The Human and Economic Impact of Digital Public Infrastructure

A quantitative analysis of the potential impact of digital public infrastructure by 2030 across the finance, climate and justice sectors

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GLOSSARY

TERM	DEFINITION
Access	The ability to obtain and make use of digital solutions, particularly ones that use customized products and services that are geared towards targeted users, such as underserved groups.
Digital public good	Any open-source software, open data, open AI model, open standard or open content that does no harm by design, as well as helps with the attainment of the Sustainable Development Goals.
Digital public infrastructure	A set of digital building blocks which are interoperable, built on open standards and specifications providing access to public and private services at societal scale and are governed by enabling rules to drive innovation, inclusion, and competition in the digital economy.
Early warning system	A system that is designed for early detection of an event.
Efficiency	A measure of the cost of delivering essential services at population scale. It weighs up the resources spent by the system in relation to the impact of that spending on the intended beneficiaries.
Inclusive and rights-based approach	An approach that focuses on better serving vulnerable and marginalized groups and communities with an emphasis on promoting human rights.
Innovation	A system that is designed for customization, encourages competition and promotes the development of new solutions on top of existing platforms and digital systems.
Interoperability	The ability to freely exchange and use data between services, regardless of origin, programming language or interface.
Leapfrogging	Accelerating progress towards achieving the targets of the Sustainable Development Goals.
Open-source system	A system where the copyright holder grants users the right to use, study, change and distribute the software and its source code to anyone for any purpose.
Privacy and security frameworks	In the context of digital systems, privacy and security frameworks provide a regulatory structure to protect individuals, organizations, data and a country's sovereignty over its public services and digital systems.
Resilience	The enhanced capacity and conditions of individuals and organizations to face and respond to external economic or social shocks.
Smallholder farm	A farm with an area of less than two hectares in size.
Sustainable digital solution	Any digital solution that ensures long-term economic and technical viability.
Trust	A public service system is deemed trustworthy if there is no significant gap between what is promised and what is delivered.

LIST OF ACRONYMS

AI	artificial intelligence
API	application programming interface
BAU	business as usual
CMS	case management system
DEPA	data empowerment and protection architecture
DPG	digital public good
DPI	digital public infrastructure
EWS	early warning system
FEWS NET	famine early warning system network
G2P	government-to-person
GDP	gross domestic product
GFW	Global Forest Watch
GHG	greenhouse gas
GLAD	global land analysis and discovery
$GtCO_2e$	giga tonne carbon dioxide equivalent
ITMO	internationally transferred mitigation outcome
KYC	know your customer
LMICs	low- and middle-income countries
MRV	monitoring, reporting and verification
MSME	micro, small and medium enterprise
$MtCO_2e$	million-tonne carbon dioxide equivalent
NDCs	nationally determined contributions
OCEN	Open Credit Enablement Network
ODR	online dispute resolution
PKI	Public Key Infrastructure
P2B	person-to-business
P2P	person-to-person
RIMA	resilience index measurement and analysis
SDGs	Sustainable Development Goals
SIM	subscriber identity module
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme

I. EXECUTIVE SUMMARY

With the rapid pace of digitization in countries, it is critical that rights-based and inclusive digital transformation is embedded across technology, governance and local digital ecosystems. In this context, implementing responsible and people-centred digital public infrastructure (DPI) is a must.

Right technology architecture: There are five core DPI categories that create the underlying rails to facilitate interoperability and reusability between systems and use-cases: IDs and Registries; Electronic Signatures, Public Key Infrastructure (PKI) and Trust; Data and Credentials; Payments; and Discovery and Transactions. Many of these components can also be introduced as separate solutions in the form of digital public goods (DPGs).

Open digital and technology standards and protocols: These enable interoperability to ensure that digital tools and solutions work together – and do not create, entrench, or exacerbate siloes that limit scale or impact. Some everyday examples of this include interoperability between civil registration and identity, or interoperability between national ID systems and health ID cards, or among social protection registries across various government ministries in a country.

Governance frameworks that are transparent, accountable, and participatory: Robust and clear cross-system governance and regulatory frameworks are critical components of safe, inclusive, and secure DPI. For example, data privacy rules should apply to both, whether it is a health registry and/ or a social protection registry. Similarly, people centricity through clear public accountability norms and redressal mechanisms apply to ID systems, payment systems, education systems, and others.

Creating local digital ecosystems to cohere fragmented operators: DPI tech architecture enables public and private innovators to build solutions and services using the DPI at scale (akin to highways or the Internet) and to power multi-modal access: across online, semi-online (low bandwidth connectivity) and offline modes, self-service and assisted modes, and in smartphone/feature phone/ no-phone modes. This is essential to catalyse innovation that closes the digital divide, at scale.

The above are all intended to function at societal scale: reaching all parts of, and all communities within, a country. DPI is a shared means to many ends, with numerous benefits and significant – and positive – multiplier effects. For example, financial service providers and businesses can leverage digital payment components to facilitate secure and efficient payments to support lives and livelihoods. Healthcare providers and social welfare services can use digital identity solutions to ensure that crucial support services reach those who need them most. And governments can securely share data with partners and other service providers – improving decision-making, shaping better policies, and supporting the growth of new and innovative ways to solve key challenges.

The impact of DPI across societies is becoming more evident. In India, a DPI approach led the way for ID provision to more than a billion people. Building blocks supporting a DPI approach have contributed to the share of adults with a financial account, rising from 51 percent in 2011 to 76 percent today worldwide[1]. Data exchange also supports better government services, for instance in Mauritius where over 30 government entities were able

Figure 1:
Impacts of sectoral DPI by 2030

By 2030, LMICs can reach a GDP of US$19.2 trillion faster. Without DPI, the World Bank estimates this will only be achieved by 2032–2033.

Countries can achieve this

20 to 33%

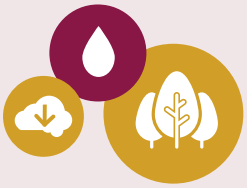
acceleration by adopting finance related DPI in payments and credit.

By using DPI to expand access and revamp formal justice systems, LMICs can reach 52 million to 63 million additional people by 2030.

This leapfrogs development trajectories by over

10 years

as only 26.5 million people in 70 LMICs have access today.



Open and inclusive software systems can accelerate sustainable development for LMICs. DPI systems, along with existing solutions, can reduce carbon dioxide emissions by nearly 5 $GtCo_2e$ by 2030.

Without DPI, current systems would require

5 to 10 years

more to reach the same reduction in emissions.

to share data safely, and provide more than 500 new e-services to people and businesses[2]. However, despite increasing evidence, the development impact of DPI largely remains an under-researched area. Recognising this, the current study aims to estimate the economic and human impact of implementing DPI across the finance, justice and climate sectors in 70 low- and middle-income countries (LMICs).[3] These sectors were chosen in line with the priorities of the Sustainable Development Goals (SDGs), as well as the reach and availability of existing use cases. While this report focuses on the sector-specific, or sectoral, impact of DPI for each of these three areas, the introduction and scaling of DPI across these topics also has wider benefits. This includes the potential to unlock further economic and societal value through open design principles, open interfaces and open standards.

Across finance, climate and justice, LMICs can use DPI to:

Speed up their economic growth by up to 33 percent - or the equivalent of two to three years of growth – by implementing DPI in the financial sector. DPI can accelerate and deepen the penetration of digital financial services. For example, countries are leveraging DPI to improve the financial inclusion of the nearly one in three adults who still lack access to a bank[4] - including Togo, which has expanded its social protection systems using open AI algorithms and models to identify vulnerable populations and provide contactless social protection payments.[5] The implementation of DPI and other associated approaches can also lead to inclusive economic growth, expand access to new types of financial services such as digital payments, tackle corruption, and strengthen the economic resilience of households.

