure that all communities, everywhere, can reap the many benefits of our burgeoning digital world. We hope that this first-of-its-kind compendium inspires you to consider the many possibilities that DPI can offer as a means to accelerate progress across all 17 SDGs.

Achim Steiner
Administrator
United Nations Development Programme

INTRODUCTION

Digital public infrastructure is described as a set of shared digital systems that should be secure and interoperable, and can be built on open standards and specifications to deliver and provide equitable access to public and/or private services at societal scale and are governed by applicable legal frameworks and enabling rules to drive development, inclusion, innovation, trust, and competition and respect human rights and fundamental freedoms. As infrastructure, they cut through the siloed approach of designing and implementing digital solutions with interoperable, society-scale programmes that shift innovation and competition to activities that take place atop it.[1]

The scale and scope of digital transformation globally necessitates DPI approaches to maximize the opportunities to accelerate the SDGs and reduce the risks that digital technologies bring. The conventional approach is to create specific solutions to specific problems that work in specific contexts only. An alternative approach is to think 'DPI' – a combination of the right technology architecture, transparent, accountable and participatory governance-enabling local digital ecosystems to drive sustainable innovation and scale.[2]

With a DPI approach, countries can advance a range of development objectives and respond better during crisis. Although each piece of DPI can have impact on its own, the interaction of this infrastructure can unlock the most significant impacts in countries and across the SDGs.

DPI can accelerate global economic growth, support the transition to sustainable and green economies, and grow accessibility and public trust in institutions.

Exhibit 1: DPI can accelerate economic growth, offset carbon emissions and improve access to public institutions

20–33%

potential acceleration in economic growth by 2030 through financial DPI[3]

0.8–1 $GtCO^2e$

of 2030 targets for LMICs (about 4%) in carbon emission reduction through carbon trading DPI[3]

28–42%

potential increase in access to justice by 2030 as DPI facilitates faster case management and reliable ODR[3, 4]

The compendium assumes a 'big tent' approach to include population-scale systems at varying levels of maturity. This was important to create a collective space to inspire and foster discussions, and highlight DPI approaches that accelerate, or possess the potential to accelerate attainment of the SDGs.

It is not the aim of this work to definitively classify a digital solution as a DPI or otherwise. Recognizing the ongoing development and evolution of the DPI space – with an emerging consensus around a DPI framework – this compendium is an attempt to stimulate progressive thinking and explore potential across the key challenges facing our 2030 Goals. It showcases the innovative applications, use cases, and potential of DPI to build a greener, more inclusive and sustainable future.

The intention is to update and publish this compendium annually, ensuring that the case studies and perspectives evolve in lockstep with the field.

Sources: (1) G20 consensus on DPI, under the India Presidency in 2023 (refer to the Digital Economy Ministerial Declaration for exact language); (2) Some organizations have defined DPI, while this compendium gives meaning to their impact and potential in accelerating SDG outcomes; (3) UNDP, The Human and Economic Impact of Digital Public Infrastructure, 2023; (4) Online Dispute Resolution

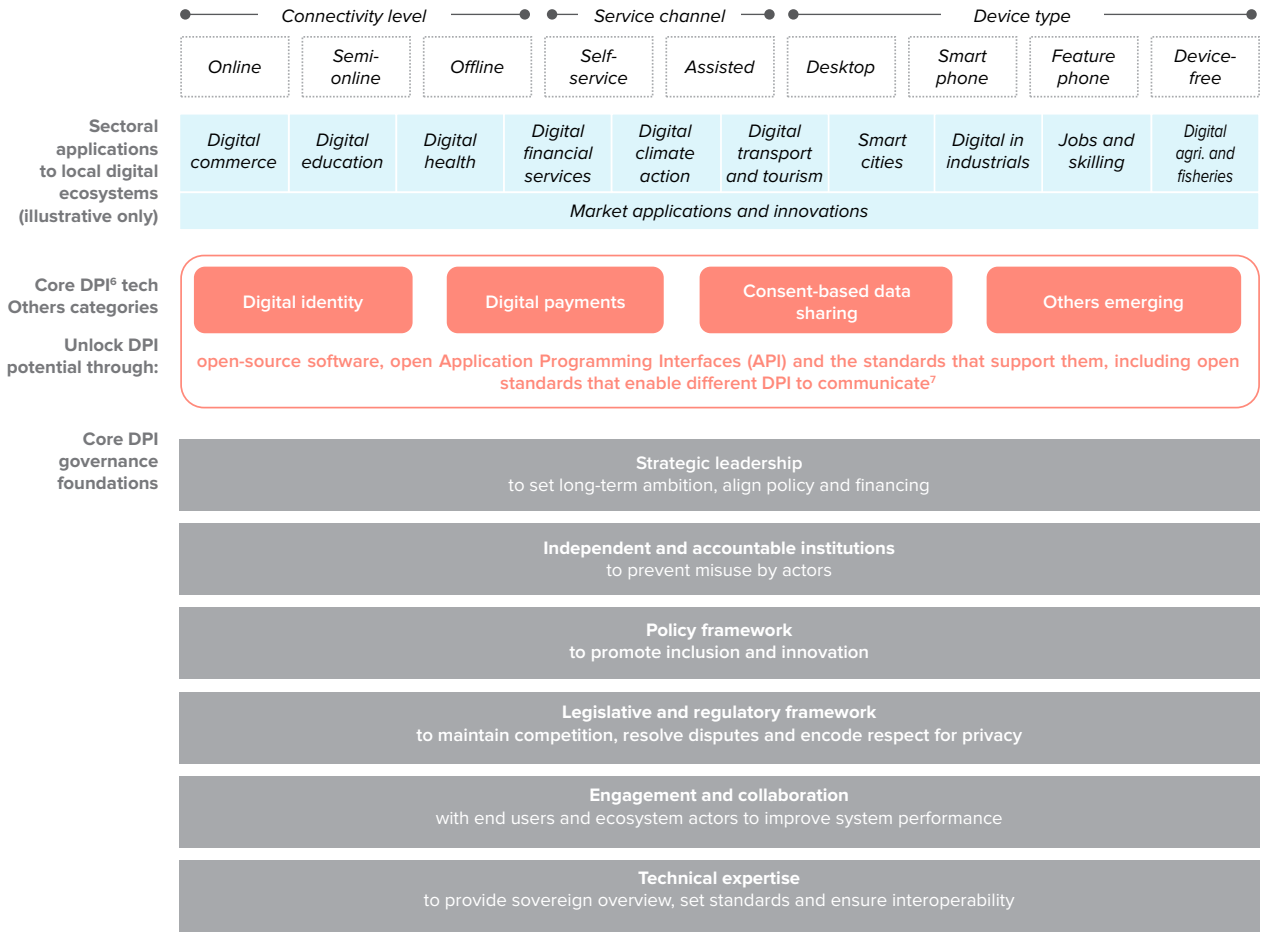
UNDERSTANDING DPI

DPI has four characteristics: it (1) is interoperable (forms the underlying infrastructure for a variety of use cases alongside a range of tools, technologies and service providers); (2) can be built on open standards (is available to anyone to build on to and integrate services for people); (3) operates at a societal scale (is not restricted by geography or demographic); and (4) has robust enabling rules and regulations (has unified and coherent governance frameworks to safeguard people and prevent misuse).[5]

DPI also varies in form. There is emerging consensus on the following three categories of DPI resulting from their functions, in additions to others emerging:

a) **Digital identity:** The ability for people and businesses to securely verify their identity, as well as complementary trust services such as electronic signatures and verifiable credential.
b) **Digital payments:** Easy and instant transfer of money between people, businesses and governments.
c) **Consent-based data sharing:** Seamless flow of personal data across the public and private sectors, with safeguards for personal data protection as per relevant applicable data governance frameworks.
d) **Others emerging:** There may be other emerging core DPI tech functions, such as discovery and fulfilment, geospatial DPI, AI models, and aggregation of data and content.

Exhibit 2: A framework to understand the DPI approach



Source: (5) G20 consensus on DPI, under the India Presidency in 2023 (refer to the Digital Economy Ministerial Declaration for exact language); (6) G20 consensus on DPI, under the India Presidency in 2023 (refer to the Digital Economy Ministerial Declaration for exact language); (7) G20 DEWG India Presidency, 2023

G20 FRAMEWORK FOR SYSTEMS OF DIGITAL PUBLIC INFRASTRUCTURE[1]

SUGGESTED PRINCIPLES[2]: Technology, governance and community

01 **Inclusivity:** Eliminate or reduce economic, technical, or social barriers to enable inclusion, empowerment of end-users, last-mile access, and avoid erroneous algorithmic bias.

02 **Interoperability:** Enable interoperability by using and building on open standards and specifications with a technology neutral approach, wherever possible, while accounting for appropriate safeguards and keeping in view the legal considerations and technical constraints.

03 **Modularity and Extensibility:** Extensible approach implies a building block or modular architecture to accommodate changes/modifications without undue disruption.

04 **Scalability:** Use flexible design to easily accommodate any unexpected increase in demand and/or to meet expansion requirements without changing existing systems.

05 **Security and Privacy:** Adopt an approach that embeds key privacy enhancing technologies and security features within the core design to ensure individual privacy, data protection, and resilience based on standards offering appropriate levels of protection.

06 **Collaboration:** Encourage the participation of community actors at different stages of planning, designing, building, and operating to facilitate and promote a culture of openness and collaboration. Enable the development of user-centric solutions and facilitate widespread and sustained adoption and allow innovators to develop new services.

07 **Governance for Public Benefit, Trust and Transparency:** Maximise public benefit, trust and transparency while respecting applicable legal frameworks. This means that laws, regulations, policies and capabilities should seek to ensure that these systems are safe, secure, trusted and transparently governed, and also promote competition and inclusion, and adhere to principles of data protection and privacy.

08 **Grievance redress:** Define accessible and transparent mechanisms for grievance redress, i.e., user touchpoints, processes, responsible entities, with a strong focus on actions for resolution.

09 **Sustainability:** Ensure sustainability through adequate financing and technological support and enhancements to facilitate uninterrupted operations and seamless user-focused service delivery.

10 **Human rights:** Adopt an approach that respects human rights at every stage of the planning, designing, building, and operating.

11 **Intellectual Property Protection:** Provide adequate and effective protection and enforcement of intellectual property rights for the rights-holders of technologies and other materials used based on existing legal frameworks.

12 **Sustainable Development:** Seek to develop and deploy these systems that contribute to the implementation of the 2030 Agenda for Sustainable Development and achievement of Sustainable Development Goals.

Source: (1) G20 Digital Economy Ministerial Declaration, 2023; (2) The aim of these Principles is to build upon the advancements in this domain, such as the Principles on Identification for Sustainable Development, the CPMI-IOSCO Principles for Financial Market Infrastructures, UN Principles for Responsible Digital Payments and the Principles for Digital Development.

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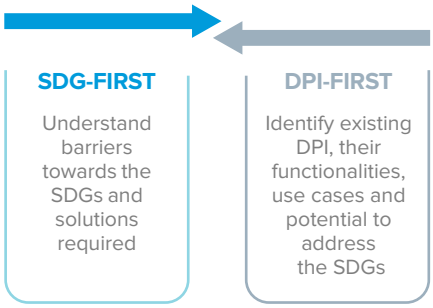
METHODOLOGY

This compendium draws on a **mapping of nearly 50+ exemplars across 17 SDGs. It assumes a 'big tent' approach to include solutions at varying levels of maturity.** In this spirit, some digital public goods[1] and open-source projects that deviate slightly from the definition of DPI are included. Consequently, the selection process for the case studies has deviated slightly from the definition of DPI applied to embrace those that incorporate elements of DPI. In some instances, there were neither adequate DPI solutions nor instances of extant DPGs, yet they remain due to their significant latent potential. The team proceeded as follows:

1. **Landscape proven and nascent DPI** that have been developed and scaled globally across sectors and identify typologies.
2. **Develop a framework** around DPI functionalities and their use cases.
3. **Identify open challenges and white spaces across SDGs** and assess the potential for DPI approaches to address them.
4. **Map DPI across the SDGs** based on their functionality and potential to impact spotlight case studies.
5. **Validate and test mapping** with expert conversations and secondary research.
6. **Synthesize into a crisp final report** with two pagers on each SDG, highlighting communities, and identifying best practices and principles for practitioners.

Dual approach of identifying DPI approaches across the SDGs



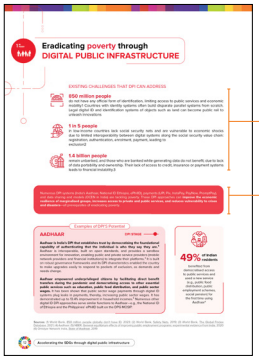
The purpose is to underscore the potential impacts that DPI and DPI-like solutions can affect, demonstrating how a comprehensive DPI approach could be adopted to magnify their beneficial efficacy. **It is hoped, this approach mitigates misapprehension that DPI methodologies are pertinent only to a subset of the SDGs.**

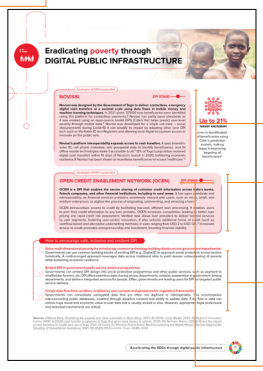
Sources: (1) Digital public goods (DPGs) are open-source software, open data, open AI systems, and open content collections that adhere to privacy and other applicable laws and best practices, do no harm, and help attain the SDGs. Case studies of solutions that are DPGs or open-source projects are included.

It is not the aim of this work to **definitively classify a solution or system as DPI or otherwise.** Recognising the ongoing development and evolution of the DPI space – with an emerging consensus around a DPI framework – this compendium is an attempt to **stimulate progressive thinking and explore potential across the key challenges facing our 2030 Goals.** The intention is to **update and publish this compendium annually**, ensuring that the case studies and perspectives evolve in lockstep with the field. Additionally, it should be noted the DPI maturity-indicators serve as guidance for readers to attain an overview, and are indicative by nature.

The overarching aim of this compendium is to serve as a point of dialogue and collaboration, encouraging DPI approaches that are people-centric and rights-based.

HOW TO READ THESE PAGES





1. **Challenges:** The first section illustrates challenges within the specific SDG that can be addressed by DPI. These are not exhaustive.
2. **Progress overview:** This section provides an overview of the progress made so far in the DPI space for that SDG.
3. **Case studies:** This section contains case studies showcasing implementations of DPI or 'DPI-like' approaches. The case studies provide an overview of what the DPI does in addressing the SDG.
4. **Actionable recommendations:** This section contains recommendations to ensure that the relevant DPI is safe, inclusive and rights-based to spur progress towards the SDG.
5. **Stages of DPI Maturity:** Each case has a DPI maturity indicator. To explore the dimensions of the indicative maturity indicator, please see Exhibit 3.