Mitigate the equivalent of five gigatonnes of carbon dioxide by 2030, and accelerate emissions control efforts by five-to-ten years. DPI in the climate sector can bring benefits to carbon offsets and trading, land mapping, and weather information and monitoring – founded on building and sharing open datasets and coordinating cross-border digital and other efforts. For example, the 'Platform for Voluntary Bilateral Cooperation' uses a DPI approach with open components that tracks carbon credits and enables credit transfers in an efficient and transparent manner between host and buying countries. However, in other settings, this data ends to be inaccessible due to gaps in digital infrastructure or because of national interests. But opening-up this data, and driving the above work, can reduce carbon emissions, increase income for smallholder farmers with more timely data insights to better inform practices and efficiencies, improve nutrition and food security, and reduce deforestation.

Bring judicial services to their populations at least 10 years sooner through introducing DPI focused on justice. DPI can accelerate digital transformation efforts within the justice sector, increasing and enhancing service provision. Currently, only around 9 percent[6] of people that need to access formal judicial processes and support are able to do so. Open and digital solutions are still absent in many parts of the justice sector and, where present, have generally taken longer to develop and deploy. However, countries have started to use DPI[7] to support processes such as scheduling trials[8] and to provide alternate mechanisms for conflict resolution. By implementing DPI in the justice sector, countries can lower legal costs, reduce corruption and shorten the average time of civil cases, and expand the efficiency and effectiveness of judicial systems – with positive impact on wider society.

Figure 2:
Impacts of finance-related DPI by 2030

LMICs can grow their GDPs by

$200 to $280 billion

This amounts to an additional 1 to 1.4% growth in GDP levels by 2030.

An additional

12 to 16%

of the LMIC population will have access to digital payments. **That is close to 530 million to 730 million people.**

DPI can plug the credit gap for

16 to 19 million

additional MSMEs in 2030 alone. **This represents nearly 7% of total formal MSMEs.**

Government direct benefit transfers can increase by between

$17 to $21 billion

by 2030. **This will lead to a $80 to $100 increase in household benefits.**

Figure 3:
Impacts of justice-related DPI, by 2030

DPI can lead to

28 to 42%

increase in individuals with access to state-backed dispute resolution systems by 2030. **This is equivalent to 23 million to 35 million people.**

DPI can lead to savings of $40 to $63 for each person who faces a legal challenge in 2030.

This is equivalent to

12 to 19%

of the total cost of litigation for individuals.

DPI can lead to

19 to 31%

faster resolution of cases by 2030 as compared to current solutions. **It will also reduce the backlog of cases and improve judicial accountability and trust.**

Overall, sectoral implementation of DPI could allow for faster adoption of services, improved inclusion and transparency (and reductions in corruption), and increased efficiencies compared to siloed or proprietary solutions. The building blocks supporting DPI are generally built on open-source technologies. Open source makes the underlying code freely available for all to study and use - in contrast to proprietary solutions that are not publicly shared, and where innovators retain intellectual property rights. Open source can create benefits in enabling digital solutions to be adapted or modified to meet different needs and requirements. However, open-source technologies are not a panacea. They may not be suitable for all contexts, and can also require different ways of working – both aspects discussed in more detail later in this report.

In order to achieve the above benefits of DPI, countries need to enable the implementation and scaling of these components. This involves:

Shaping a local digital ecosystem to drive the development of DPI. DPI cannot be sustained or flourish in a vacuum; it requires the combined efforts of the public and private sectors –and civil society. Governments can shape an enabling environment of policies and regulation to encourage digital development, and build digital skills and capacities across society. In turn, the private sector (and other innovators, including in academia) should be supported to develop the skills, knowledge, and expertise required to build digital solutions that support and leverage DPI.

Strengthening the capacities and capabilities of the public sector for implementation and scaling of DPI. Digital solutions alone are not sufficient if governments are not aware of them – or able to implement them. Policymakers, service designers, and other civil servants need to be supported to build understanding of the role and potential of DPI in achieving key development outcomes. This

should also be part of a broader process of digital transformation, that leverages digital as a key tool for public service delivery – founded on principles of openness, interoperability, and inclusion.

Promoting increased knowledge sharing and technology exchange among countries. As a toolkit of digital components and solutions, DPI can be implemented in different contexts. This provides an exciting opportunity to share learning between teams, departments, governments, and countries – accelerating digital development. This includes learning from the efforts and experience of countries such as Estonia, India, and Ukraine that have been forerunners in DPI design and implementation - and who have achieved positive outcomes in terms of innovation and inclusion.

At the midway point of the 2030 Agenda for Sustainable Development, progress is slowing – and across some targets, reversing. Millions more people risk being pushed back into poverty, and the impacts of climate change are worsening. Digital tools and technologies can play a valuable role in getting countries back on track, but only if these approaches are applied in an inclusive, sustainable, and comprehensive way.

This is the focus of digital public infrastructure: shaping the digital components to enable public and private service delivery at the largest scale, and to support and catalyse vibrant and dynamic innovation ecosystems of businesses, civil society organizations, and other innovators. By applying DPI across economies and societies, and by using DPI to address and tackle sector-specific priorities and challenges, countries can accelerate their growth and development – with positive impacts for people, the planet, and prosperity.

Figure 4:
Impacts of climate-related DPI by 2030

Global weather data and early warning systems can improve annual income for smallholder farmers by $95 to $170 per household by 2030. **That is an increase of**

5 to 11%

Improved cereal yield can prevent undernourishment for

55 million to 115 million

people by 2030.
This accounts for 8 to 17% of the undernourished population.

Near real-time alerts that monitor land use can save 115,000–230,000 hectares of forest cover from illegal deforestation by 2030. **This represents**

15 to 20%

of total illegal deforestation.

Using DPI for common MRV systems and interlinking carbon registries can lead to a reduction of at least 0.8 to 1.1 GtCo2e by 2030. **This is**

3 to 4%

of LMIC targets.

II. INTRODUCTION

Countries require a set of digital systems and networks to provide digital services at population scale. These information networks span sectors and allow data and information to be easily shared and used across services. For example, countries need digital payment rails that enable individuals to make digital payments to small merchants. Likewise, people and businesses need access to a form of identity that can be verified online in a cost-effective manner. Specific use cases, such as issuing COVID-19 vaccination e-certificates, require digital tracking and certification, which can be shared with individuals and institutions.

These digital systems and networks make up a country's DPI. DPI is a set of digital solutions that are interoperable and built on open standards and specifications. DPI provides access to public and private services at societal scale and is governed by enabling rules to drive innovation, inclusion and competition. DPI can also be seen as an approach that emphasizes an ongoing and deliberate effort to develop and implement open, interoperable and standards-based digital infrastructure. These digital systems and networks can enable the provision of population-scale services and act as an underlying infrastructure upon which additional services can be built. For example, India has taken steps towards adopting and implementing a DPI for education, namely through Digital Infrastructure

for Knowledge Sharing, also known as DIKSHA. This is a versatile, free-to-use school platform that provides various solutions for students, teachers and administrators and can be leveraged for the country's multiple use cases for school education. It reaches more than seven million teachers, more than 180 million students, allowing for creation, curation, consumption of local content, with local context and in local languages. While DPI in digital ID, payments, education and health are emerging, their advantages tend to be poorly documented and are rarely quantified or studied.

When governments plan their digital infrastructure, their default choice is not always based on community-led, open-source and interoperable software that enables DPI. In part, this is because proprietary and closed-source solutions are marketed as safer and more mature than open-source alternatives. While this is true in some cases, these solutions come with challenges of their own. Closed-source solutions increase dependence on the vendor for implementation, shackle countries with limited digital sovereignty, and slow the learning exchange and reuse of solutions across countries. On the other hand, the use of open and interoperable systems is held back by a limited understanding of their potential, a lack of documented evidence of their effects, and technical nomenclature that decision makers are often unfamiliar with.

This study aims to address some of these challenges—particularly regarding evidence. It also seeks to demonstrate how adopting DPI within sectors can improve public service delivery, with greater efficiency, transparency and sustainability. Within the broader definition of DPI described above, there are different types of digital building blocks. This study quantifies the potential human and economic impacts of DPI across three sectors, namely finance, climate and justice. These sectors were selected based on several factors, including the level of maturity of related systems, the adoption and use of DPI, and the outcomes for people and the planet.

APPROACH

The study follows a four-step, mixed-methods approach to estimate the added impact of DPI implementation in the finance, climate and justice sectors across 70 selected LMICs.[9]

1. Map use cases and associated impact pathways across each sector.

Impact pathways refer to a series of logical steps or mechanisms through which a DPI intervention could effect change. The research team selected eight use cases[10] across the three sectors for examination. These were chosen based on their potential for impact and availability of DPGs within the sector. For example, open and interoperable DPI could lead to an increase in access to credit for businesses. Increased credit availability is linked to increases in economic growth, the availability of jobs, and the resilience of small businesses to external economic shocks.

2. Forecast the impact of DPI assuming an S-shaped adoption curve.

S-shaped curves are often related to the adoption of any technology or innovation[11] and represent the potential speed of adoption. Data from proxies, expert conversations and a literature review were used to model the curve and impact of DPI up to the year 2030. For example, penetration of mobile money in Kenya began slowly rising to about 1.5 million in December 2007, about 1.5 years after its introduction. However, in the next 3 years it grew nearly 10 times, rising to 16.5 million individuals by 2010.[12] When expanded to include years beyond 2010, this growth curve resembles the letter “S”.

To estimate the potential impact of DPI within sectors, the research team: (i) completed a comprehensive scan of more than 20 studies to build an understanding of potential impacts and pathways, (ii) used data from more than 40 databases and real-world proxies, and (iii) validated estimates with more than 15 experts. Additional details on the methodology used are provided in the annex of this report.

The results reported in this study are conservative. Erring on the side of caution,the study relies on evidence-based assumptions. The estimates should not be read as a rigorous, conclusive evaluation of these DPI but as an empirical indication of their potential.

3. Estimate the incremental impact of DPI vs. next-best plausible solutions, for instance closed and proprietary solutions.

All estimates in this report refer to the added impact of a DPI over proprietary systems. For some impact pathways, such as the use of court management systems, business-as-usual is largely offline. Therefore, the incremental impact can be attributed mostly to digitalization. For other sectors, such as in finance, ample closed-source and proprietary digital solutions exist. The incremental impact over and above those existing digital solutions was estimated. For example, digitizing judicial procedures through a case management system (CMS) is likely to lead to improvements in the efficiency and speed of service delivery. However, open and transparent design of these DPI is expected to build trust and drive increased adoption compared to proprietary systems. This inclusive and community driven design can lead to an even higher boost in efficiency and speed.

4. Extrapolate steps two and three for 70 LMICs, accounting for the maturity and digital readiness of their sectors.

To improve the precision of estimates, the 70 LMICs were shortlisted based on their political stability, access to free internet and presence of a reasonable population base. For example, data from Global Forest Watch (GFW) —a DPG focused on monitoring global forest lands—suggests that the digital forest alert and awareness system could lead to a 52 percent reduction in deforestation.[13] However, these estimates were only quantified for the countries in Latin America. These estimates were extrapolated for the 70 LMICs, assuming that a few countries would see a larger impact of such systems based on the presence of other mature digital and sectoral systems (and vice versa).

III. WHY OPEN AND INCLUSIVE APPROACHES TO DPI MATTER

Public service delivery systems are evolving through digitalization, and DPI is one of the key enablers. But whether it is foundational or sectoral DPI, research is needed to evaluate the effectiveness of this approach. From an analysis of countries that have been developing and implementing DPI, the evidence shows that inclusive DPI can:

- **Increase efficiency of existing systems.** The interoperability and openness of the technical components and standards allow systems to share data. This replaces the need to develop new ways for users to input information and new databases to store near-identical information. This reusage based on uniformity leads to more cost-effective digitalization. For instance, DPI that is linked to digital ID can allow social protection agencies to verify beneficiaries more effectively than is possible with proprietary identity solutions. As a result, these agencies can make social grant transfers directly, cut out corrupt intermediaries and reduce leakages.

- **Increase access to services.** With open blueprints, technical components and standards, there are fewer barriers to adopting DPI. These elements also accelerate DPI implementation and adaptation to local needs. For example, the European Union (EU) implemented an online dispute resolution (ODR) system that allows users to resolve challenges related to e-commerce through an intuitive and user-friendly interface. There were no solutions prior to the EU ODR system that allowed such unmitigated access to dispute resolution for European consumers.[14]

- **Unlock innovation.** More value-added services can be built on open and interoperable systems than on proprietary systems. Creating the necessary application programming interfaces (APIs) to make data available in one particular sector can create opportunities elsewhere at the same time. For example, open payment systems can enable lenders to use a user's transaction history as a proxy to determine the creditworthiness of prospective clients. Similarly, open geo-spatial and weather data can allow financial service providers to better tailor their products for farmers, offering more cost competitive insurances or lending terms.[15, 16]

Despite emergent benefits, there are underlying challenges that need to be addressed.

Currently, the development and use of DPGs and DPI are limited to few use cases. This is in part due to a low level of awareness among many governments about DPGs and DPI. This is compounded by outdated and exclusionary procurement guidelines that fail to embrace IT vendors who can deliver open-source solutions for governments. In addition, there are only a few IT vendors who specialize in implementing DPI that relies on DPGs. There are some well-financed DPGs that act as building blocks for DPI, but they are few and far between. To ensure rapid scale and sustainability, countries need long-term funding and business model innovation around the core building blocks of DPI. As with any public system, digital systems that are designed to enhance public service delivery need to be supplemented with robust governance and redressal mechanisms to ensure they are not misused.

And for DPGs and DPI to thrive, governments must also take proactive measures to strengthen digital ecosystems with an inclusive and rights-based approach.

IV. MAKING AN IMPACT CASE FOR SECTORAL DPI

LMICs can accelerate their development trajectories by adopting DPI that are open, interoperable and inclusive by design. This approach can create a virtuous cycle of prosperity and accelerate an increase in GDP, reduce greenhouse gas emissions and improve access to judicial systems.[17] The following sections describe the added impact DPI within sectors could yield by 2030.

- The section on **DPI in the finance sector** builds a case for implementing open and inclusive account systems, payment rails and credit disbursement systems. These systems can allow LMICs to speed up cash transfers, broaden access to credit, and increase the use of retail digital payment. This leads to increased economic activity and other benefits. The results of this research analysis suggest that **LMICs can speed up their GDP growth by 20–33 percent (meaning LMICs could hit their target two to three years earlier than if they continued on the current trajectory without a finance-related DPI).**

- The section on **DPI in the climate sector** quantifies the impact of improved carbon trading, forest land use tracking and weather monitoring systems. The findings suggest that these examples of DPI may allow LMICs to capture nearly 5 $GtCO_2e$ by 2030. Without these initiatives, this level of capture would only be achieved between 2035 and 2040. **That means open and inclusive DPI in the climate sector can accelerate efforts to control emissions by 5 to 10 years.**

- The section on **DPI in the justice sector** focuses on digital systems that increase the efficiency of case management and the ease of dispute resolution for those with the least access to redressal mechanisms. DPI can increase access to the judiciary, and in so doing help to strengthen law and order and build trust in the country's judicial systems. The levels of access LMICs would achieve in 2030 with the implementation of a DPI would only have been achieved by 2040 the earliest without such DPI. **By implementing DPI, LMICs can accelerate access to judicial systems by at least 10 years.**

In sum, DPI can speed up progress towards numerous social and economic goals. This can contribute to a compounding cycle of impact. For instance, inclusive economic growth would bring millions of individuals out of poverty. These people would require essential services, leading to increased production and income. This, in turn, would contribute to economic growth. As open, interoperable and inclusive digital systems focused on specific sectors, DPI can therefore accelerate development progress and help LMICS to meet their priorities at a faster rate compared to the status quo.