Exhibit 3: Stages of DPI maturity

	Stage 1	Stage 2	Stage 3
Technology must be adaptable, scalable and resilient	• Lack of integration and reusability across digital systems	• Open APIs and closed network • Interoperable only for a single utility	• Open protocols, APIs and networks • DPI is interoperable and extensible
Governance must protect human rights, data security and privacy and must hold parties accountable to people and public interest	• Poor regulatory oversight to protect people from exclusionary policies and surveillance	• Reactionary and singular instead of proactively planning unified system	• Participatory community governance • Consultative policy-setting
Enabling ecosystems must facilitate private and public innovation and competition	• High barriers to entry • Not easy to integrate into the network low-service coverage • Low-service coverage	• Medium barriers to entry • Not easy to integrate into the network • Low-service coverage	• Low barriers to entry • Easy to integrate into the network • Wide coverage of services
Examples from India	Open Credit Enablement Network	Agricultural Advisory DPI based on Farmstack	Aadhaar

HOW TO USE THIS COMPENDIUM

This compendium is designed to assist decision makers in government, international development, the private sector, technology organizations and civil society working to accelerate progress towards the SDGs. It provides a global snapshot of DPI that has worked and further opportunities to innovate. The compendium serves as a guide, showcasing approaches, insights and principles that support the scaling and implementing of safe, inclusive and rights-based DPI.

FOR GOVERNMENTS

seeking to accelerate the progress of SDGs in their countries. This compendium showcases examples that have worked globally and provide insights and inspiration for your own digital transformation efforts.

FOR MULTILATERALS

advocating for the benefits of a DPI approach. This compendium highlights the potential impacts of DPI across sectors, shares compelling evidence for their adoption, and demonstrates the imperative to invest.

FOR THE PRIVATE SECTOR

wishing to stay abreast of upcoming innovations and their impact. The compendium shares examples of new services and innovations unleashed by DPI and their impact on revolutionizing service delivery.

FOR CIVIL SOCIETY ACTORS

working to ensure sustainable and responsible digital transformation. This compendium highlights global exemplars and synthesizes findings to help craft safe, inclusive and rights-based DPI.

Eradicating poverty through DIGITAL PUBLIC INFRASTRUCTURE

EXISTING CHALLENGES THAT DPI CAN ADDRESS

850 million people

do not have any official form of identification, limiting access to public services and economic mobility.[1] Countries with identity systems often build disparate parallel systems from scratch. Legal digital ID and identification systems of objects such as land can become public rail to unleash innovations.

1 in 5 people

in low-income countries lack social security nets and are vulnerable to economic shocks due to limited interoperability between digital systems along the social security value chain (registration, authentication, enrolment and payment) leading to exclusion.[2]

1.4 billion people

remain unbanked, and those who are banked while generating data do not benefit; this is due to lack of data portability and ownership. Their lack of access to credit, insurance or payment systems leads to financial instability.[3]

Numerous DPI (India's Aadhaar, National ID Ethiopia and ePhilID), payments (UPI, Pix, InstaPay, PayNow and PromptPay), and data sharing and models (OCEN in India) are tackling poverty. These DPI approaches can **improve the economic resilience of marginalized groups, increases access to private and public services, and reduces vulnerability to crises and disasters**—all prerequisites of eradicating poverty.

Example of DPI's potential

AADHAAR

DPI STAGE

Aadhaar is India's DPI that establishes trust by democratizing the foundational capability of authenticating that the individual is who they say they are.[4] Aadhaar is interoperable, built on open standards, and provides a sandbox environment for innovation, enabling public and private service providers (mobile network providers and financial institutions) to integrate their platforms.[4] It is built on robust governance frameworks and its DPI characteristics enabled the country to make upgrades easily to respond to pockets of exclusion, as demands and needs change.

Aadhaar empowered underprivileged people by facilitating direct benefit transfers during the pandemic and democratizing access to other essential public services such as education, public food distribution and public sector wages. It has been shown that public sector wage payments through digital ID systems plug leaks in payments, thereby increasing public sector wages. It has demonstrated up to 13.4% improvement in household incomes.[5] Numerous other DPI-related digital ID approaches serve similar functions to Aadhaar—e.g., the National ID of Ethiopia and the Philippines' ePhilID built on the Modular Open Source Identity Platform (MOSIP), a DPG.

49% of Indian residents

benefited from democratized access to public services and used a new service (e.g., public food distribution, public employment schemes and social pension) for the first time using Aadhaar[6]

Sources: (1) World Bank, 850 million people globally don't have ID, 2023; (2) World Bank, Safety Nets, 2019; (3) World Bank, The Global Findex Database, 2021; (4) UIDAI, Aadhaar; (5) NBER, General equilibrium effects of improving public employment programs: experimental evidence from India, 2020; (6) Omidyar Network India, State of Aadhaar, 2019

Eradicating poverty through DIGITAL PUBLIC INFRASTRUCTURE

Example of DPI's potential

NOVISSI

DPI STAGE

Novissi was designed by the Government of Togo to deliver contactless, emergency digital cash transfers at a societal scale using data flows in mobile money and machine learning techniques. In 2021 alone, 57,000 new beneficiaries were identified using this platform for contactless payments.[7] Novissi has partly open standards as it was created using Cider (an open-source toolkit that is a DPG) that helps predict user-level poverty through mobile data.[8] Novissi was developed for a single use-case – social disbursements during COVID-19. It can amplify its impact by adopting other core DPI tech such as Verifiable ID and Registries and allowing local digital ecosystem access to innovate on the public rails.

The interoperability of Novissi's platform expands access to cash transfers. It uses biometric voter ID, cell phone metadata and geospatial data to identify beneficiaries, and its offline mobile technologies make it accessible to all.[9] Within 10 days of Novissi's launch in 2020, 12% of Togo's population received digital cash transfers, bolstering economic resilience.[9] Novissi has been shown to incentivize beneficiaries to access healthcare.[10]

Up to 21%
lesser exclusion

error in identification of beneficiaries using Cider's prediction models, making leaps in improving targeting of beneficiaries[11]

Example of DPI's potential

OPEN CREDIT ENABLEMENT NETWORK (OCEN)

DPI STAGE

OCEN is a DPI that enables the secure sharing of customer credit information across India's banks, fintech companies and other financial institutions, including in rural areas. It has open standards and interoperability, as financial service providers can seamlessly interact with users (such as micro, small and medium enterprises) to digitize the process of originating, underwriting, and servicing a loan.[12]

OCEN democratizes access to credit by facilitating low-cost, efficient loan processing. It enables users to port their credit information to any loan provider. OCEN increases competition, leading to better loan pricing and rapid credit risk assessment. Verified data allows loan providers to deliver tailored services to user segments, fostering user-centric innovation. It also unlocks additional forms of credit (such as cashflow-based and alternative underwriting methods) in sizes ranging from US$2 to US$12K.[13] Increased access to credit promotes entrepreneurship and investment, boosting financial stability.

How to encourage safe, inclusive and resilient DPI

Solve multi-dimensional poverty by introducing common technology building blocks across government departments: Governments can use common building blocks of existing DPI (e.g., Digital ID to approach social protection across sectors holistically. A multi-pronged approach leverages data across traditional silos to yield deeper understanding of poverty while bolstering economic resilience.

Embed DPI in government public service delivery programmes: Governments can embed DPI design into social protection programmes and other public services, such as payment to smallholder farmers, etc. DPI offers seamless data sharing across departments, enables cooperation in government among departments, and delivers integrated services for people. Often, governments are leading users for DPI for targeted public service delivery.

Create data free-flow corridors, enabled by user consent and people-centric regulatory frameworks: Governments can consolidate variegated data that are often not digitized or interoperable. This encompasses interconnecting public databases, enabled through people's consent and ability to update data. Free flow in data can unlock huge social and economic value in user data that is usually locked in silos. However, appropriate legal protections and redressal mechanisms are critical.

Sources: (7) World Bank, Prioritizing the poorest and most vulnerable in West Africa, 2021; (8) OCHA, Cider Model, 2022; (9) Regional Innovation Centre UNDP, A COVID cash transfer programme in Togo that gives more money to women, 2020; (10) Springer Nature, COVID-19 and the impact of cash transfers on health care use in Togo, 2021; (11) Centre for Effective Global Action, Machine Learning and Mobile Phone Data Can Improve the Targeting of Humanitarian Assistance, 2021; (12) Credable, What is Open Credit Enablement Network (OCEN), 2022; (13) Economic Times, OCEN, 2022

Ending hunger through DIGITAL PUBLIC INFRASTRUCTURE

EXISTING CHALLENGES THAT DPI CAN ADDRESS

2.3 billion people

face severe food insecurity, with inadequate, closed and disparate digital food systems.[1] Ensuring a demand-driven agri-food system necessitates the development of new capabilities that cohere the intricacies of the highly dynamic and interconnected factors.

31% global rise in price

of farm commodities following the COVID-19 pandemic due to vulnerable food supply chains and volatile prices,[2] creating new inequities and exclusion of smallholders, many of whom despite access to internet or digital identity have limited access to information and services.

A negative 0.31% growth

annually in global agricultural productivity in low-income countries[3] signaling lack of interoperability, inclusivity, affordability and accessibility, such as of weather and market information.

There are a few examples of DPI today that support the eradication of hunger. Most that do are limited to the sharing of agricultural data and credentials (FarmStack, kenya agricultural observatory platform - KAOP). These allow local actors to create tailored solutions on top of DPI, such as for market linkage or tailored advisory, which promote greater resilience and better management of food supply chains. More agricultural DPI and innovative applications are required to support the agriculture supply chain from procurement to storage and sale. There is a need for safe and secure open systems that go beyond agriculture to support the management of market linkages, water and waste. A new initiative Digital Public Infrastructure for Agriculture (DPI4A)[4] aims to address critical bottlenecks of agri food systems in the Global South and address some of the inherent challenges.

Example of DPI's potential

AGRICULTURAL ADVISORY DPI BASED ON FARMSTACK

DPI STAGE

FarmStack is a DPG implemented as DPI in Ethiopia for powering data transfer in agriculture to supercharge collaboration and boost productivity.[5, 6] The DPI approach has benefited 3.5 million farmers in Ethiopia and is part of the open ecosystem of Digital Agricultural Advisory Services.[7] Organizations can build their own applications by leveraging its open data standards that enable data sharing. FarmStack can be used to combine farmer profile information with other datasets (soil, weather and market prices) to create customized videos about improved agricultural practices.[8]

The platform increases farming productivity through advisories based on data aggregated seamlessly from various sources. It facilitates better opportunities for credit through the secure exchange of financial data to determine creditworthiness.[7]

21% higher likelihood

among FarmStack users to adopt new practices that improve agricultural productivity[8]

Sources: (1) Food and Agriculture Organization, The State of Food Security and Nutrition in the World, 2022; (2) Welt Hunger Hilfe, Food Price Increase Exacerbates Hunger, 2023; (3) Virginia Tech College of Agriculture and Life Science, GAP Report, 2022; (4) T20 Policy Briefs, The Vision of a Digital Public Infrastructure for Agriculture, 2023; (5) Digital Green, Introducing Farmstack; (6) Digital Public Goods Alliance, Registry; (7) Digital Green, Farmstack brochure; (8) IDinsight, Digital Green Farmstack Evaluation Results, 2021

Ending hunger through DIGITAL PUBLIC INFRASTRUCTURE

Example of DPI's potential

KENYA AGRICULTURAL OBSERVATORY PLATFORM (KAOP)

DPI STAGE

KAOP is an online platform aggregating data on crop performance, climate patterns and soil health.[9] It is implemented with the Kenyan Government and scaled across multiple countries, linking over one million farmers.[9, 10] KAOP uses satellite imagery, weather stations and agricultural sensors to provide accurate information. The platform makes open data available in a standardized format and helps disseminate advisories to farmers through an online portal and SMS.[11] To unlock its full potential as DPI, KAOP needs to allow interoperability to leverage KAOP as a public rail.[12]

KAOP increases food security and labour productivity and promotes sustainable agriculture in Kenya by standardizing and analysing information from multiple sources, which allows farmers and policymakers to make evidence-based decisions. Through KAOP, farmers access personalized ways to improve their crop yields and manage pests and diseases. The platform provides live market information to help farmers decide when to sell their crops and at what price.

Example of DPI's potential

LINUX AGSTACK

DPI STAGE N/A[16]

Linux AgStack provides open-source software infrastructure that can build, manage and run applications.[13] It also offers data repositories including an asset registry containing a map of global agricultural land alongside near-real-time information about soil, weather, market predictions and nearby insect infestations that improve farmers decision-making.[14, 15] It provides open software application frameworks, open models, and data repositories. It is interoperable with third-party applications via a suite of open standards like curated APIs, extensions and toolboxes.[13] It is an emerging solution and its DPI implementations are yet to emerge.

Tech players, local ecosystems and governments can use Linux AgStack to improve agricultural productivity by equipping farmers with near-live data that provide timely warnings and enable superior outcomes. Data governing the location and size of farmland can be leveraged by financial service providers, AgTechs, agri-businesses and governments to meet the needs of smallholder through innovative services and by the research community to better understand crop suitability and how food systems can prepare for climate change.[15]

How to encourage safe, inclusive and resilient DPI

Drive public and private sector actions to invest in DPI for agriculture:
Given agriculture's intricate complexities and intersection with every other sector, such as finance, supply chain, manufacturing, water and chemicals, DPI for agriculture can break down data silos and create shared technology infrastructure together to translate the vision into reality to end hunger worldwide.

Open agriculture data:
Due to the lack of standardization, calibration and certification, most agri datasets are ineffective for use, hence limiting value of data exchanges as a public rail. Sound data interoperability policies are of utmost importance to improve data trust and farmer adoption. Similarly, enabling data portability protects farmer interests when switching service providers.

Build integrated services and engagement with smallholder farmers:
DPI related to this SDG could handle large volumes of diverse agricultural datasets and employ tools such as video, voice and vernacular translation to enhance farmer engagement. By doing so, it can foster platform economies and enable a wide array of digital innovations spanning the entire agri food systems value chain, ultimately benefiting smallholder famers.