FINANCE

Financial service providers have been led to consider DPI across their operations, which has led to further innovations across other public services. The rapid spread of mobile phones, internet access and mobile money catalysed digital financial penetration across LMICs. The sector has transitioned from offline, traditional modes of money transfer to faster, more cost-effective and inclusive digital systems. This has led to an increase in the breadth (number of people with access to formal financial systems) and depth (range of services that people can use) of financial inclusion. These digital systems also played a supporting role in laying digital infrastructure across sectors such as digital ID, healthcare and agriculture, among others.

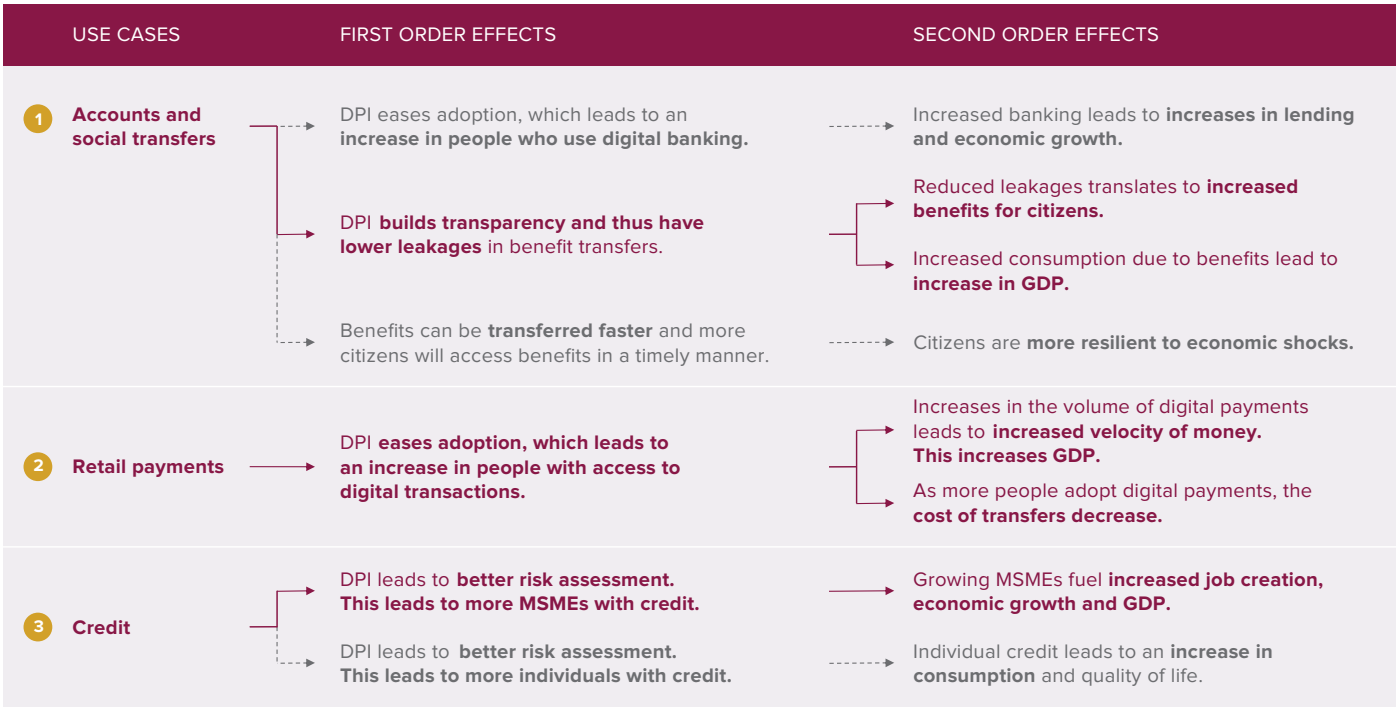
However, current use of digital financial services still has some way to go to address the inequity in access. Nearly 29 percent of the adult population in LMICs lack access to a formal bank account and over 85 million unbanked adults continue to receive government transfers in cash.[18] The lack of regulated digital bank accounts limits the ability to service people and limits data availability, preventing lenders from underwriting small ticket loans for unserved and underserved communities. Government-to-person (G2P) transfers are often plagued by high levels of leakages—through corrupt intermediaries and ineffective programme implementation— leading to reduced capital available to people and households. Similarly, micro, small and medium-sized enterprises (MSMEs) are constrained due to a lack of access to financing, the high cost of borrowing and a lack of financial products customized to their needs.

Adopting DPI within finance can help LMICs improve account access and use, increase the efficiency of G2P transfers, and expand credit availability. Leaning on DPGs can further drive access, use and resilience across the financial journey of a user: from opening an account to making digital payments, applying for credit, and other financial services. These open and interoperable digital solutions generally have significant benefits over and above those achieved through closed and proprietary solutions. They increase trust across the financial system, help avoid vendor lock-in and enable innovation. Since they are easier to customize and can increase the speed of service delivery, likewise they can push countries to improve efforts that focus on inclusivity and building resilience

In the following sections, the potential impact of DPI is quantified based on the following use cases: (i) accounts and social transfers, (ii) retail payments, and (iii) credit. These use cases are informed by existing DPGs and other interoperable open-source software that has been implemented in these three areas, such as Novissi, Pix and OCEN.

Figure 5:
Potential impact pathways of finance-related DPI
We should note there are benefits that go beyond the cases mentioned below. For example, digital payments unlock new business models, from pay as you go to circular economy models. Retail payments have enabled remote payments during the pandemic. There are many potential impacts from which some have been quantified.

Text in color highlights pathways that have been quantified.



Accounts and social transfers

Mobile money has accelerated financial inclusion and access to social benefits for many of LMICs yet gaps remain. Bank and mobile money account ownership increased by 50 percent between 2011 and 2021.[19] This was driven primarily by the use of mobile money systems. However, nearly one in three adults in LMICs still lack access to an account. And millions lack access to social transfers (or receive them in cash).[19] COVID-related lockdowns emphasized the challenges many face to access their accounts and benefits.

Open and interoperable DPI supports countries in providing last-mile service delivery at scale. For example, Togo expanded its social protection systems using open AI algorithms and models to identify vulnerable populations and provide contactless social protection payments (see box above).[20] Similarly, the Indian Government leveraged its digital ID and payment systems to transfer social benefits to marginalized populations more quickly and efficiently.[21]

In addition to increased speed of delivery, G2P related DPI can also reduce leakages due to corruption and rent-seeking behaviour.

Nearly 3–5 percent of annual social transfers are lost due to corrupt activities.[22] G2P systems designed for openness can help accelerate government's ability to reduce leakages by verifying the identity of beneficiaries and reducing the intermediaries responsible for transfers. Evidence suggests that the savings could boost the agricultural subsidies and social protection transfers that people below the poverty line receive from their governments. Such systems could reduce leakages by nearly 2–3 percent,[23] and increase the average benefits households receive by US$80–$100. This is equivalent to a cumulative increase of $15 billion to $20 billion in household income, in 2030 alone.

Photo: UNDP

Box 1

Novissi—Empowering the economically vulnerable in Togo

The Novissi cash transfer scheme allowed the Togolese government to make quick and cost effective social transfers to the most vulnerable households. This helped to avert human crisis during the COVID-19 pandemic. Novissi uses existing data and machine learning systems to identify the most vulnerable households and executes payments in partnership with mobile network providers. The program was designed to adjust to the changing needs of the population through real-time tracking of cash transfer registrations, stages of disbursement and allocation. It filled gaps in household level economic data using machine learning predictions that pulled from open geospatial and mobile usage data. As a DPI, Novissi affords flexibility and easy adoption as it uses APIs to interact with mobile networks and was built on a publicly available research paper.

Novissi propelled financial accessibility by enabling anyone with a SIM card to register for the scheme. This spurred the creation of 170,000 new mobile money accounts, representing a 7 percent increase in mobile money penetration as of 2021. It disbursed nearly $24 million to 820,000 vulnerable beneficiaries. As 65 percent of beneficiaries were women, it also made strides in empowering women.

Retail payments

Retail payment systems may be referred to as the 'digital rails' that enable person-to-person (P2P) and person-to-business (P2B) payments. Open and interoperable digital payment solutions can reduce barriers to use and expand access to underserved communities. At the same time, retail payment DPI can reduce the costs of digital transactions, improve user interfaces, increase convenience, and build trust in their use.

DPI that is focused on retail payment could potentially increase digital payment penetration by 4.5–5 percent per annum.[24] As a result, open payment systems could lead to 530 million to 730 million more individuals accessing digital payments in LMICs by 2030, equivalent to 12–17 percent of the LMIC population. They also reduce the time taken per transaction (due to interoperable and interlinked payment systems) as well as fees and charges incurred (due to increased competition from payment providers), leading to significant improvement in service delivery for people.[25]

Furthermore, increased access to and convenience of digital payment infrastructure can increase people's resilience to economic shocks.

As seen in Kenya, access to mobile money systems improves access to remittances during economic shocks—by as much as 15 percent.[26] As such, access to real-time and convenient payment solutions can help households to withstand sudden loss of income. As households recover more quickly from such shocks, they can also earn additional income faster than if they did not have access to such digital payments systems. As a result, open retail payment systems could increase income gains by $41 billion to $51 billion in 2030 alone. This can boost GDP levels by 0.3 basis points for every 1 percent growth in digital payment volume.[27]

Photo: UNDP

Box 2

Pix and Instapay

Pix is a real-time retail payment system, supported by the Central Bank of Brazil. It facilitates seamless payments between individuals, companies and the government using a QR code or an alias (a unique identifier that is linked to an account). Despite a cultural mistrust of banks, Pix enjoys popular support.

Pix is available across a range of interfaces, which drove rapid growth and participation. Nearly all bank and non-bank payment service providers adopted the payment protocol.

Prior to Pix, banks and post offices served as intermediaries for payments and could charge high fees for payment services. In comparison, Pix charges zero fees for both senders and receivers of payments. This makes the system more accessible and distinguishes it from traditional digital payment methods.

Similar to Pix, the Philippines unveiled a retail payment system (InstaPay) in 2018. It was designed to facilitate small value payments for e-commerce, tolls and tickets, retail goods, etc. By 2021, nearly 450 million payments were made annually through the system. Due to its open and interoperable framework, over 70 partner financial institutions have enrolled under the InstaPay network. This led to universal access for citizens across financial service providers.

Credit

Without affordable and quickly accessible credit, MSMEs growth remains severely constrained across LMICs. MSMEs have limited access to quality collateral and financial assets, and often struggle to borrow from formal lenders. This leaves MSMEs susceptible to predatory lending from informal money lenders, as well as economic shocks. The credit gap for MSMEs in developing countries was estimated at $5.2 trillion in 2018 alone.[28]

Open, interoperable and transparent DPI can bridge the gap between capital providers and MSMEs at lower costs.

DPI could allow data to be transmitted more quickly, and improve determination of credit risk, as well as preventing market capture by closed-loop systems, driving prices down, more access for SMEs, better choices, and healthier businesses. This can increase the number of MSMEs with access to credit support. When compared to proprietary solutions, which are unable to fully meet the credit needs of MSMEs, an open-source credit DPI can bridge about 50 percent of the credit gap.[29] As a result, an estimated 16 million to 19 million additional MSMEs may be able to access capital in the year 2030 due to DPI. These new MSMEs could be equivalent to nearly 7 percent of the estimated number of formal MSMEs present in 2030.

When credit and working capital are more available, countries generally see an increase in economic activity, revenue growth, and employment and job opportunities. This could raise LMICs' GDP by an estimated $100 billion to $140 billion in 2030 over what's expected at the current GDP trajectory.

Photo: UNDP

Box 3

OCEN for democratization of credit

Open Credit Enablement Network (OCEN) is a digitally enabled protocol that seeks to act as a common language among lenders, borrowers and account aggregators to facilitate innovation at scale.

By slashing redundant paperwork, OCEN allows underwriting in real time. OCEN uses APIs to allow interaction at all stages of the credit lifecycle, from the loan origination system and consent request to loan disbursal, customer service and collections. By developing an open and interoperable system, OCEN can cut through proprietary silos and allow improved estimation of risk and increase credit disbursement for individuals and enterprises.

The recently introduced OCEN in India proposes to overhaul the current processes to access credit and make it easier for MSMEs that may need to access credit. It also has offerings like lending that is based on cash flow, embedded finance and invoice discounting. This is expected to halve the credit demand in the country by 2030.

In summary, finance-related DPI that enables and supports G2P systems, retail payments and credit disbursement can increase income, the use of digital payments, access to credit, and support economic resilience.

- DPI can increase GDP by an estimated $200 billion to $280 billion by 2030 for the 70 LMICs—over and above gains achieved through proprietary systems. This is equivalent to a 1–1.4 percent increase in annual GDP.[30]

- Access to and use of digital payments may increase by an additional 12–16 percent of the total population in the 70 LMICs. This means that close to 530 million to 730 million additional people could have access to digital payments.

- An additional 7 percent of formalized MSMEs may gain access to credit. This can help to plug the credit gap, with an addition of nearly 16 million to 19 million enterprises.

- Households can experience a $80–$100 increase in benefits in 2030 through improved direct benefit transfer mechanisms. This is above the benefits that are expected through proprietary systems.

- Through such impact, DPI can lead to a cycle of increased economic resilience, additional job opportunities and reduced poverty levels. It can also lead to more equitable access to capital—establishing the grounds for a resilient and sustainable economy.

Financial systems are among the most critical digital infrastructures of this century—next only to digital ID systems. Open and inclusive financial solutions can be adopted and customized across LMICs far faster than proprietary products. Interoperable digital infrastructure provides countries with a more cost-effective and accessible alternative to current systems. Most importantly, by building and laying these foundations for public benefit, countries can work on the financial inclusion of marginalized or underserved communities.

CLIMATE

Despite increasing global commitments, efforts to combat climate change have been slow and inadequate. While countries have taken steps to reduce emissions and implement controls to comply with the 2015 Paris Agreement, these barely scratch the surface of what is needed. To meet the 1.5°C target, the United Nations Environment Programme (UNEP) Emissions Gap Report 2021 projects that countries need to reduce carbon emissions to at least 55 percent of 2010 levels by 2030. In contrast, the updated nationally determined contributions (NDCs) show emissions are only being reduced 7.5 percent.[31] By some estimates, current investments in mitigation activities are about 65–85 percent less than required.[32]