Sources: (9) KAOP, KAOP Platform; (10) World Bank, Scaling Up Disruptive Technologies for Agricultural Productivity in Kenya, 2023; (11) KALRO, Blog, 2021; (12) UNECA, Knowledge Management Platform for Climate Information Services, 2021; (13) AgStack Foundation, AgStack Website; (14) The Linux Foundation, AgStack Project to Build World's First Global Dataset of Agricultural Field Boundaries, 2022; (15) HPE Developer, Why Open Source is more than Software: The Example of the Linux Foundation's AgStack project, 2022; (16) Not applicable as it is only a DPG

Fostering good health and well-being through DIGITAL PUBLIC INFRASTRUCTURE

EXISTING CHALLENGES THAT DPI CAN ADDRESS

6 million deaths each year

are a result of poor-quality health care.[1] A systematic review of identified studies[2] (including randomized controlled trials) demonstrate beneficial outcomes in outpatient, inpatient, emergency, and community settings from open health data information exchange to counter this.

500 million people

were infected during the COVID-19 pandemic[3] due to lack of access to prevention and care mechanisms, such as national eligibility determinations being facilitated via the integration and interoperability of eligibility and enrolment systems through combination of digital ID, registries and data exchanges.

100 million people

incur health expenses that push them into extreme poverty each year.[4] Despite progress in digital health, many countries have limitations in their DPI for health. For example, an analysis from the United Kingdom found that consolidating national health service (NHS) data into longitudinal data would bring about £9.6 billion per year in savings.[5]

Public and private players are leveraging DPI for health — such as the sharing of health data (Bahmni or OpenELIS, Brazil's Open Health and France's Health Data Hub) and leveraging verifiable IDs and registries (Ayushman Bharat Health Account, a vaccination registry based on the DPG DIVOC) — to enhance good health outcomes. This is critical for inclusion, through improved healthcare resource planning, intervention planning, disease surveillance and vaccination tracking. The World Health Organization's (WHO) formulation of digital health enterprises[6] can be linked to, or is interchangeable with DPI for health, and is critical for fostering good health and well-being.

Example of DPI's potential

AYUSHMAN BHARAT DIGITAL MISSION (ABDM)

DPI STAGE

ABDM is a Government of India initiative aimed at bridging the gap between disparate digital health systems.[7] This is achieved by dint of core building blocks or modules such as registries for patients (Health ID registry), healthcare professionals (Healthcare Professionals Registry), and healthcare facilities including hospitals, laboratories and pharmacies (Health Facility Registry). Each entity is provided a unique identifier across the ecosystem to enable linkages. The system is open source, interoperable with APIs, and has an independent regulator for enforcing regulations.[8, 9]

ABDM enables public and local digital healthcare players to provide Indians with both access to accurate information on healthcare facilities and service providers, as well as the option to access health services remotely through tele-consultation and e-pharmacy.[10] Over 100 health programmes (including A-HIMS, eSushrut, e-Sanjeevani 2.0, ESIC, Haryana e-Upchaar and West Bengal Integrated HMIS) from the government sector along with 33 health apps from private sector innovators have been integrated with ABDM.[11]

Sources: (1) Leapfrog to Value, Flagship report, 2019; (2) PubMed, The benefits of health information exchange: an updated systematic review, 2018; (3) UN, SDG Progress report, 2022; (4) WHO, Half the world lacks access to essential health services, 2017; (5) Ernst & Young, "Realising the Value of Health Care Data: A Framework for the Future", 2019; (6) Observer Research Foundation, Strengthening Digital Public Infrastructure for Health, (7) Government of India, ABDM, 2023; (8) Government of India, Press release, 2022; (9) Springerlink, The ABDM: Making of India's Digital Health Story, 2023; (10) Government of India, Press Release, 2023; (11) Government of India, ABDM FAQ

Fostering good health and well-being through DIGITAL PUBLIC INFRASTRUCTURE

73%

of vaccination sessions in rural areas

facilitated on India's DIVOC based vaccination platform, making immunisation accessible in hard-to-reach places[12]

Example of DPI's potential

VACCINE ADMINISTRATION DPI BASED ON DIVOC

DPI STAGE N/A[20]

DIVOC is a DPG that facilitates vaccine administration and issues verified certificates.[13] It is a building block for major health DPI and digital solutions, such as ABDM in India and Peduli Lindungi in Indonesia. The platform issued up to 25 million certificates a day. It has enabled the delivery of 2 billion vaccination certificates in a single year.[14] It has open standards that support all vaccine providers in registration, appointment scheduling, vaccine allocation, and monitoring of distribution and utilisation. It is interoperable as it verifies certificates across platforms. To qualify as DPI, it must be minimal and enable third-party innovation. **DIVOC streamlines the vaccination process making it more efficient and accessible.** India's vaccination platform was available in 12 languages, enabled users to search the nearest centres even in hard-to-reach rural and tribal areas, and allowed walk-ins for those without access to the internet.

Example of DPI's potential

FRANCE'S HEALTH DATA HUB

DPI STAGE

France's Health Data Hub is a unified platform that aggregates administrative data from various sources such as hospitals, insurance providers and research institutions.[15] The platform, which has supported more than 1,600 projects,[15] confers interoperability through international standards that allow data to be pooled with external databases.[16] While secure authorization is required for select databases, data about medicine use, health insurance expenditure, and other less-sensitive data are openly available through APIs.[16] The data hub supports open-source tools built by a thriving community to analyse and use the data on the platform.[15] **The Health Data Hub fosters innovation in healthcare and medicine and improves the quality of healthcare** by providing data for research, insurance, decision-making and management.

Example of DPI's potential

LABORATORY MANAGEMENT DPI BASED ON OPENELIS

DPI STAGE N/A[20]

OpenELIS is a DPG specifically tailored for LMICs for enterprise-level laboratory information management.[17, 18] It has been implemented independently as DPI in four LMICs and in conjunction with Bahmni in 14 more countries.[17] In Mauritius, during COVID-19, it managed labs for processing virus tests.[19] It enables data interoperability by adhering to open standards such as HL7, FHIR and ASTM.[18] To unlock its potential as DPI, it must be minimal and allow third-parties to build on top of it.

OpenELIS bolstered the resilience of health systems in Mauritius by scaling to integrate labs, in only three weeks, compared with traditional procurement systems which take 6+ months.[19] It saved US$5 million in implementation and reduced the number of people required for analysis from 60 to five.[19]

How to encourage safe, inclusive and resilient DPI

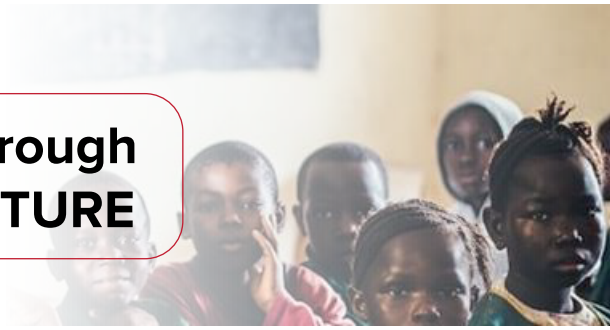
Embed DPI approaches across digital health initiatives:
Policy, investments and other efforts focused on DPI and DPGs should include health as a critical sector, and should highlight the linkages between DPI for health and DPI for other sectors, such as financial services, or sectors included in WHO's 'One Health' initiative (e.g. environment, agriculture and veterinary).

Drive accessibility in the last mile:
Last-mile reach is critical to expanding the delivery of health services. Governments and stakeholders must focus on optimal last-mile workflow management systems that support tools for accessibility and integrate seamlessly with open and integrated healthcare system. Capacity building and sensitivity training must be provided to workers.

Integrate with health-adjacent systems:
Countries can ensure that investments in digital health promotes the adoption of broader DPI that can serve a range of health use cases. These approaches to funding can be built on existing approaches and principles, such as the Principles of Donor Alignment for Digital Health.

Sources: (12) UNDP, Winning over Covid (CoWIN); (13) eGov Foundation, DIVOC; (14) DIVOC, The road to 2 Billion; (15) Health Data Hub; (16) SNDS, Documentation, 2023; (17) OpenELIS Global, OpenELIS Website; (18) Digital Public Goods Alliance, Registry; (19) UNDP, How open source made a difference in Mauritius' pandemic response, 2020; (20) This is not applicable as it is not minimal.

Achieving quality education through DIGITAL PUBLIC INFRASTRUCTURE



EXISTING CHALLENGES THAT DPI CAN ADDRESS

37% of adolescents
are out of school in Sub-Saharan Africa due to inadequate access to education, including due to stagnation in access to digital learning, as globally one-third of nationally-developed digital systems are outdated and no longer fully functional.[1]

1 in 4 schools
globally does not have electricity,[2] highlighting the need to invest in open, interoperable and evolvable DPI for education that can be used by multiple platforms and point solutions to solve for scale, diversity, complexity and device and electricity penetration.

64% of 10-year-olds globally
do not meet minimum proficiency levels due to inadequate education.[3]

Emergent DPI approaches support improved educational outcomes. Existing efforts are limited to discovery networks (DIKSHA), verification systems (OpenCerts), and data sharing to improve planning and resource management (educational DPI based on DHIS2). These **improve access to quality education**. More educational DPI is necessary to amplify traditional learning systems.

Example of DPI's potential

DIGITAL INFRASTRUCTURE FOR KNOWLEDGE SHARING (DIKSHA)

DPI STAGE

DIKSHA is a DPI operated by the Indian Government that provides over 180 million students with educational resources.[4, 5] Built on the open-source building blocks of the DPG Sunbird ED, it supports value-added applications using its APIs.[6, 7]

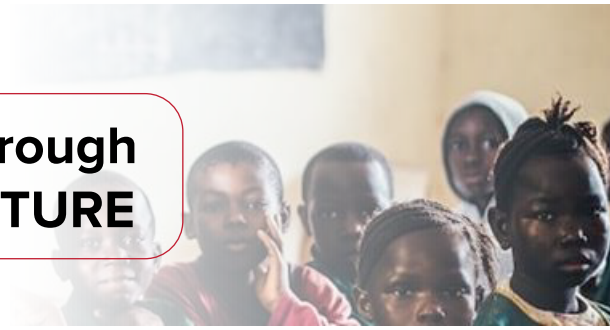
DIKSHA has expanded access to quality educational content, streamlined teaching processes and made customizable resources widely available to learners and teachers. Its open aggregated content structure enables collaborative learning and teaching resources, eliminating duplication of effort and generating customizable content. With 11,000 contributors and 10,000 courses, DIKSHA has welcomed over 168 million course enrolments.[4] It eliminates disparities in access by offering multilingual content in 30+ languages and provides assistive tools for the differently-abled.[5]

95% **cost reduction in**

the training of three million teachers at quadrupled speed, enabling undisrupted quality education during the COVID-19 pandemic[5]

Sources: (1) UNESCO, Global Education Monitoring Report, 2020; UNICEF, Press Release, 2022; (2) UN, UN SDG progress report, 2022; (3) UNICEF, Press Release, 2022; (4) DIKSHA, Dashboard; (5) Ministry of Education India, DIKSHA - Learnings from India Experience, 2021; (6) Sunbird ED, DIKSHA; (7) DIKSHA, DIKSHA OSS

Achieving quality education through DIGITAL PUBLIC INFRASTRUCTURE



Example of DPI's potential

OPENCERTS

DPI STAGE

Singapore's OpenCerts, built on DPG OpenAttestation, is a blockchain-based platform for issuing and verifying digital academic certificates.[8, 9] It has been used to verify 5,000 education credentials monthly.[10] As an open and interoperable platform, it supports storage and verification across different institutions.[10]

OpenCerts bolsters the robustness of education systems and delivers fair practices for employment by enabling accurate, low-cost qualification checks.[10] It reduces waiting time and process complexity for students with seamless integrations.

7 months

of working time saved per institute

improving process efficiency in educational institutes[10]

Example of DPI's potential

OPEN edX IMPLEMENTATIONS

DPI STAGE N/A[14]

Open edX is an open-source learning management system empowering students and institutions to customize learning services for diverse use cases.[11] It has been employed for 50K courses in 53 languages, reaching 55M learners.[11] It is interoperable, allowing content to run on other learning management systems.[12] If implemented with governing rules, it becomes DPI.

It enables knowledge and upskilling through highly customizable systems that cater to diverse student and industry needs.[13] It empowers organizations worldwide to customize learning services for diverse use cases, from self-paced learning to life-long learning for employees and civil servants. It helps its learners pursure higher education and advance their careers through MicroMasters, MicroBachelors and other professional certificates.

How to encourage safe, inclusive and resilient DPI

Leverage education for broader outcomes:
By integrating upskilling and learning as critical components of public rails, policymakers unleash gains across a spectrum. Holistic education powered by DPI supports the verification of educational attainment for economic and other credentials, promotes civic engagement, fosters entrepreneurship and economic growth and improves education outcomes.

Strengthen the local digital ecosystem for education:
DPI approaches create the public rails and open ecosystems that can drive user-centric innovation at scale. It is critical that robust data protection and regulatory frameworks are in place to address the risks of exclusion, complemented by non-technological innovations to reach every child.

Embed DPI approaches in education strategies and policies:
Enabling, future-proof policies and frameworks in place can set out how countries break down data silos and create shared technology infrastructure.

Sources: (8) OpenCerts, OpenCerts; (9) OpenAttestation, OpenAttestation; (10) OPSI, Case Study Library – OpenCerts; (11) Open edX, Home; (12) Open edX, Using Open edX as an LTI Tool Provider; (13) Open edX, Use Cases; (14) Not applicable as it is only a DPG

5 GENDER EQUALITY

Achieving gender equality through DIGITAL PUBLIC INFRASTRUCTURE

CHALLENGES THAT DPI CAN ADDRESS

At least 247 million women
live in extreme poverty as they disproportionately work in the informal sector and are less likely to qualify for government services.[1]

20%-30% gendered
yield gap in agricultural productivity is attributed to inequitable resource use.[2]

80 million
unbanked women continue to receive private sector wage payments in cash.[1]

16% more women
than men do not have access to ID, resulting in limited legal status and asset ownership.[3]

Unless DPI approaches systematically include women, the true benefits of DPI approaches will not match the massive scale and urgency of addressing exclusion of women. Thinking Gender by Design:[4]

1. Data in DPI information systems embody and exercise power, and therefore, design choices must be evaluated through the gender justice lens.
2. Digital systems and datafication processes should respond to the complexities of women's embedded realities.
3. The design and implementation of digital systems must account for women's time poverty and unpaid labour.
4. Patriarchal societal norms and information literacy gaps are particularly acute for marginalized women, requiring last-mile strategies to be gender agile.
5. Data and data-enabled intelligence from information systems must be governed through legal-institutional frameworks that are adequate for women's human rights.