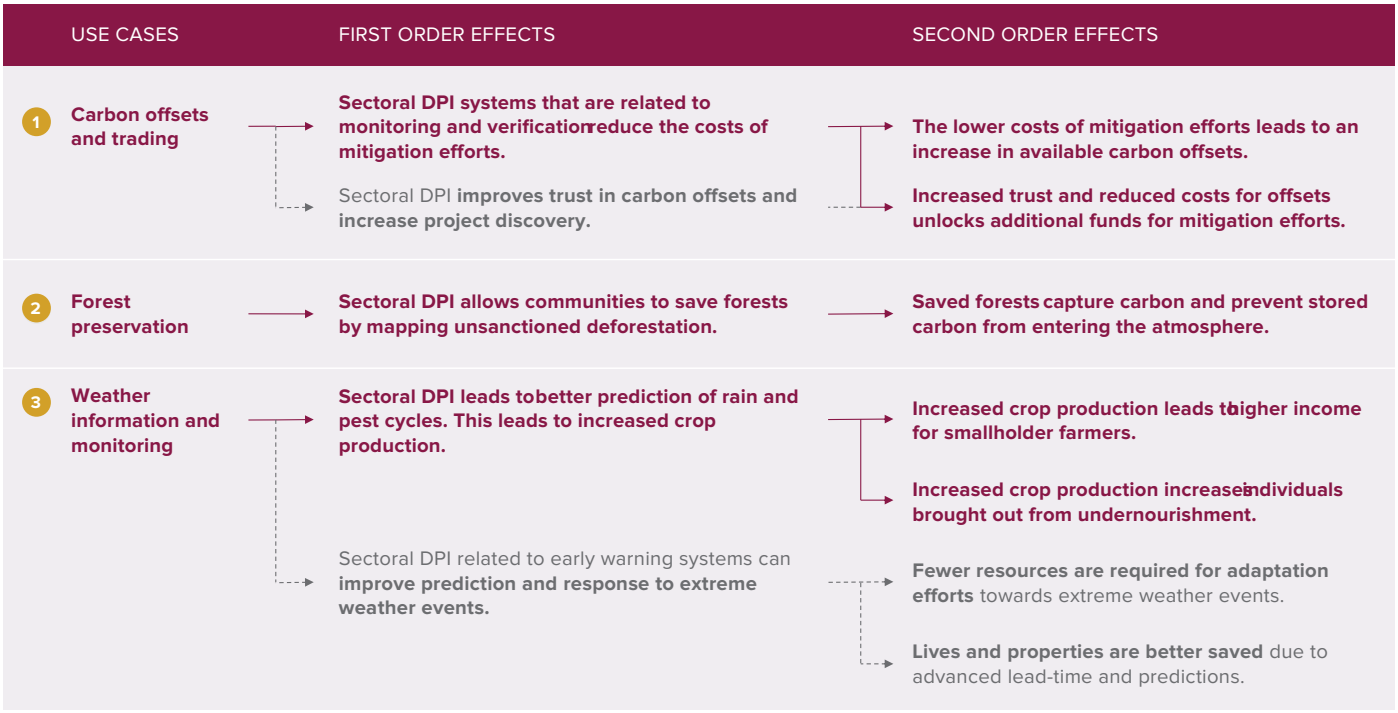
The global community must urgently adapt to and mitigate the effects of changing climates through coordinated efforts. The pace of climate change has been faster than previously predicted.[33] Climate solutions must cater to the broad set of needs of LMICs, and account for their lower investment capacity and need to prioritize economic growth. And these solutions must be adopted fast. However, currently digital tools for climate adaptation and mitigation efforts are used only across a scattering of systems and regions. The lack of open tools and technologies prevent a collective and holistic approach.

DPI can support countries in more effective, coordinated and inclusive climate action. Open and inclusive systems allow all LMICs to participate in climate action, regardless of their investment capability and capacity. Open geospatial datasets, for example, reduce the need for LMICs to develop local mapping systems. Instead, they can coordinate their actions to reduce unsustainable land use.

The following sections estimate the impacts of DPI in (i) carbon offsets through carbon credit systems, (ii) forest preservation systems, and (iii) weather information and monitoring systems. These estimates are informed by existing or upcoming DPG implementations such as the UNDP Carbon Cooperation platform, GFW and MET Norway among others.

Figure 6:
Potential impact pathways of climate-related DPI

Text in color highlights pathways that have been quantified.



Carbon offsets through carbon credit trading

Countries and global enterprises are increasingly turning to carbon offsets to achieve net-zero emissions. Voluntary carbon credit registries[34] issued nearly 300 million credits in 2021, nearly double the credits issued in 2017 (155 million).[35] However, despite the high interest in carbon credits, poorly designed offsets can actively hurt global mitigation efforts. Siloed carbon markets—with dissimilar and slow verification methods—can lead to a net increase in emissions instead of a reduction.[36]

An open and end-to-end digital carbon credit platform can mitigate some of the challenges with current trading mechanisms. To ensure transparency and efficiency, a common standard on monitoring, reporting and verification (MRV) of carbon emissions is necessary for such a platform, in addition to being linked to national and voluntary carbon registries. This can build trust in mitigation efforts and support increased carbon trading— for both voluntary trading systems and internationally transferred mitigation outcomes (ITMO) trading systems as defined under Article 6 of the Paris Agreement.[37] It can also unlock sustainable financing for developers of carbon offset programmes.

- Open carbon credit platforms can increase access to trading of carbon credits, both for developing countries that find it difficult to develop a local trading platform, as well as for enterprises looking to offset their emissions.

- Besides expanding participation, an open platform can make projects more discoverable by creating a single repository of projects. Without the need to coordinate between multiple platforms, it can also shorten implementation time for green projects. And with streamlined end-to-end processing, it can also lower transaction costs.

- Common MRV systems bring additional transparency when issuing credits. They also build trust around the quality of the credits and make it less expensive for developers of offsets projects. Together, this can increase both the demand for and supply of, carbon credits.

- The digital systems can be enhanced to include green investment schemes (GIS):[38] funds generated during the sale of unused emission allowances and ear-marked for use in climate adaptation and mitigation efforts. It could also include information on the impacts of national policy efforts and serve as a real-time measure of a nation's progress towards its NDCs.

Despite their benefits, carbon markets are not a cure-all for reducing global emissions. They face several challenges including ineffective project verification systems, limited oversight on credit issuance and delayed credit retirement. While DPI can support these systems in creating more robust and transparent rules for engagement, they can not solve all challenges that these systems face.

Nonetheless, DPI has the potential to accelerate climate change mitigation efforts by 5 to 10 years in LMICs and unlock increased sustainable funding for projects. By creating transparent, end-to-end MRV systems, the demand for quality carbon offsets could nearly double in growth,[39] and drive up carbon prices and the supply of credits and climate financing. This could help capture an additional 0.8–1.1 $GtCO_2e$ emissions by 2030 over current systems,[40] which is equal to 3–4 percent of current LMICs' emission reduction targets. In addition, they can nudge countries into a higher carbon capture trajectory, accelerate climate mitigation efforts by 5 to 10 years and unlock an estimated $25 billion to $53 billion in climate financing by 2030.[41]

Photo: UNDP

Box 4

UNDP platform for voluntary bilateral cooperation

A total of 193 nations have committed to the Paris Agreement and NDCs to track climate action and national progress in reducing greenhouse gas (GHG) emissions. However, it is challenging to ensure that carbon credits and green finance makes its way to projects for countries to adapt and mitigate climate change. The complex process often means project managers give up on carbon credit-based finance altogether.

Together with a group of international partners, the UNDP led the development of an open-source platform for climate transparency and carbon registries as a DPG. It tracks carbon credits issued to projects and enables credit transfers in an efficient and transparent manner. In this way, it effectively creates a marketplace for emissions reductions. The platform intends to reduce transaction costs and implementation timelines for projects. This will make mitigation outcomes more financially feasible and stimulate further climate investments. Following a DPI approach, the system's technical architecture consists of several open components. It is also interoperable with other major platforms, including the UNFCCC global registry, the World Bank Data Warehouse, and the UNDP Internationally Transferred Mitigation Outcome (ITMO) platform, which makes it an end-to-end digital solution. It is open for all countries to study and implement nationally, or in specific environmental agencies or departments, and can be amended to fit national requirements for workflow management and information needs. This includes integrating with national MRV systems to track NDC progress.

Forest preservation

LMICs across Africa, South America and Southeast Asia have massive ecological diversity. But this is under threat due to human activity. Many of the 36 globally recognized biodiversity hotspots are distributed across these regions. They house endemic flora and fauna, support local communities with fresh water and valuable resources,[42] and provide some of the oldest carbon sinks on the planet. Losing ancient forests and other important flora means not only the loss of the planet's current capacity to capture CO_2 and other greenhouse gases (GHGs), but also the potential release of vast amounts of previously captured carbon. Unfortunately, deforestation of these ancient storehouses has been growing unsustainably.

Near real-time monitoring of geospatial data has shown success in preventing unsustainable deforestation. DPGs that provide open datasets on land use patterns and forest cover provide an effective monitoring tool against forest cover loss. Platforms like GFW use NASA's Landsat satellite imagery to generate open datasets and provide weekly data and alerts on deforestation. Crucially, this system empowers local communities to act and prevent unsustainable deforestation by disseminating information directly to them. This allows for rapid action by the communities that are most directly impacted by deforestation.

Evidence from existing literature estimates that weekly alerts that identify areas with disturbances in forest cover can effectively prevent unsustainable deforestation in nearly one out of five instances.[43] Based on current rates of unsustainable deforestation and illegal logging, we estimate that similar systems in LMICs could preserve nearly 0.2–0.4 million hectares of unique forest area[44] by 2030. Additionally, the systems could save nearly 30–60 metric tonnes of CO_2, including the carbon captured from the atmosphere and the stored carbon in the biomass that would be released if the area were deforested.

Preventing runaway deforestation has further positive effects in maintaining land quality and supporting vulnerable communities. Loss of forest cover leads to reduced biomass and the degradation of soil quality and other biotic components, which are major causes of carbon emissions. Forests also serve as important natural resources and are vital to the livelihoods of the communities that inhabit them. Conserving the biodiversity within them has been shown to be ecologically and economically beneficial. Countries can also generate a successful tourism industry around biodiversity protection that further funds conservation. DPI can grow this industry further by empowering local communities—as in the case with GFW—to improve conservation efforts and gain from the revenue generated.

Photo: UNDP

Box 5

Global Forest Watch: Local communities for climate action

Global Forest Watch (GFW) is an open digital platform that uses geospatial analysis to generate near real-time deforestation alerts. The alerts are shared with local communities both digitally and through analog systems (due to the limitations of digital penetration and network access). Members of the local communities are equipped with smartphones and training to use the devices to identify unauthorized deforestation efforts.

Studies have shown the importance of enabling local systems with digital technologies such as this. GFW found a 52 percent decline in deforestation among Indigenous groups that were empowered by GFW's platform, as compared to control groups without technology-based monitoring.

Weather information and monitoring systems

Climate change is changing weather patterns. This can overturn global food production and harm global food security. Rapidly changing climatic conditions and more frequent extreme weather events harm agricultural production and growth. For example, a study simulated an all-day warming of 2°C and found a decrease in rice grain yield by 43–78 percent.[45] Similarly, changes in precipitation patterns impair the ability of farmers to optimize planting cycles. For example, rice yields can drop by 6 percent if planting is delayed by just one week.[46]

Open-source weather monitoring systems can improve crop yields. Open access to reliable local weather forecasts can empower farmers to schedule planting and field fertilization. This increases their yield and reduces pressure on forestland that could otherwise be deforested for increased agricultural production. However, local weather forecasts can be unreliable as the range of the forecasts increases. DPI can support countries in improving the reliability of their existing systems by leveraging internationally available open data. This can then improve agricultural production.

Improved cereal yield can bring 55 million to 115 million people out of undernourishment by 2030. By increasing cereal production and use, we can improve health outcomes for all. And improved yields also generate economic benefits for smallholder farmers.[47] Smallholder farmers produce nearly a third of the world's food[48] and can stand to benefit by $30 billion to $70 billion in increased income in 2030 alone. That is equivalent to what smallholder farmers would make if they each completed between 19 and 41 days of additional work each year.

Open and community-led early warning systems (EWSs) can help to mobilize resources early to curb the impact of extreme weather events. Open-source EWSs can serve the dual purpose of preventing loss of life and mobilizing resources early to contain the economic impact of fast-moving disasters. For example, the 1988 Bangladesh cyclone, which is one of the worst tropical cyclones in the nation's history, was originally miscategorized as a low-intensity cyclone. The mislabelling of the cyclone reduced the time for at-risk individuals to take adequate safety measures, and increased the cost that families had to pay in the aftermath of the disaster.

In summary, climate-related DPI that enables carbon capture through trading, land-use planning, and weather monitoring systems can reduce carbon emissions, improve food security and prevent deforestation:

- By creating a robust ecosystem and increasing the volume of credits, end-to-end carbon credit monitoring and trading systems are estimated to reduce carbon emissions by an additional 0.8–1 $GtCO_2e$.
- Using near real-time deforestation alerts built on geospatial mapping, countries could save 115,000–230,000 hectares of forest cover in 2030 alone.
- With DPI, cereal production could rise by an additional 5–10 percent. Thi would improve food security and increase smallholder farmer income by $95–$170 per household across the shortlisted countries in 2030 alone.
- Increased food productivity can further improve nutrition efforts and bring an additional 55 million to 115 million people out of undernourishment by 2030
- In turn, improved climate mitigation and adaptation efforts can build human resilience to climate change and support a greener planet.

To avert the most devastating impacts of climate change, countries need to undertake large-scale and coordinated action. DPI can change how technologies are applied to combat climate change and assist LMICs in securing the lives and livelihoods of their people. By creating an underlying infrastructure that is built on open-source principles, DPGs and DPI can promote sustainable climate action. And with adequate investment, DPI can create the launchpad for future climate innovations.

JUSTICE

An estimated 1.5 billion people lack access to justice globally.[49] This is due to the limited capacity of local and national judicial systems, spiralling costs of litigation, arcane court procedures and lack of alternative mechanisms. An estimated 9 of 10 conflicts do not reach a dispute resolution system.[50] Individuals either do not know that legal remedies exist, or the costs of litigation are too high.[51] Lack of affordable, timely and corrective dispute resolution drives up the pendency of disputes—the period spent waiting for settlements— increases costs for businesses and slows economic development. Furthermore, the lack of alternative means of resolutions that are trustworthy and affordable limits justice to individuals who can afford it. This has the potential to decrease trust in the state and generate conflict.