Examples of DPI's potential

UNIFIED PAYMENT INTERFACE (UPI)

DPI STAGE

India's Unified Payments Interface is an instant, digital payment system for interbank, peer-to-peer and person-to-merchant transactions.[6] It is interoperable using open standards (in the form of open APIs) that facilitate innovation by third-party developers).[7] It has 260 million users, enabling over 2,000 transactions every second in 2022 and connects 414 banks and hosts 9 million monthly transactions.[8, 9]

Leveraging UPI reduces inequalities in financial access by reducing barriers to formal financial systems, bringing in the unbanked population, who are often women. It supports transactions in low-resource and offline environments through a suite of call-based solutions for feature phones called UPI 123Pay.[10] Multi-mode delivery models – across connectivity levels, channels and device types – promote inclusion across genders, economic backgrounds and literacy levels.

~70 million
Indian women are UPI users
indicating that in a short time, many female users have found this technology useful[5]

Note: While this report tries to be as inclusive of all genders as possible, in cases where examples are limited to women, insights from these examples can be extended to the broader conversation for all genders | **Sources**: (1) BTCA, Reaching Financial Equality for Women, 2021, 2023; (2) ORF, Gender Gap in Agriculture and the 'South Asian Enigma', 2021; (3) Biometric Update, Massive gender disparities in digital ID systems persist, 2021; (4) It for Change, Gender by Design: Principles for Genderresponsive Public Digital Infrastructure, 2023; (5) Economic Times, UPI use among women low, assisted onboarding can drive uptake, 2023; (6) Forbes, Is India's UPI Real-Time Payments System Ready To Go Global?, 2023; (7) NPCI, UPI Product Overview; (8) Inc42, India's Digital payments ecosystem, 2023; (9) NPCI, Product Statistics, 2023; (10) NPCI, UPI 123Pay Product Overview

Achieving gender equality through DIGITAL PUBLIC INFRASTRUCTURE

Examples of DPI's potential

LOKOS

DPI STAGE N/A[15]

LokOS, run by India's National Rural Livelihood Mission (NRLM), provides a book-keeping platform for Self-Help Groups[11] (which typically consist of women).[12] It has a scalable architecture and creates financial data that are securely portable using APIs by both public and private financial service providers. It leverages Aadhaar for simplifying eKYC (Know Your Customer).[13] It was piloted in 2022 and is yet to achieve its scaling potential as DPI.[14]

LokOS increases women's access to credit and financial services by eliminating barriers through cashflow-based underwriting and simplified KYC. It automates lending processes, improves the economics of serving women groups, and makes interoperable data freely available. LokOS makes microfinance commercially viable by significantly cutting costs in the lending process associated with manpower, travel and paperwork.

Examples of DPI's potential

BANGLADESH'S CIVIL REGISTRATION AND VITAL STATISTICS SYSTEM

DPI STAGE

Bangladesh Government's Civil Registration and Vital Statistics (CRVS) system uses the DPG OpenCRVS.[16] It is a registry for life events (such as birth, death and marriage) and helps prevent child marriages.[16, 17] In its pilot in Bangladesh, birth registrations increased by 49%.[16] It is built on an open-source interoperable technology stack that integrates with other platforms and DPGs including government systems, MOSIP, DHIS2 and others.[17, 18]

This gender-inclusive national registry protects girls' rights by verifying age. It addresses child marriages by letting marriage registrars verify age from a national ledger via SMS before officiating a marriage.[19]

How to encourage safe, inclusive and resilient DPI

Embed gender intentionality in all DPI:
All DPI must inculcate gender inclusivity as a design principle. Governments and stakeholders must ensure that disadvantaged genders are not denied access to digital services, including protection against new threats that are created.

Create pathways for women to participate in the design and implementation of DPI:
Civil society groups can play a lead role in collaborating with women's collectives to build capacities for social audits using a digital and/or data justice lens. Women should be part of ongoing public consultations (rather than one-off) that make deliberate attempts to include the participation of those whose rights are often denied or invisible.

Introduce offline alternatives and support structures in context-sensitive ways:
Women must be assured of adequate support that enables them to meaningfully engage and know what to or whom to fall back upon when they encounter specific barriers. Allowing alternative procedures for those not comfortable with digital interfaces, through print-based or voice-based mechanisms. Importantly, ensure that offline structures do not give rise to duplication or reconciliation which can potentially disempower women, either by increasing their labour or by reducing their agency to participate in the system on equal terms.

Sources: (11) Self-Help Groups are informal associations of people who pool funds to manage saving, borrowing, and lending in times of need and are typically composed of economically disadvantaged women; (12) NRLM, LokOS Demo Portal; (13) UP State Livelihood Mission, LokOS Application; (14) The Hindu, LokOS mobile app, 2022; (15) Not applicable as it is yet to achieve meaningful scale; (16) Digital Public Goods Alliance, Registry; (17) OpenCRVS, Case Studies – Bangladesh; (18) OpenCRVS, Interoperability, 2022; (19) World Nomads, Footprints Project; (20) Eurasianet, Blog, 2017

Achieving clean water and sanitation through DIGITAL PUBLIC INFRASTRUCTURE

CHALLENGES THAT DPI CAN ADDRESS

4 billion people

still lack access to safely-managed sanitation along the entire service chain marketplace of products and services, renewable resource flows, data and information that could together transform future cities, communities, and businesses.[1]

80% of wastewater

is discharged untreated in the Asia-Pacific region due to insufficient and disparate surveillance of wastewater management.[2]

Nearly 2 billion people

lack access to basic sanitation[3] due to limited systems and usage data that could strengthen existing systems, and shift responses to disease outbreak from reactive to preventative.

As sanitation and water systems become more digital, a distinct opportunity arises to share these data streams with municipalities for the benefit of the consumer and the city. Increasingly, we are seeing sanitation and water operators work with municipalities and governments to map their systems and usage data. With emerging technologies, we can envision public health and infectious disease or vaccine monitoring layering on top of that data. There are a few DPI approaches that have managed safe drinking water and sanitation services (DIGIT) and information management and real-time monitoring systems (DHIS2 and mWater), increasing access to clean water and sanitation. DPI approaches are opening new ways to re-think sanitation services if we imagine them not as a system apart, but an integral and visible part of the wider infrastructure, services and resource flows.

Example of DPI's potential

SANITATION SERVICE DPI BASED ON DIGIT

DPI STAGE N/A[6]

Digital Infrastructure for Governance, Impact & Transformation (DIGIT) is a DPG conferring access to public services securely and conveniently. DIGIT helps the Indian Government digitize services and improve efficiency by offering online payments, digital certificates and citizen engagement tools in 330 administrative units (or districts) in five Indian states.[4, 5] DIGIT interoperates between local bodies and rapidly scales via open-source modules.[5] It can unlock its full potential as DPI by allowing third-party players to build on top of it.

DIGIT's water and sanitation function boosts operational efficiency of faecal sludge management. It allows people to place service requests, make payments online and check their status via messaging systems. Stakeholders monitor the performance of de-sludging operators within administrative units.

40 million

Indian residents

seamlessly access public services, including sanitation services[5]

Sources: (1) IWA, Improving Public Health Through Smart Sanitation and Digital Water (2) Asian Development Bank, Digitalizing H2O for water security and resilience, 2020; (3) WHO, Sanitation, 2022; (4) eGov Foundation, eGov Sanitation; (5) Bridgespan, Leveraging Technology to Advance Urban Governance, 2018; (6) Not applicable as it doesn't allow third-party players to build their own applications on DIGIT

Achieving clean water and sanitation through DIGITAL PUBLIC INFRASTRUCTURE

Example of DPI's potential

Bharat BillPay

DPI STAGE

Bharat BillPay is a service by the Indian Government that integrates with other government agencies for seamless and easy payments of bills for electricity, gas, water, etc.[7] It is interoperable as it connects banking and non-banking entities in the bill aggregation business, billers, payment service providers and retail bill outlets.[7] It standardizes the process of bill payment for the entire ecosystem. It provides a sandbox environment that third-party players can use for building innovative apps and services. It offers open APIs for fetching and validating bills, facilitating payments, tracking transaction status, etc.[8] It enabled US$14 billion in transaction volume in 2022.[9]

Bharat Billpay can build trust in the water supply system by enabling efficient and sustainable management of water supply. It reduces leakages and avoids penalties and disconnections by promoting water bills to be paid on time. It also maintains operational efficiency and financial efficiency for water service providers.

Example of DPI's potential

mWATER

DPI STAGE N/A[12]

mWater is an open-source software platform that tracks real-time water data (water quality, water supply and sanitation data).[10] It is one of the most widely-used data platforms in the water and sanitation sector, with over 100,000 accounts in 184 countries.[10] mWater can realise its full potential and become DPI by affording linkages to other digital tools and technologies for interoperability and by rapid scaling.

mWater promotes data-driven decision-making across various water and sanitation issues. About 60,000+ water points have been mapped across 10 departments in Haiti using mWater to foster improved water governance.[11] Ultimately, this will help plan community-level interventions and optimize water use.

How to encourage safe, inclusive and resilient DPI

Accelerate global DPI ecosystems:
Multilateral organizations, civil society and governments can work to build the data architectures with local and municipal governments and stakeholders to demonstrate the value and efficacy of DPI approaches. This will foster a better understanding of the data privacy policies and standardization protocols that are needed to accompany DPI approaches.

Adopt a Stack approach to manage water:
Access to water is essential for the functioning of sectors such as energy, agriculture and industry. Creating a web of services linked to water availability promotes efficient water management by assessing resource availability and linking this data to farmer subsidies. Multilateral organizations, banks and the international community can integrate these approaches into their programmes for pandemic response in the future.

Take a leadership role in providing vibrant open ecosystems:
Investments will be needed to build the software integrations between operators and smart city systems to create the public rails for open ecosystems and innovations at scale. The power of political will to facilitate this development, particularly on a country level, is a defining factor in the success for safe, secure and rights-based DPI approaches.

Sources: (7) Bharat Billpay; (8) Setu Docs, BBPS API Integration; (9) Statista, Value of BBPS transactions, 2023; (10) mWater, mWater Platform; (11) mWater, Haiti – Case Study; (12) Not applicable as it is not interoperable

Achieving affordable and clean energy through DIGITAL PUBLIC INFRASTRUCTURE

CHALLENGES THAT DPI CAN ADDRESS

45% of the world
live without reliable power,[1] where the supply does not match the growing demand at 3% a year[2] due to limited access to digital commons.

1 gigatonne of CO_2
released into the atmosphere in 2018 as a result of losses in transmission and distribution. This is due to a lack of or limited energy load management.[4]

Nearly 3 billion people
lack access to clean cooking fuels due to high costs and the inability to use subsidies,[3] complicated by disparate projects and initiatives' non-interoperable systems without economies of scale.

Few DPI approaches are helping achieve affordable and clean energy. Efforts are limited to sharing data and credentials on energy (OpenEI and X-Road) while work is just starting on creating global ecosystems for carbon registries and Monitoring, Reporting and Verification (MRV). This can support decision-making and management for energy use for equitable access. DPI approaches can be a crucial driver for deep sustainability transformation aligning with international environmental agreements like the Paris Climate Accord, the Montreal Protocol and other global commitments by countries to create global digital ecosystems for enhanced transparency, data sharing, innovative green financing mechanisms and scalable approaches that could empower countries, communities and people to mitigate and adapt to the planetary crisis.

Example of DPI's potential

OPENEI

DPI STAGE N/A[9]

Open Energy Information (OpenEI) uses the DPI approach to aggregate energy data and make it accessible.[5] The platform offers standardized energy consumption and production data and interactive maps on energy infrastructure that improve the production and distribution of energy. OpenEI's 2,200+ users have created nearly 40,000 content pages (including data on energy infrastructure, technology and policies).[6] OpenEI has open standards. Consequently, applications for data visualization (VizGen) and analysis (e.g., Procurement Analysis Tool and Small Wave Energy Converter Analysis) have been built on the platform.[7] To unlock OpenEI potential as DPI, it must embrace the principle of minimalism and allow third-party players to build value-added services.

The verified and standardized data available on OpenEI informs rapid analysis and improved decision-making. Applications built on OpenEI visualize energy data, analyse, and enable scenario viewing and comparison functions. These capabilities refine understanding and deliver superior outcomes on energy infrastructure development, energy production and energy distribution.[8]

Sources: (1) Energy for Growth Hub, 3.5 Billion People Lack Reliable Power ; (2) IEA, Surging electricity demand is putting power systems under strain around the world, 2022; (3) IEA, Access to clean cooking; (4) IEA, Sustainable recovery – electricity; (5) OpenEI; (6) The White House, Innovations – OpenEI; (7) OpenEI, OpenEI Platform; (8) OpenEI, OpenEI Platform; (9) It doesn't qualify as DPI as it is not minimal.

Achieving affordable and clean energy through DIGITAL PUBLIC INFRASTRUCTURE

Example of DPI's potential

NATIONAL CARBON REGISTRY

DPI STAGE[11]

The National Carbon Registry, developed by UNDP through a collaborative effort with Digital4Climate Working Group, is a DPG enabling countries to manage national data and processes for the effective trading of carbon credits.[10] It allows countries to replicate and adjust the data to suit national contexts. The registry's modules, software and technical documentation can be reused and tailored, which reduces production costs and implementation timelines.

Built as an interoperable digital system, it can be integrated with national measurement, reporting and verification (MRV) systems and international digital systems, such as Climate Action Data Trust (CAD Trust) by the World Bank. The result is a broader suite of building blocks in DPI approaches to address climate challenges.

Example of DPI's potential

ENERGY DATA EXCHANGE BUILT ON X-ROAD

DPI STAGE

X-Road is a DPG that Estonia has implemented as DPI to facilitate the secure exchange of information between government agencies, including data exchanges about energy use on the smart grid. X-Road is an interoperable platform that seamlessly exchanges data across end-consumers, energy distributors and producers to monitor the value chain at a societal scale. This information flow enhances the feasibility of sound energy policy creation.

X-Road supports power distribution companies in undertaking informed monitoring and redistribution of energy. It exchanges energy meter data and grid data sensors to estimate energy demand. Such information supports balancing loads, managing outages, maintaining assets, reducing energy losses and making informed investment decisions, ensuring efficient and reliable energy redistribution.[12]

How to encourage safe, inclusive and resilient DPI

Interlink last-mile energy access with DPI:
Governments can promote energy access through combining DPI across sectors. For example, Account Aggregator (AA) network in India enables the digital sharing of an individual's financial information to unlock pay-as-you-go models to purchase distributed energy products, such as solar lanterns.

Data and digital commons:
DPI can help democratize access to remote monitoring, smart diagnostics, among others by developing open and common platform, optimizing energy generation for MSMEs and improving access for people. This can also unlock innovations such as peer-to-peer energy trading, leveraging open digital rails that ensure interoperability among various trading platforms within and across countries with appropriate regulations.

Embed a DPI approach in transition plans:
Governments urgently need to prepare investment-ready energy transition plans. Given the shifts required in the transition to clean energy, they can re-imagine digital technology to support population and planet-scale energy systems. DPI approaches should be embedded at the core of design by bringing energy and DPI experts together to develop collaborative spaces and investments, including political will to understand the opportunity and integrate DPI approaches.

Sources: (10) UNDP, Promotion of Carbon Markets in Namibia for an enhanced implementation of the nationally determined contributions (NDC) towards net-zero emissions and climate-resilient development, in response to the climate emergency; (11) UNDP, National Carbon Registry DPG; (12) X-Road, Case Study

Bolstering work and economic growth through DIGITAL PUBLIC INFRASTRUCTURE

CHALLENGES THAT DPI CAN ADDRESS

14% of global youth
are in precarious informal jobs without social protection, despite increased funding for social protection worldwide. This is in large part due to disparate systems that lead to exclusion.[1]

4 out of 5 enterprises
operate in the informal economy, excluding them from protection during economic shocks.[2]

1 in 4 young people
is not in education, employment or training, with young women twice as likely as young men to be in this situation despite digital skilling initiatives. This is due to limited interoperability among skilling and education platforms, especially in rural areas.[1]

While over 90% of countries have implemented some form of remote learning policy, limited scale and investments, as well as siloed solutions and lack of evolvability significantly hamper impact on productive employment and decent work for all. Globally, a number of DPI approaches have accelerated improved economic growth and financial access through payment rails in the informal economy and among disadvantaged communities (UPI, Pix, PayNow and PromptPay), as well as through sharing of data and credentials (OCEN) and discovery networks for MSMEs and capacity development (Open Network for Digital Commerce - ONDC). These examples of DPI are turbocharging employment generation and employability. However, much more needs to be done through combination of policies, local digital ecosystems and collaboration to unlock the sustainable implementation of DPI for productive employment and decent work.

Example of DPI's potential

OPEN CREDIT ENABLEMENT NETWORK (OCEN)

DPI STAGE

OCEN is a DPI that securely shares customer credit information across India's banks, fintech companies and other financial institutions. It has open standards and interoperability. Financial services providers can seamlessly interact with users encompassing MSMEs to digitize the underwriting, and servicing of loans. It integrates with Aadhaar for eKYC. To date, US$2 million have been disbursed.[3, 4, 5]

OCEN boosts economic growth and productive employment by bridging the credit gap, catalyzing entrepreneurship and expanding businesses. It makes small loans more viable (loans ranging from US$2000 - 12,000)[5] and increases access to finance by replacing traditional collateral needs with cashflow-based underwriting.[5] It has been shown that integrating loan systems with digital ID has improved the repayment rates of borrowers at a high risk of defaulting.[6]

Sources: (1) UN SDGS, Goal 8; (2) ILO, Informal Economy; (3) India Stack, Open Networks; (4) ORF, OCEN: A Digital Transformation of Credit Systems, 2022; (5) The Economic Times, How OCEN is democratising credit, 2022; (6) American Economic Review, Credit Market Consequences of Improved Personal Identification: Field Experimental Evidence from Malawi, 2012

Bolstering work and economic growth through DIGITAL PUBLIC INFRASTRUCTURE

Example of DPI's potential

OPEN NETWORK FOR DIGITAL COMMERCE (ONDC)

DPI STAGE

ONDC, an open e-commerce platform connecting sellers and buyers across multiple ecommerce platforms,[7] has scaled to 236 cities and hosts 36,000+ merchants.[8] It uses the open Beckn protocol for customizing and integrating commercial modules while ensuring seamless data exchange.[9]

ONDC supports economic growth by reducing the entry barrier for small businesses through reduced operations costs and increased access to wider markets. The transaction fees are one-fourth those of private e-commerce players.[10]

Example of DPI's potential

INSTAPAY

DPI STAGE

InstaPay is a retail payment service in the Philippines that enables payments across different banks and wallets.[11] It facilitates interoperability between banks and e-wallets for small-value payments like toll fees, tickets and e-commerce.[13] Its monthly transaction volume has reached 52 million.[12]

InstaPay helps MSEs collect payments and build credit-worthiness by building rich digital transaction histories for cash-flow-based credit.[13] To realise its potential as DPI, it will need to offer open standards for informal workers to benefit from their data, beyond credit.

Example of DPI's potential

FEDNOW

DPI STAGE

FedNow is a DPI by the US Government that enables real-time payments and automatic settlements between e-wallets and other payment platforms. It has 57 early adopter organizations, including financial institutions and service providers.[14, 15] It facilitates interoperability through the ISO 20022 standard for data exchange (Data sharing & Models). It provides microservices and APIs that enable scalability and allow third-party players to integrate into a wide range of applications. It provides a high level of customization to players building on top of FedNow and can be used for C2B, B2B or C2C transactions.

It seeks to improve the economic resilience of small businesses by simplifying supply chain payments and improving liquidity. It facilitates instant and automatic payment of B2B and C2B bills from its customers, increasing the reliability of business cashflows. It will eliminate delays in payments to financial institutions and simplifies financial processes for consumers, including small enterprises, by automating payment of insurance premiums, loans and other pending payments.[16]

How to encourage safe, inclusive and resilient DPI

Support equitable growth for MSMEs:
MSMEs provide the majority of employment opportunities across countries. Government must work with industry to ensure an equitable playing field (further supported by DPI) and support the growth of MSMEs (ease access to working capital, procurement practices focusing on MSMEs and digital capacity building).

Encourage responsible business practices:
Governments may consider supporting sustainable and responsible business practices, through mandates on corporate social responsibility (CSR), environmental audits in ecologically fragile environments and ethical supply chain sourcing and management. All of these can be bolstered via DPI to improve traceability and create public rails for innovation.

Protect workers and entrepreneurs and build trust:
Governments and stakeholders can build trust, protect workers' and businesses' privacy rights, and actively avoid discrimination. This is accomplished through building interoperable social protection schemes, transparent and open-source algorithms that address gender biases, robust grievance redressal systems, and the protection of sensitive personal and business information.

Sources: (7) ONDC, ONDC Platform; (8) Swarajya, ONDC's one-year milestone, 2023; (9) LiveMint, The internet can regain the openness envisioned for it, 2020; (10) Economic Times, The A to Z of ONDC's Commission Structure, 2022; (11) InstaPay; (12) InstaPay, Q1 2023 Report, 2023; (13) Bangko Sentral Ng Pilipinas, National Retail Payment System; (14) The Federal Reserve, Organizations Certified as Ready for the FedNow Service, 2023; (15) Forbes, On The FedNow Service: What To Expect From The First Version, 2023; (16) ComputerWorld, Fed's Zelle-like instant payment system to go live in July, hundreds now testing, 2023

Achieving sustainable industrialization through DIGITAL PUBLIC INFRASTRUCTURE

CHALLENGES THAT DPI CAN ADDRESS

Only 3.3% global manufacturing growth

in 2022 which slowed down from 7.4%[2] in 2021 due to energy price shocks, supply disruptions and inflation. This created new vulnerabilities that were exacerbated by new data and digital harms due to limited interoperability among data flows and digital systems without adequate protection.

Only 1 in 6 SMEs

in least developed countries (LDCs) has a line of credit despite generating data through digital transactions and digital interactions such as mobile data.[1]

95% mobile broadband coverage

exists across the world (3G or higher). However, coverage is only 82% in Sub-Saharan African and 68% in Oceania, signaling the need for DPI approaches that are adaptable and evolvable in low-connectivity areas.[2]

DPI approaches have helped to simplify government compliance (Chorus Pro and ASYCUDA), support information exchange between businesses and governments (TradeTrust and SGFinDex), unlock new competitive markets through data sharing and discovery (OCEN and ONDC), as well as reduce the overall cost of doing business. They are increasing access to **finance, improving the efficiency of business processes, and making supply chains more resilient.**

Example of DPI's potential

OPEN NETWORK FOR DIGITAL COMMERCE (ONDC)

DPI STAGE

ONDC is an open e-commerce platform to connect sellers with buyers across multiple e-commerce platform.[3] It has scaled to 236 cities and hosts 36,000 merchants.[4] Its modular approach is highly customizable - building blocks can be easily reconfigured to build e-commerce platforms. It uses open protocols for customising and integrating commercial modules whilst ensuring seamless data exchange and interoperability.[5]

ONDC simplifies doing business for small- and medium-sized enterprises, including those run by women in informal sectors by facilitating logistical support and fair competition. It delivers resilience by supporting modular and adaptable supply chains. Its highly modular approach lowers the barrier of entry to e-commerce as it standardizes operations, including cataloguing, inventory management and order fulfilment.[6] Logistics and financial service providers are integrated with the platform, allowing customizable and innovative offerings. The transaction fees are a quarter of those offered by private e-commerce players.[7]

Up to 25,000

daily retail orders

facilitated through ONDC with a focus on MSMEs[4]

Sources: (1) UN, UN SDG progress report, 2022; (2) UN SDGS, Goal 9; (3) ONDC, ONDC Platform; (4) Swarajya, ONDC's one-year milestone, 2023; (5) LiveMint, The internet can regain the openness envisioned for it, 2020; (6) OpenGov Asia, India's ONDC to Democratise E-Commerce, Support Small Traders, 2022; (7) Economic Times, The A to Z of ONDC's Commission Structure, 2022

Achieving sustainable industrialization through DIGITAL PUBLIC INFRASTRUCTURE

Example of DPI's potential

SINGAPORE FINANCIAL DATA EXCHANGE (SGFINDEX)

DPI STAGE

Singapore's SGFinDex builds foundational infrastructure for digital finance. It ensures integrity and user protection by enabling people to access and understand how their financial data is employed by government agencies and private service providers.[8] The data exchange has 30,000 monthly active users.[9] It shares data using open data standards and APIs,[8] and its OAuth 2.0 authorization framework enables third-party applications to obtain user consent and retrieve data on behalf of the user.[10] SGFinDex integrates with the National Digital Identity SingPass for authorization.[11]

Example of DPI's potential

TRADETRUST

DPI STAGE

Singapore's TradeTrust is built on the blockchain-based DPG OpenAttestation for the exchange of trade documents between governments and businesses, alongside document verification.[12, 13] It has been piloted in five countries.[14] It can integrate with the backend of existing open-source systems. TradeTrust simplifies doing business and improves the efficiency and adaptability of supply chains. It reduced the time taken for trade processes from 10+ days to under a day.[14]

Example of DPI's potential

CHORUS PRO

DPI STAGE

France's Chorus Pro is an e-invoicing platform for B2G, B2B, and B2C transactions.[15] France is ensuring all such transactions will be reported on the Chorus Pro platform in real time.[16] The highly customizable platform facilitates interoperability through open APIs[17]—partners can build their own private, third-party platforms for e-invoicing and reporting in a standardised format.[16] Chorus Pro introduces efficiencies, cuts costs and fights fraud by automating seamless processes and transparency for tax authorities.[18]

Example of DPI's potential

AUTOMATED SYSTEM FOR CUSTOMS DATA (ASYCUDA)

DPI STAGE[24]

ASYCUDA is a platform created and maintained by UNCTAD[19] for managing customs data and processes.[20] As an open and standardized platform, ASYHUB enables interoperability with local government systems through open APIs.[21, 22] It can unlock its potential as DPI by embracing minimalism, allowing third-party players to build on top of it. ASYCUDA strengthens supply chains and eases doing business, by making the customs process time and cost efficient. It reduced the time taken to process goods in Gambia by 50% and increased Bangladesh's annual customs revenue by 11%.[23] It has been adopted by 102 countries.[20]

How to encourage safe, inclusive and resilient DPI

Drive adoption by strengthening local digital ecosystems:
Governments can design with industry players, secure their buy-in and encourage their participation through incentives in the form of ease of doing business, cost and time savings. The government and local digital ecosystem can collaborate to deliver sustainable industrialization that is resilient, green and inclusive of women's participation.

Balance economic growth with sustainability:
Governments and the local digital ecosystems can ensure that incentives are aligned to spur economic growth without compromising social accountability, energy efficiency and reducing environmental impact. The governing rules around DPI approaches can be designed in collaboration with industry and academia, including gender intentionally.

Facilitate data exchanges with clear governance and safeguards:
Increased transparency must ensure industry adheres to regulations and prevent government malpractice. Governments must protect businesses against the risks of misuse of sensitive business and personal data.

Sources: (8) Monetary Authority of Singapore, SGFinDex; (9) Monetary Authority of Singapore, Financial Planning for Singaporeans Enhanced with Insurance Data on SGFinDex, 2022; (10) SGFinDex API, SGFinDex, 2023; (11) The Association of Banks in Singapore, SGFinDex, 2022; (12) TradeTrust; (13) OpenAttestation, Gallery; (14) Infocomm Media Development Authority, Trade Digitalisation, 2022; (15) Government of France, Chorus Pro; (16) Pagero, Chorus Pro, 2022; (17) Agency for State Financial Information Technology, External Specification; (18) Pagero, French e-Invoicing Mandate; (19) United Nations Conference on Trade and Development; (20) ASYCUDA; (21) UNCTAD, ASYCUDA Report, 2021-22; (22) UNCTAD, ASYCUDA Newsletter, 2021; (23) ASYCUDA, Case Studies; (24) It doesn't qualify as DPI as it is not minimal

10 REDUCED INEQUALITIES

Eliminating inequalities through DIGITAL PUBLIC INFRASTRUCTURE

CHALLENGES THAT DPI CAN ADDRESS

Women are twice as likely

as men to report experience of discrimination based on their sex. In addition, 20% of them are less likely to have access to formal finance due to lack of fiscal and social policies that promotes equality.[2]

34.9 million refugees

with a tragic loss of 7,000 lives lost along migratory routes. Challenges posed by unchecked data extraction, data monopolization and obstacles to the sharing of verifiable and consent-based data hamper information flow that could otherwise accelerate positive outcomes.[1]

17% of mothers of the poorest

quintile in LMICs access basic healthcare (compared to 74% in the wealthiest quintile) due to disparities in service access.[3]

Evolving DPI and digital soutions are reducing inequality through providing basic services, including finance (Bhashini, UPI, Pix, InstaPay, PayNow, PromptPay, OCEN and FedNow), access to verifiable identity and social protection (ePhilID, Aadhaar, National ID Ethiopia, FranceConnect and Novissi) and better monitoring of inequalities by sharing of data (NDAP). More needs to be done to adopt DPI approaches that can accelerate reduction of inequalities within and across countries.

Example of DPI's potential

PAYNOW

DPI STAGE

PayNow is a payment system provided by the Association of Banks in Singapore that facilitates peer-to-peer and peer-to-merchant transactions and social benefit transfers.[4] It enables transactions between member banks and financial institutions and links with payment systems in other countries, such as India's UPI, Thailand's PromptPay, USA's FedNow and Malaysia's DuitNow.[4] PayNow builds on the open standard for electronic fund transfers, FAST (Fast and Secure Transfers), eliminating the need for bank account numbers and replacing them with identifiers such as mobile numbers, Unique Entity Numbers and QR codes. The system provides an API payment gateway to connect to FAST for non-banking financial institutions.[5] In the first months of its operation, PayNow enabled 150,000 transactions worth US$18 million.[5]

PayNow reduces inequalities in financial access by reducing barriers to inter-bank transfers, including cross-border remittances, and by swiftly delivering social benefits. During COVID-19, the Government supported vulnerable individuals and businesses through targeted wage disbursements using PayNow as a part of the Job Support Scheme.[5] It has been shown that the delivery of public sector wages directly into women's accounts using digital ID increases their annual wages by 24% and 16% fewer men describe their wives' occupation as 'housewife', thereby, improving women's financial agency and social status.[6] More than US$28 billion were disbursed through a combination of channels, including PayNow.[7]

Sources: (1) World Bank, The State of Social Safety Nets, 2018; (2) World Bank, Expanding Women's Access to Financial Services, 2014; (3) WHO, World Bank and WHO: Half the world lacks access to essential health services, 100 million still pushed into extreme poverty because of health expenses, 2017; (4) Asssociation of Banks in Singapore, PayNow; (5) World Bank, Fast Payments Toolkit; (6) American Economic Review, On Her Own Account: How Strengthening Women's Financial Control Impacts Labor Supply and Gender Norms, 2021; (7) Ministry of Finance Singapore, Press Release, 2022

10 REDUCED INEQUALITIES

Eliminating inequalities through DIGITAL PUBLIC INFRASTRUCTURE

Example of DPI's potential

EPHILID

DPI STAGE

ePhilID is the Philippines' digital ID system used to access services and social benefits.[8] By May 2023, 30 million IDs were issued.[10] It is built on the DPG MOSIP. It integrates with payment channels and uses interoperable databases to confirm beneficiary eligibility.[9, 11] It achieves its potential as DPI when implemented with open standards.

ePhilID protects economically vulnerable groups with benefits, grants legal status, and provides access to basic services. Similar digital ID systems include National ID Ethiopia and Aadhaar.

Example of DPI's potential

BHASHINI

DPI STAGE N/A[18]

Bhashini is India's AI-led translation platform for creating content in multiple regional languages.[16] It is a forthcoming DPI approach that will offer open data repositories to build solutions and interoperable translation APIs.[16] **Bashini seeks to improve access to digital services by overcoming barriers of language and literacy.** It will offer interoperable APIs for speech-to-text conversion, optical character recognition, translation and more, built on crowd-sourced data and inputs using a DPI approach.[16] These will be made available to developers for building accessible digital products and services.

Example of DPI's potential

NOVISSI

DPI STAGE

The Government of Togo's Novissi delivered emergency digital cash transfers using mobile money during COVID-19.[13] Within a year, the platform disbursed US$24 million to 0.8 million beneficiaries[13] identified using Cider (an open-source toolkit that is a DPG).[14] Telecom operators integrated with government systems to automatically create mobile money accounts.[15] Novissi was a one-time solution and will become DPI when it is continuously operable.

Novissi increased access to economic resources for vulnerable populations. Only a SIM card was required for receiving money. Women were targeted (63% of beneficiaries were women) and received more money than men.[13]

Example of DPI's potential

MASAKHANE

DPI STAGE N/A[18]

Masakhane is an initiative that develops the data sets and software tools needed for translation of less-represented African languages.[12] It is a pan-African volunteer effort led by African researchers and coders. It provides open data, code, and tools. A thriving community of African startups use its digital commons to build AI translation tools and chatbots to help people access services in their native languages. To qualify as DPI, it must adopt robust governance.[12] **The initiative seeks to bridge language divides for participation in the global economy.** It enables people to access financial services and follow legal communication and news in diverse local languages.

How to encourage safe, inclusive and resilient DPI

No one left behind:
It is essential to go beyond targeting underserved groups as end beneficiaries. They must also be supported with capacity building so that they can be equal participants in the DPI journey and reap its benefits. They must be part of the process, from design and development to implementation, and must be able to leverage DPI to access value-added services and grow their businesses and careers alongside it.

Harness data securely:
The wealth of alternative data created, including in the informal sector, can be used as public rails to better identify and understand inequalities, enabling accountability and improved policy design. But it must also be ensured that sensitive data are not misused. Governments must establish robust guidelines and legal mechanisms to protect users against digital harms.

Reducing inequalities is a guiding principle across all DPI:
Since DPI can either eliminate or exacerbate existing inequalities, it must be intentionally built with the reduction of inequality as a fundamental design principle. Governments must institute strong regulations and align incentives to ensure that any private sector innovation that happens on top of DPI also embodies this principle.

Sources: (8) Philippines Statistics Authority, PhilSys; (9) MOSIP, News, 2021; (10) Philippines Statistics Authority, Official Statement, 2023; (11) Philippines Statistics Authority, Project Information Memorandum, 2020; (12) Masakhane, Masakhane; (13) Not applicable as it doesn't have robust governance frameworks, Press Release, 2022; (14) IPA, Togo's Novissi Cash Transfer: Designing and Implementing a Fully Digital Social Assistance Program during COVID-19, 2021; (15) OCHA, Model Report, 2022; (16) Apolitical, Coronavirus forced Togo to take a big bet on a digital service, 2021; (17) MEITy, Bhashini; (18) It doesn't qualify as DPI yet as it is in its early stages and hasn't been implemented fully.

Creating sustainable cities & communities through DIGITAL PUBLIC INFRASTRUCTURE

CHALLENGES THAT DPI CAN ADDRESS

3.5 billion people, half of the world's population
now live in cities. Smarter cities that brings together the flow of data, people and money across energy access to social protection and skilling and other sectors can deliver a range of large-scale impact in cities.[1]

1.6 billion people
worldwide lack adequate housing and around 100 million people are homeless.[2]

53% of internal displacements
in 2022 were caused by hazards linked to climate change, with limited access to real-time warnings due to limited open, interoperable and accessible systems.[3]

Emerging DPI and digital solutions are supporting sustainable cities by providing data for disaster management and urban planning (PLACE, PRISM, NUIS and DIGIT), and by powering fulfilment of transportation services (Namma Yatri). Together, these systems have contributed to making cities more sustainable and efficient. At the heart of cities and communities are strong infrastructure, seamlessly connected and coordinated, and requires investments and approaches that understand interconnected problems such as waste management, sanitation and access to water and clean energy, human settlement planning and accessibility. Cities worldwide face similar challenges, and building re-usable DPI approaches through DPGs can deliver significant efficiencies.

Example of DPI's potential

NAMMA YATRI

DPI STAGE

Namma Yatri is a solution for multi-modal Open Mobility by the government operating in the city of Bangalore, India.[4] It has 82,000 drivers and 1.5 million users and has enabled six million trips in under a year.[4] It enables interoperability through the open-source Beckn protocol defined by ONDC.[4, 5] It can be integrated with digital payment providers and allows any app compliant with network standards to offer a ride.[4, 6] It is built for a collective ecosystem of multiple mobility service providers to coexist on a common network.[4] It has primarily offered rides on three-wheeler auto rickshaws but is expanding to incorporate the metro rail in its ecosystem.[7]

Namma Yatri democratizes access to transport for commuters and access to markets for drivers by eliminating middlemen. It connects commuters directly to drivers and eliminates commissions and surge pricing. It has contributed US$11 million in earnings.[4]

Sources: (1) UN Habitat, Building & securing digital public infrastructure - A playbook for local and regional governments, 2020; (2) IDMC, Internal displacement and food security, 2023; (3) UN, First-ever United Nations Resolution on Homelessness, 2020; (4) Namma Yatri, Namma Yatri; (5) Open Network for Digital Commerce; (6) Economic Times, Namma Yatri opens to ONDC, why it may be 'bad news' for Uber, Ola, 2023; (7) Indian Express, After Namma Yatri, Bengaluru auto drivers' union to launch Metro Mitra app to boost last mile connectivity, 2023

Creating sustainable cities & communities through DIGITAL PUBLIC INFRASTRUCTURE

Example of DPI's potential

PLACE

DPI STAGE NA[13]

PLACE provides open, standardized geospatial data and tools to support evidence-based decision-making and policy development in 25 countries.[8] This is hyperlocal mapping data, granular to individual buildings and street segments, which foster improved urban planning and disaster risk reduction at a societal scale. PLACE aims to collect 40 million km^2 of ground data and can achieve its full potential of functioning as DPI when it establishes open standards.[8, 9] To unlock its potential as DPI, it should be minimal and allow third-party players to build their own applications by leveraging PLACE.

PLACE delivers an easy-to-use and accurate map that provides an inventory of housing and population, as well as proofs of occupation and usage, which are essential to securing property rights. Access to reliable data on assets develops improved catastrophe risk models, enabling accurate and timely analysis to quantify risk and inform risk management.

Example of DPI's potential

CLIMATE AND WEATHER-RELATED HAZARDS SYSTEM BASED ON PRISM

DPI STAGE NA[14]

PRISM (Platform for Real-time Information and Systems Monitoring) is a DPG providing real-time data on climate and weather-related hazards, such as floods, landslides and droughts. Its implementation works at a societal scale in Indonesia, Sri Lanka, Mongolia and Cambodia. Fifteen climate monitoring products have been integrated into PRISM. As native to platforms such as the KOBO toolbox, its interoperable nature is evident.[10] It can be considered DPI by embracing minimalism and allowing third-party players to build their own applications on top of PRISM. **PRISM enables governments and organizations to monitor and respond to climate hazards in real time.**

Example of DPI's potential

NATIONAL URBAN INNOVATION STACK (NUIS)

DPI STAGE NA[15]

NUIS, launched by the Government of India, provides cities with technology solutions to address urban challenges.[11] Solutions include citizen engagement platforms and Geographic Information System (GIS). NUIS empowers governments to create smarter cities. It is interoperable, run by the government at a societal scale, and has open standards.[12] It can unlock its potential as DPI by embracing the principle of minimalism and enabling third-party players to build their own applications on top of NUIS.

NUIS enables data-driven decision-making for urban planning. It facilitates data exchanges and registries for traffic management and public transport systems, vehicles and water processing.

How to encourage safe, inclusive and resilient DPI

Improve the convenience an accessibility of services through embedding DPI approaches:
a DPI approach that is adaptable and evolvable creates new opportunities for local and national governments to ensure that public benefits can be more appropriately allocated, avoiding inclusion errors and exclusion errors and powers public rails for digital services by public and private sector alike.

Develop open and interoperable ecosystems:
Municipalities can bring together various datasets to track assets, access and services, thereby building open systems as public rails that facilitate interoperability, accessibility and governance. Doing so is vital to the ability of local governments to guarantee public interest and safeguard human rights.

Adopt DPI approaches that build on existing ecosystems and can improve the lives of people:
Communities and cities can remove barriers preventing regional and municipal governments from adopting DPI approaches within Smart Cities and Communities investments. The core characteristic is the connection and data generation, which can be used to ensure optimal use of resources and unlock innovation at scale for people's benefit.

Sources: (8) This is Place, PLACE, (9) Expert Interviews; (10) WFP, Innovation Accelerator – PRISM; (11) NUIS, National Urban Innovation Stack; (12) NUIS, Strategy and approach; (13) It doesn't qualify as DPI as it is not minimalist; (14) It doesn't qualify as DPI as it is not minimalist; (15) It doesn't qualify as DPI as it is not minimalist.

12 RESPONSIBLE CONSUMPTION AND PRODUCTION

Achieving responsible consumption through DIGITAL PUBLIC INFRASTRUCTURE

EXISTING CHALLENGES THAT DPI CAN ADDRESS

A 70% global increase
in material usage in the last two decades is depleting natural resources.[1]

57.4 metric tonnes of e-waste
were generated globally in 2021 due to poor management.[2]

14% of the world's food
is lost in the supply chain due to unsustainable production processes.[1]

There are a few examples of DPI and digital solutions that are promoting sustainable consumption and production. Those that exist are limited to supporting circular economies[3] with product lifecycle tracking (Madaster and the EU's Digital Product Passport - DPP), and tracking electricity use (OpenEI). Together they are making supply chains more sustainable and mitigating the depletion of resources. DPI has the potential to fight food insecurity, prepare for extreme weather crises and enable sustainable urban planning. Through the digitization of administrative processes, smart infrastructure development, renewable energy integration, citizen engagement and innovative waste management solutions, DPI approaches can lead to open ecosystems to support a country's journey towards a more sustainable future.

Example of DPI's potential

OPENEI

DPI STAGE N/A[9]

OpenEI is an open energy data platform operated by the US government for collecting, analysing and building tools.[4] It collects data from countries using linked open data standards,[4, 6] and offers 40,000+ content pages to its more than 110,000 visitors so far.[5] OpenEI also allows interaction with its data frameworks using APIs, enabling numerous applications to be built on the platform.[7, 8] To unlock its potential as DPI, it must embrace the principle of minimalism and allow third-party players to build value-added services.

OpenEI promotes improved monitoring of resource depletion and sustainable and more efficient energy management. It can be used for procurement analysis, unearthing data about materials and navigating permits for renewable energy projects.[4] Standardized data allow for direct comparison of information.

Sources: (1) UN, UN SDG progress report, 2022; OECD, Press release, 2021; (2) The Roundup, Latest Global E-Waste Statistics And What They Tell Us; (3) A circular economy seeks to minimise material footprint and waste through reuse and regeneration of used products; (4) OpenEI; (5) The White House, Innovations - OpenEI; (6) NREL, OpenEI and Linked Open Data, 2013; (7) OpenEI, Apps; (8) OpenEI, Web Services; (9) It doesn't qualify as DPI as it is not minimal

12 RESPONSIBLE CONSUMPTION AND PRODUCTION

Achieving responsible consumption through DIGITAL PUBLIC INFRASTRUCTURE

Example of DPI's potential

MADASTER

DPI STAGE N/A[13]

Madaster is an online registry for materials and products used in construction.[10] It is live in six countries enabling improved reporting and compliance practices and informing decisions surrounding maintenance and reuse.[10] It creates unique IDs for materials and products and links to all relevant data about those product, including lifespan and provenance. This can be accessed and verified by interoperable systems. It can unleash its full potential as DPI by instituting open standards and governing rules, as it is a private and closed solution.

Madaster injects traceability into supply chains and limits resource wastage by acting as a keystone of circular economies. Such traceability improves regulatory compliance and facilitates supply-chain management for building circular economies through enabling decision-making for reuse and recycling.

Example of DPI's potential

DIGITAL PRODUCT PASSPORT (DPP)

DPI STAGE N/A[14]

EU's DPP, once adopted in 2024, will record all supply chain activities for a product.[11] A unique ID will be assigned to every product, and its activities stored in a linked registry using interoperable data exchange standards.[12] This will be used to track a product's life cycle to monitor its environmental impact and to make decisions for improving its sustainability.

DPP increases supply chain traceability and efficiency, helps reduce wastage and promotes sustainable resource use. It will form a building block for circular economies and enable consumers to make increasingly informed and sustainable choices.

How to encourage safe, inclusive and resilient DPI

Meet common infrastructure standards:
Governments can facilitate industry-wide collaboration to ensure responsible production and build circular economies. These include interoperable registries for tracking supply chain activities, common credit exchanges for plastic and uniform standards for reporting.

Provide regulatory support:
Governments can augment DPI with regulatory support and ensure compliance with standards and sustainability requirements. This encompasses carefully designed incentive systems, sandboxes, better monitoring, standardized audits and ratings, and robust legal mechanisms. Regulatory support must be informed by the latest developments in business, technology and academia.

Foster participation of local digital ecosystem:
The local digital ecosystems' creation of sustainable value-added services must be fostered to build efficiencies. Governments can also build collaboratively, engaging the private sector and academia and securing private sector buy-in for responsible consumption.

Sources: (10) Madaster; (11) A&L Goodbody, The EU Digital Product Passport: the future of free movement of goods and a sustainable Europe, 2023; (12) PSQR, All You Need To Know About the EU Digital Product Passport (psqr.eu), 2023; (13) Not applicable as it is a private solution without governing rules; (14) It is not applicable as it is yet to achieve meaningful scale.

Driving climate action through DIGITAL PUBLIC INFRASTRUCTURE

EXISTING CHALLENGES THAT DPI CAN ADDRESS

A US$4 trillion deficit
in financing for solutions constrains developing countries from tackling climate change.[1]

15X higher mortality rates
from disasters experienced by highly vulnerable regions compared to very low vulnerability regions.[2]

149% higher CO_2 levels
than pre-industrial levels remain on the increase due to poor enforcement of environmental regulations.[3]

DPI and digital solutions support climate action through carbon markets (Climate Action Data Trust and Namibia's National Carbon Registry), early warning systems and deforestation alerts through data sharing (PRISM and Global Forest Watch). They incentivize climate action and build climate resilience. New initiatives such as Norway's Open Earth Platform initiative[7] are starting to create the open reusable DPGs to drive climate action, leveraging DPI approaches of open data across projects and sectors.

Example of DPI's potential

CLIMATE ACTION DATA TRUST

DPI STAGE N/A[6]

Climate Action Data Trust (CAD Trust) is a digital platform that connects carbon markets.[4] A total of 11 national governments utilized Climate Action Data Trust during its prototype phase with the World Bank to mobilise funding to promote net carbon positive activities.[5] It is open source, using blockchain technology to establish a decentralised record of carbon market activity in distributed ledgers. It seeks to link, aggregate and harmonise major carbon credit registries. CAD Trust is a prototype and is being tested with 30 carbon market organizations.[4]

CAD Trust reduces carbon emissions by supporting carbon markets through transparency and quality climate data (international transfer of mitigation outcomes). It integrates disparate registry systems to process data to support Article 6.2 of the Paris Agreement.

90%
of activities
in the voluntary carbon market are set to be integrated into the CAD Trust platform, unifying fragmented carbon markets around the world[7]

Sources: (1) UNEP, The state of finance for nature in the G20 report, 2022; (2) UNDP, The People's Climate Vote, 2021; (3) UN, SDG 13, 2023; (4) CAD Trust, CAD Trust; (5) Climate Warehouse, CAD Trust; (6) Not applicable as it is yet to achieve meaningful scale; (7) S&P Global , INTERVIEW: CAD Trust drives data consolidation to improve carbon market transparency, 2023

Driving climate action through DIGITAL PUBLIC INFRASTRUCTURE

Example of DPI's potential

CLIMATE AND WEATHER-RELATED HAZARDS SYSTEM BASED ON PRISM

DPI STAGE N/A[16]

PRISM (Platform for Real-time Information and Systems Monitoring) is a DPG that provides real-time data enabling governments and organizations to monitor and respond to climate- and weather-related hazards such as floods, landslides and droughts.[10, 11] It works on a societal scale in Indonesia, Sri Lanka, Mongolia and Cambodia.[10] Fifteen climate monitoring products have been integrated into PRISM.[10] It is interoperable with the KOBO toolbox. To unlock its potential as DPI it should be minimal and allow third-party players to build their own applications by leveraging PLACE.

52%

decline in deforestation

among groups empowered by GFW's platform compared to control groups[15]

Example of DPI's potential

GLOBAL FOREST WATCH

DPI STAGE

Global Forest Watch (GFW) is a digital system using geospatial data to generate near-real-time deforestation alerts.[12] GFW makes open data accessible through open APIs to develop custom applications.[13] It has been adopted across nearly 25 countries.[14] It needs to enable broader participation of the local digital ecosystem to achieve its potential as a DPI.

GFW disseminates verified information that fosters evidence-driven community action to prevent unsustainable deforestation. Members of local communities are trained to identify and control unauthorised deforestation. Alerts are shared with local communities both digitally and through analog systems where digital penetration and network access are limited.

How to encourage safe, inclusive and resilient DPI

Increase global cooperation and funding for joint DPI for planet:
While the need for climate adaptation and nature data is established in global conventions, greater investments and collaboration is required to build DPI approaches to tackle climate action. Doing so avoids fragmentation and duplication while channeling the cooperation and actions needed for common challenges facing our planet.

Build open ecosystems across the climate value chain:
Digitization of administrative processes, smart infrastructure development, renewable energy integration, people and community engagement and innovative waste management solutions can facilitate creation of public rails in open ecosystems to support the global journey towards a more sustainable future.

Strengthen local community engagement through shared infrastructure:
Countries and stakeholders can cohere engagement with local communities (through offline and analog). The modular nature of DPI can customise solutions to local needs and budgetary limitations, within an open ecosystem to ensure that DPI approaches for climate action delivers impact in the lives of people.

Sources: (8) Digital Public Goods Alliance, Registry; (9) GitHub. Carbon Registry; (10) WFP, PRISM, 2022; (11) Digital Public Goods Alliance, Registry; (12) Global Forest Watch, Global Forest Watch Website; (13) Global Forest Watch, GFW Tile Cache API; (14) Global Forest Watch, Grants and Fellowships; (15) PNAS, Satellite-based deforestation alerts with training and incentives for patrolling facilitate community monitoring in the Peruvian Amazon, 2021; (16) It is not applicable as it is not minimal.

Protecting life below water through DIGITAL PUBLIC INFRASTRUCTURE

CHALLENGES THAT DPI ADDRESS

26 million metric tonnes of fish
are caught annually illegally. Regulatory mechanisms alone cannot prevent overfishing and illegal fishing.[1]

~9 million metric tonnes of plastic
each year end up in the ocean. Uncontrolled marine pollution devastates marine life and ecosystems.[2]

14% of the world's coral has been lost
since 2009, disrupting the lives of one billion people who rely oncoral reefs.[3, 4]

There are a few examples of DPI that directly support life below water. These are limited to better monitoring of fishing activities (Global Fishing Watch) and marine and freshwater ecosystems (EMODnetand SEPA). Together, these solutions **monitor activities in marine and freshwater systems to inform planning and action.** More DPI approaches are required to accelerate attainment of this SDG, such as those addressing sharing data and driving actions against marine pollution and habitat destruction.

Example of DPI's potential

GLOBAL FISHING WATCH (GFW)

DPI STAGE

GFW tracks fishing vessels to combat illegal, unreported and unregulated fishing.[5] It integrates data from national vessel monitoring systems, registries and satellite imagery to track over 200,000 fishing vessels everyday.[6] GFW allows open APIs to interact with the system and supports new solutions, such as the Marine Manager tool that aggregates critical data in protected waters. GFW was launched by Google in collaboration with two NGOs and can achieve its full potential as DPI by instituting governing rules.[5]

GFW enforces fishing policies, enabling governments to monitor commercial fishing activities. For example, GFW provided data to the government of Kiribati on illegal fishing boats, leading to the levy of a US$2 million fine.[6] A total of 900 fishing vessels from a Southeast Asian country were proved to have illegally fished in a neighbouring country's waters by Global Fishing Watch.[7]

20%
of the global industrial fishing fleet

are covered by the Open Ocean Project, an initiative under GFW. It seeks to expand its coverage to 100% by 2028, facilitating extensive transparency on illegal fishing activities[8]

Sources: (1) Food and Agriculture Organization, IUU Fishing; (2) UNESCO, Ocean plastic pollution an overview: data and statistics, 2022; (3) UNEP, Status of Coral Reefs of the World, 2020; (4) UNEP, Life Below Water; (5) Global Fishing Watch; (6) Google Cloud, Global Fishing Watch; (7) Global Fishing Watch, North Korean Vessels Remain Active Despite Sanctions , 2020; (8) The Audacious Project, Global Fishing Watch, 2023

Protecting life below water through DIGITAL PUBLIC INFRASTRUCTURE

Example of DPI's potential

EUROPEAN MARINE OBSERVATION AND DATA NETWORK (EMODNET)

DPI STAGE

EMODnet is a consortium of 160+ organizations that assemble European marine data.[9, 10] It provides open access to bathymetry, ocean geology, chemistry, biology, seabed habitat and human activity data. An ingestion portal standardizes interoperable data. Offline datasets and live streams from multiple providers (research organizations, government sources and the private sector) integrate seamlessly.[10] Open APIs encourage web services to be built on top of it.[11]

EMODnet enables the planning and development of renewable energy fields and monitors pollution and biodiversity in oceans. EMODnet also evaluates coastal infrastructure resilience, detects abnormal vessel behaviour and charts the distribution of reef activity to support sustainable planning that increases reef resilience.[12, 13]

Example of DPI's potential

SCOTTISH ENVIRONMENT PROTECTION AGENCY (SEPA) HYDROMETRIC DATA

DPI STAGE

The SEPA Hydrometric Data provides information on water levels, flow rates and water quality of rivers, lochs and coastal waters in Scotland.[14, 15] These data are collected by SEPA's network of nearly 400 monitoring stations accurately measuring water properties.[16] SEPA collects and shares real-time river flow data for 267 sites in Scotland and England through open APIs.[17] It can unleash its full potential as DPI by becoming interoperable.

SEPA tracks the spread of pollutants in rivers and coastal waters and assesses the health of aquatic ecosystems. SEPA shares hydrometric data with government to enforce environmental laws and develop standards for water quality and pollution control, alongside sustainable practices in fishing and aquaculture.

How to encourage safe, inclusive and resilient DPI

Encourage innovations in marine data collection:
Governments and stakeholders can develop and deploy DPI approaches furthering marine conservation. This includes building interoperability of systems forgrant provision, tax incentives, partnerships and so on.

Drive international coordination:
DPI approaches can enable interoperable tracking and data systems for cooperation on protecting life below water in international waters.

Create integrated data for monitoring and awareness:
DPI can contribute to integrated marine and water data systems, leveraging data to inform decisions, policies and actions.

Sources: (9) European Commission, EMODnet; (10) EMODnet, Data Ingestion Portal; (11) EMODnet, Web service documentation; (12) EMODnet, GRISIS research project, 2021; (13) EMODnet, Detection of abnormal vessel behaviour, 2022; (14) SEPA, SEPA Website; (15) Digital Public Goods Alliance, SEPA; (16) SEPA, Blog; (17) UK Centre for Ecology and Hydrology, SEPA, 2022

Protecting life on land through DIGITAL PUBLIC INFRASTRUCTURE

CHALLENGES THAT DPI ADDRESS

420 million hectares of forest
have been lost in three decades due to the lack of evidence-driven action.[1]

US$4–20 trillion per annum
is the cost of inaction on biodiversity loss due resource over-exploitation.[2]

25% of the Earth's ice-free land area
have been impacted by degradation due to the lack of sustainable land use practices.[3]

Few DPI and digital solutions support terrestrial biodiversity. Those that do are limited to aggregating data about forest and land use (Global Forest Watch, Environmental Rural Registry). They are promoting sustainable land use practices through improved evidence. There is potential for DPI to support advisory services and combat poaching. By filling data gaps on poaching - and other illegal activities - DPI can enable pooled data analysis to generate recommendations, alerts and more in real time, by leveraging communities.

Example of DPI's potential

GLOBAL FOREST WATCH

DPI STAGE

Global Forest Watch (GFW) is a digital system that uses geospatial data to generate near-real-time deforestation alerts.[4] It has been adopted across nearly 25 countries,[5] and provides open standards to develop custom applications through APIs.[6] GFW can realize its potential as DPI by enabling interoperability. Organizations and individuals can use GFW to monitor largescale land use projects, enforce community land rights, defend critical habitats and influence forest policy.[5]

GFW encourages evidence-driven community action to prevent deforestation by disseminating verified information. Members of local communities are trained to identify and control unauthorized deforestation. Alerts are shared with communities both digitally and through analog systems where digital penetration and network access are limited.

52%
decline in deforestation

among indigenous groups empowered by GFW's platform, compared with control groups[7]

Sources: (1) FAO, The State of the World's Forests, 2020; (2) OECD, Biodiversity: Finance and the Economic and Business Case for Action, 2019; (3) IPCC, Special Report On Climate Change and Land; (4) Global Forest Watch, Global Forest Watch Website; (5) Global Forest Watch, Grants and Fellowships; (6) Global Forest Watch, GFW Tile Cache API; (7) PNAS, Satellite-based deforestation alerts facilitate monitoring in the Peruvian Amazon, 2021

Protecting life on land through DIGITAL PUBLIC INFRASTRUCTURE

Example of DPI'S Potential

ENVIRONMENTAL RURAL REGISTRY (CAR)

DPI STAGE

Brazil's Environmental Rural Registry is a public database recording information on rural properties, including land use changes, environmental liabilities and conservation areas.[8] It assists in the enforcement of Brazil's forest code. Property owners are required to register their land on CAR. By 2020, nearly 550 million hectares of land were on the platform.[9] It is built using free and open-source software.[10] By providing open standards and APIs for interoperability, it can unleash its potential as DPI.

CAR enables better monitoring and enforcement of environmental laws. The comprehensive registration of properties helps identify areas of forest cover and areas that require restoration. This enables better monitoring and enforcement of environmental laws. Nine policy programmes have integrated CAR into their functionality.[9] For example, Brazil's Agricultural Plan offers producers with validated CAR a 10% higher credit limit than those without it.[11]

Example of DPI'S Potential

UN BIODIVERSITY LAB (UNBL)

DPI STAGE N/A[16]

UNBL[12, 13] supports country-led efforts to use open-access spatial data and analytic tools to generate insight and impact for conservation and sustainable development.[12] It informs biodiversity conservation decision-making, particularly around the Convention on Biological Diversity (CBD), and is used across 150 countries.[14] UNBL is made possible through partnership involving a team of professionals from the Secretariat of the CBD, UNDP, the UN Environment Programme (UNEP), and the UN Environment Programme World Conservation Monitoring Centre (UNEP-WCMC).[12] To unlock its potential as DPI, UNBL must embrace the principle of minimalism and allow third-party players to build value-added services.

UNBL's curated geospatial data provides more than 400 global data layers as well as metrics on biodiversity, climate and carbon, land use, and ecosystem services to support governments to plan, monitor, and report on the state of nature. UNBL led to an 81% increase in the number of maps used in countries' reports to the CBD.[15] The platform allows users to visualize core spatial datasets, calculate dynamic indicators of change for any country/region, facilitate data transparency and cross-sectoral collaboration, and draw on the expertise of the UNBL partners to develop national strategies and plans.[12]

How to encourage safe, inclusive and resilient DPI

Interoperable data flows:
DPI can monitor the loss of biodiversity on land and predict the impacts of this loss on human wellbeing, by creating exchanges between existing digital solutions and systems. Robust, consistent and timely data from various sources can be used to raise government and stakeholder awareness and drive concerted action.

Engage with local communities in the last mile:
Governments and stakeholders can introduce community-centred design and ensure last-mile access and engagement through open ecosystems. DPI approaches can incorporate build on existing systems and requires minimal connectivity in low-resource environments.

In countries with commodities such as coco, coffee and shea, there is a dire lack of data on farmland and agricultural inputs, which lead to various global commodity companies or value chain support ventures duplicating data collection and providing various platforms.

Enable cross-boundary collaboration:
Countries can collaborate across national border as biodiversity is not contained by political borders. Countries must share insights and experiences, and multilaterals can adopt regional perspectives in their solutions. DPI confers the necessary data transfer and enables coordinated action across borders.

Sources: (8) Government of Brazil, CAR; (9) GIZ, An environmental registry is protecting the Amazon rainforest (CAR); (10) Ministry of Environment, CAR, 2017; (11) Climate Policy Initiative, A Snapshot of the CAR and the PRA in Brazil's States, 2020; (12) UN Biodiversity Lab, UNBL; (13) Digital Public Goods Alliance, Registry; (14) UNBL, Annual Report, 2022; (15) UNDP, UN Biodiversity Lab Brochure; (16) It is not applicable as it is not minimal.

Achieving peace and justice through DIGITAL PUBLIC INFRASTRUCTURE

CHALLENGES THAT DPI ADDRESS

1.5 billion people
cannot obtain justice for civil, administrative or criminal issues due to lack of institutional capacity.[1]

US$3.6 trillion is lost to corruption
annually (5% of global GDP) due to weak regulations, low transparency and poor accountability.[2]

108.4 million people
have been forcibly displaced worldwide, 2.5X more than just 10 years ago, highlighting the need for more robust and coordinated digital systems interacting with them.[3]

There are a few examples of DPI that are improving access to and strengthening justice systems through registries and trust systems for verifiable ID and assets (FranceConnect and other identifier DPI) and online case management and dispute resolution systems (Mizan and Consumidor).

These are improving the efficiency of legal systems and access to legal identity, especially for women. There is potential for DPI approached to cohere existing disparate systems and reimagine access to justice.

Example of DPI's potential

FRANCECONNECT

DPI STAGE

FranceConnect is a state-run online identity solution that helps more than 40 million users access 1,400+ digital services online via identity verification.[4] It contains multiple services, like managing health insurance, filing taxes, consulting rights and conducting benefit simulations.[4] It's interoperable by adoption of the common standard of OpenIDConnect for the user's digital identifiers.[5] User identity is verified against the National Directory for Natural Persons (RNIPP).[5] FranceConnect offers API support that enables administrations, local authorities and companies to integrate it onto their platforms.[6]

FranceConnect's foundational platform fosters strong institutions, promoting justice and equal access to public services for everyone, including non-French individuals with French social security. This streamlined system confers access to legal services, justice processes, ID applications, criminal records checks and social rights consultation.[4]

65%
of French citizens trust FranceConnect[5]

Sources: (1) World Justice Project, Measuring the Justice Gap, 2019; (2) World Economic Forum, Corruption costs the global economy $3.6 trillion every year, 2018; (3) United Nations, UN SDGs Goal 16; (4) Government of France, FranceConnect; (5) World Bank, FranceConnect Webinar, 2021; (6) FranceConnect, APIs

Achieving peace and justice through DIGITAL PUBLIC INFRASTRUCTURE

18%
increase

in the number of judgements enforced by conciliation courts, growing access to justice[8]

Example of DPI's potential

MIZAN

DPI STAGE

The State of Palestine's MIZAN is a digital case management system that improves access to justice. The system performs end-to-end case management, including managing judges' calendars and paperwork flows to facilitate payments and allow complainants to track their cases. This service is available to multiple government departments. MIZAN can achieve its full potential as DPI by incorporating open standards.[7]

MIZAN enhances integration between governmental agencies, legal aide associations and builds transparency and trust in the judicial system. Users can track their disputes online and make digital payments. Through improved transparency, MIZAN has also contributed to reduced corruption among judicial officers.[8]

Example of DPI's potential

CONSUMIDOR

DPI STAGE

Consumidor is an online alternate dispute resolution system launched by the Brazilian Government.[9] The system offers a secure and transparent space for consumers to register and manage their complaints with service providers. Service providers on the platform are mandated to respond to disputes within 10 days. The service allows multiple public departments and private businesses to onboard and manage disputes.[9] By providing open standards or APIs for further value-added services, it can achieve its full potential as DPI. The system is voluntary but service provider participation is encouraged by the Government of Brazil.

Consumidor enhances consumer confidence in the marketplace, builds transparency, and increases the efficacy of redressal systems. Since launched, Consumidor has registered nearly 6 million complaints, of which 77% have been resolved within seven days.[10] By providing public data on complaints, Consumidor also supports evidence-driven policy-making on redressal mechanisms.

How to encourage safe, inclusive and resilient DPI

How to encourage safe, inclusive and resilient dpi enable inclusive and equitable access to judicial services:
Governments can ensure that online justice systems complement physical counterparts and are accessible to everyone through creating open ecosystems of data exchanges, with appropriate safeguards. Embedding a DPI approach can ensure digitization of justice and courts work in in low-resource environments, is considerate of marginalized populations and is accessible by those with limited digital literacy.

Build systems incrementally and in partnership with civil society:
Digital systems must be introduced into traditional systems gradually to ensure that traditional systems and practices are able to adapt. It is essential for governments to guard against exclusion at every step. DPI approaches for peace and justice should work in close collaboration with civil society to ensure last-mile inclusion, including designing for offline processes.

Champion public participation and engagement:
Stakeholders can encourage and enable participatory governance mechanisms, strengthen civil society organizations and foster real-time platforms for dialogue and redressal.

Sources: (7) UNDP, Rule of Law & Access to Justice Programme in the oPt, 2020; (8) UNDP, Sawasya, 2020; (9) Government of Brazil, Consumidor; (10) Consumidor, Bulletin, 2022

Fostering partnerships through DIGITAL PUBLIC INFRASTRUCTURE

CHALLENGES THAT DPI ADDRESS

US$3.3–4.5 trillion
per year is required to achieve the 2030 Agenda for Sustainable Development.[1]

80% of LMICs lack data
indicating the need for additional support to perform important data collection and analysis, with global Official Development Assisstance (ODA) funding for data dropped by more than 20% (2018-2020).[2]

37 out of 69 of the world's poorest countries
were in debt distress or at high risk of (as of November 2022). Many of them have poor public finance management systems, often working in silos.[2]

Partnerships are essential to achieving the SDGs. Precisely because all DPI is collaborative by nature, they support SDG 17, such as tracking aid (International AID Transparency Initiative - IATI),[3] enabling the cross border flow of data (X Road), and facilitating trade and remittance flows TradeTrust and UPI PayNow). DPI drives interoperability through open, accountable and trustworthy systems, and convenes diverse stakeholders to achieve common goals. The successes of DPI approaches are underpinned by digital cooperation, enhancing North South, South South and triangular regional and international cooperation. Meaningful cooperation requires every country to do their part in sharing re-usable technologies as DPGs, supporting open ecosystems and interoperability, and most importantly, strengthening coordination and digital systems in countries, particularly helping governments move to an open architecture for Public Finance Management (PFM).

Example of DPI's potential

INTERNATIONAL AID TRANSPARENCY INITIATIVE (IATI) REGISTRY

DPI STAGE

The IATI registry helps to record and track how aid money is spent.[4] Major organizations such as UNDP, UNICEF, and World Bank International Development Association[5] feature in the top and most transparent contributors of comprehensive data on IATI.[6] The open IATI standard harmonizes data from diverse organizations.[4] Open APIs facilitate interoperability by enabling the IATI community to develop tools that are then openly available.[4] Countries can integrate IATI data into their own aid information management system.[4] The IATI registry traces data through complex delivery chains using unique ID codes and enables comparison by harmonizing data from varied sources.[7]

IATI drives transparency and aid funding globally, and helps drive coordinated funding by helping to identify gaps and overlaps.

Sources: (1) UN, Financing and Funding; (2) UN SDGs Goal 17; (3) IATI, Madagascar Case Study; (4) IATI, IATI Portal; (5) World Bank, World Bank ranked among top positions in the International Aid Transparency Index (IATI), 2020; (6) Publish What You Fund, Aid Transparency Index , 2020; (7) IATI, Why use IATI?

Fostering partnerships through DIGITAL PUBLIC INFRASTRUCTURE

Example of DPI's potential

CROSS-BORDER DPI BASED ON X-ROAD

DPI STAGE

X-Road is a DPG that is implemented as DPI in 20+ countries to facilitate information exchange.[8, 9] It enables 1.5 billion data transactions annually.[8] Its inherent interoperability connects any two X-Road systems, even across boundaries.[10] It was used by the Governments of Estonia and Finland to connect their X-road systems and integrate their tax boards, business registrars and population data.[11] It has open standards and provides APIs that enable third-party builds.[12]

X-Road makes international data exchange and trade processes - like tax filing - more efficient.[11]

Example of DPI's potential

UPI-PAYNOW

DPI STAGE

UPI-PayNow is a collaborative payment corridor between the Association of Banks in Singapore and the Indian Government to reduce the cost, increase the efficiency, and facilitate the flow of cross-border remittances.[13] It links two existing payment systems using open APIs to enable simple user verification based on QR codes and virtual payment addresses across borders.[14] It also links with payment systems in other countries such as Thailand (PromptPay), Malaysia (DuitNow), France and United Arab Emirates - UAE.

Example of DPI's potential

TRADETRUST

DPI STAGE

Singapore's TradeTrust is built on the blockchain-based DPG OpenAttestation for the exchange of trade documents among governments and businesses.[15, 16] Singapore has used it for cross-border exchange with Netherlands, UAE and China.[17] It integrates with existing systems' backends using open-source code.[17]

It provides infrastructural support for international trade and makes the process more time- and cost-efficient. It reduced the time taken for trade processes from 10+ days to less than a day.[17]

How to encourage safe, inclusive and resilient DPI

Create multi-stakaeholder partnerships for discoverability, reusability and adoption of existing technologies and DPI approaches, suited to local contexts and problem statements.

Create research and knowledge hubs in partnership with local digital ecosystems across various SDGs to unpack DPI approaches that build on existing systems and solutions, and can create the public rails and open ecosystems to drive impact.

Specific DPI initiatives for public finance management need to be developed and piloted. More work is needed on enhancing 'fiscal' ID solutions (Identifiers & Registries) that expedite the identification of taxpayers and the beneficiaries of government payments, grants and transfers, thus helping to tackle evasion and corruption, among other issues. Developing a multi-dimensional classification of fiscal data that supports the automatic sharing of information and improve the allocation, execution, and control of public expenditure.[18]

Sources: (8) X-Road, X-Road Website; (9) Digital Public Goods Alliance, DPG Registry; (10) OPSI, X-Road Trust Federation for Cross-border Data Exchange, 2021; (11) X-Road, Case Study, 2020; (12) Omidyar Network, ODE Case Study; (13) ABS, Paynow-UPI; (14) Prime Minister's Office, Press Release; (15) TradeTrust, TradeTrust Website; (16) OpenAttestation, Gallery; (17) InfocommMedia Development Authority, Trade Digitalisation, 2022; (18) ODI, Making public finance digital: Challenges to the emerging digital public financial management paradigm, 2023

CONCLUSION

As the non-exhaustive examples in this compendium demonstrate, a DPI approach can drive exponential outcomes across sectors and societies to accelerate the attainment of the SDGs. By combining the right technology, governance frameworks and robust public and private innovation, DPI can bend the curve of development growth upwards.

However, building inclusive DPI requires long-term support and planning. Developing the necessary building blocks of technology, governance and local digital ecosystems requires nationally and internationally coordinated policy actions and investments to transition from passive, closed information systems to ecosystems that are utilized by a diverse range of stakeholders, with the right capacities and accountabilities.

The lessons learned so far can be applied across countries, sectors and all SDGs. A key feature of India's G20 Presidency has been its championing of global alignment around the imperative to invest in DPI approaches to inclusive, equitable and rights-based service delivery.

In summary...

1. DPI approaches are opening **new ways to re-think services** when imagined not as a system apart, but as an integral and visible part of the wider infrastructure, services and resource flows. We have an opportunity to identify collaboration points among systems and services.

2. Given the intricate complexities and intersection of digital transformation across and within the SDGs, we need to break down data silos and siloed approach of designing and implementing digital solutions and move to **shared foundations for technology, governance and ecosystems** that can prioritize access and inclusion over profits. This can unlock or surface the new potential of DPI.

3. Adopting DPI approaches will require data and digital commons where communities are stakeholders in the generation and use of data, offering avenues of new bottom-up models to reset, overcome biases and strengthen protections. Recognizing that data in information systems embodies and exercises power, **DPI design choices** need to consider the complexities of women and marginalized communities to generate multiplier returns across all SDGs.

4. Financing DPI is a complex issue that encompasses questions of objectives, operations, stakeholder management and governance. **Coordinated investments and expertise** across countries and organizations is required to ensure ongoing interoperability, address cyber threats, and for managing increased adoption and scale.

5. SDGs are our common vision and reflect the recurring aspirations across countries. Sharing technologies as re-usable resources, including as **digital public goods**, can unite us towards 'One Earth, One Family, One Future'.

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