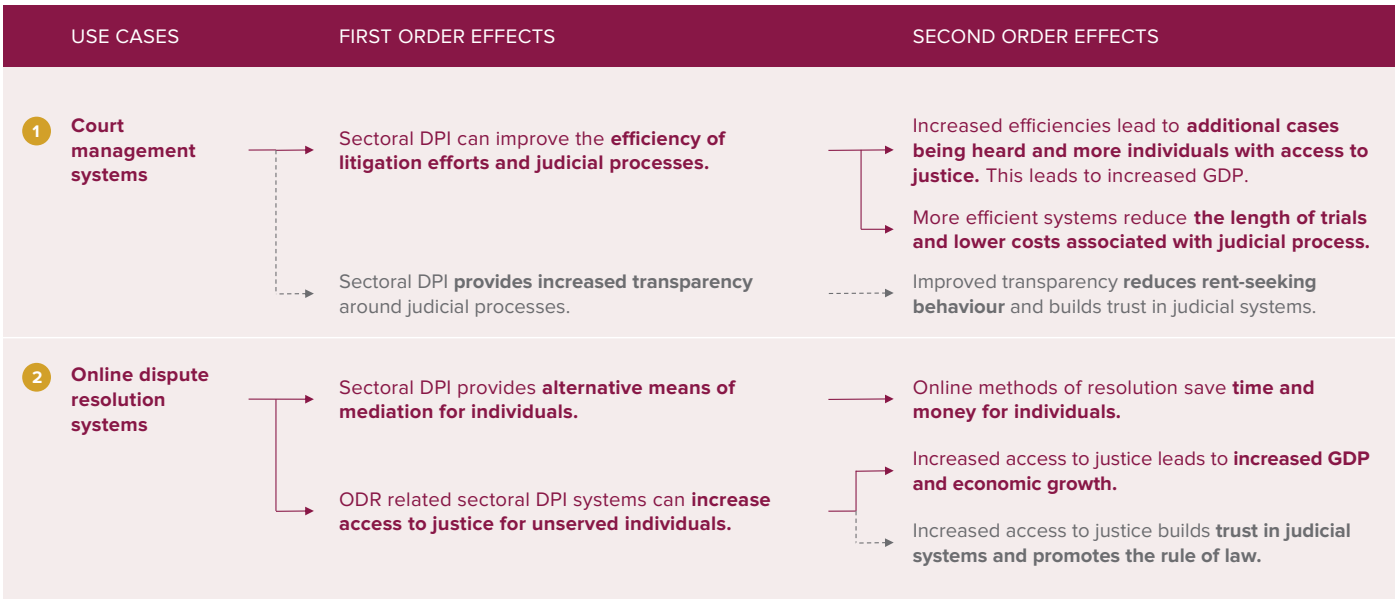
Countries have started to experiment with digital tools and technologies to spur judicial efficiency; however, they are still in the beginning stages. Transformation within the judicial sector is slow moving. The sector needs to maintain institutional trust and ensure individual rights, security and privacy. Countries like Rwanda[52] and Malaysia have adopted digital infrastructure to improve efficiencies, increase inclusion and accelerate throughput. Nonetheless, most countries still have a long way to go to transform their justice systems. A lack of funding prevents courts from expanding access. On average, countries spend less than 1 percent of their budget on judiciaries.[53] The bulk of this funding goes towards maintaining the status quo instead of upgrading their capacity and capability using digital tools and technologies.

DPI can support countries in building inclusive and resilient judicial infrastructure. While still in the earlier stages of adoption compared to sectors such as finance, several open and inclusive software solutions and DPGs are promising to reimagine how people interact with judiciaries. Together, these approaches can open the door for many more people to access judicial systems, to reduce the time and money required to resolve disputes, to speed up the disposal of cases, and unlock economic gains.

In the following sections, we detail the impact of DPI in (i) case and court management systems, and (ii) ODR systems, informed by existing DPG implementations such as MIZAN and Consumidor.gov.

Figure 7:
Potential impact pathways of justice-related DPI

Text in color highlights pathways that have been quantified.



Case management systems

Within formal judicial systems, considerable effort has been made to digitize cases and allow judicial officers and residents to easily track and manage disputes. By digitizing cases and linking them to judicial processes, CMSs are reducing the time required to dispose (or close) cases and increasing the throughput of judicial institutions by an estimated 10–16 percent.[54] With this increased speed of service delivery, comes improved enforcement of contracts and an increase in individuals accessing dispute resolution mechanisms.

Open and interoperable CMSs could lead to 6 million to 11 million more individuals accessing judicial forums in 2030 alone. This is an increase of 7–13 percent. A large proportion of these individuals are expected to be women, as more cases of gender-based violence and discrimination come to the formal dockets and are resolved through the system. For example, the State of Palestine implemented a CMS piloted by the UNDP, which saw more cases tracked and managed digitally.[55] Palestine had an increase in the number of cases heard on domestic violence and abuse.

Furthermore, CMSs also reduce the average duration of trials, as court procedures are digitized and made more transparent. This can lead to 19–31 percent time saving for individuals in the year 2030. Reduced trial length and associated savings, such as decreased expenditure on legal professionals and lower opportunity costs, are expected to lead to cost savings of $31 billion to $51 billion in the year 2030. This is equivalent to 10–16 percent of total legal costs.

CMSs also improve the transparency and accountability of judicial processes, reducing rent seeking and fraud. Studies show a direct correlation between reducing corruption and increased trust and political stability.[56] Increased trust in systems, along with increased access to justice and improved enforcement of contracts, has been shown to lead to improved economic output.[57] As such, increasing access to judicial systems is expected to add nearly $16 billion to $30 billion to national GDPs in the year 2030—an increase of nearly 0.1 percent.

Photo: Sawasya

Box 6

MIZAN for e-justice in Palestine

MIZAN is a digital case and court management system (CMS) developed by the Ministry of Justice in the State of Palestine in close coordination with the UNDP. The system is implemented in different courts in all areas of Palestine and is an end-to-end digital CMS. Its various features include notifications, calendars, integrations with card-based national ID, the option of making bank payments, and an e-portal for citizens and lawyers to track their case.

In addition to making bank transfer payments and being able to log in and see the status of their case, the behaviour of clerks, judges and prosecutors are logged. In this way, MIZAN greatly increases transparency and trust in the judicial system. Further data is gathered on procedural time for cases and is used in the resource management of judicial institutions. This helps to ensure similar quality and speed of processing across courts and case types.

While integration with instant digital payments and a national digital ID is still on the roadmap, MIZAN takes a DPI approach with national coverage of e-justice services and an open source, component-based technical architecture. It also integrates with Palestine's data exchange platform, based on Estonia's X-Road solution. This allows other institutions to improve their e-services using data from MIZAN.

Online dispute resolution

Rates of adoption for alternate, ODR mechanisms are increasing across LMICs. Traditional judicial systems are constrained by physical infrastructure and this prevents people from accessing timely resolution. ODR systems provide an alternate, mediated source of dispute resolution for residents and enterprises that is timely and costs less.

Data suggest that less than 10 percent of individuals who face a civil legal challenge, attempted to resolve their disputes through a formal dispute resolution system. Of the remaining 90 percent, one in five individuals seek out legal advice, but do not enter into any formal proceedings afterwards.[58] ODR systems can increase overall access to dispute resolution mechanisms and provide professional support and guidance for a more equitable and transparent dispute resolution. ODR platforms can provide access to the judicial system to an estimated 18 million to 25 million more people in the year 2030, an increase of 21–30 percent as compared to current systems. By speeding up the resolution of conflicts, open ODR systems can also lead to an increase in economic output of an estimated $65 billion to $90 billion in the year 2030.

ODRs can support the formal judicial apparatus by reducing pendency of cases, decreasing costs and saving time. Nearly two-fifths of the individuals who access formal resolution mechanisms consider a third-party mediator to resolve their conflicts.[59] By resolving disputes for such individuals, ODRs can save these individuals $7 billion to $10 billion in the year 2030. It can also move their cases through the formal judicial system more quickly. Moreover, ODRs promote a healthy business environment by reducing the uncertainties inherent in legal processes and expediting resolutions by nearly 40–60 percent.

Photo: UNDP / Paula Mariane

Box 7

Consumidor.gov platform in Brazil

Consumidor.gov is an online alternate dispute resolution platform for consumers and enterprises to mediate disputes quickly and cost effectively. Consumers can directly communicate with traders to resolve their challenges within a stipulated period of 10 days.

While the platform is voluntary, it is actively encouraged by the state as an alternative form of resolution and has gained widespread trust and appeal. In 2022 alone, it received nearly 1 million complaints, and about 77 percent were successfully resolved through the system.

In summary, open and inclusive approaches to CMSs and ODRs can increase access to judicial systems, provide time and cost savings, and spur economic growth.

- DPI can increase access to justice in LMICs by an additional 28–42 percent by 2030. This is equivalent to bringing 23 million to 35 million more people into state-backed dispute resolution mechanisms.

- Increased judicial efficiencies and access to alternative means of mediation can lead to additional time savings of 19–31 percent in the year 2030, and save costs worth $38 billion to $60 billion.

- Open and inclusive systems can increase access to justice and raise GDP by an additional $82 billion to $117 billion, equivalent to 0.4–0.6 percent of GDP in the year 2030.

- Moreover, these systems can spur improvements in business climate, reduce conflicts and lend to a more just, peaceful and trustworthy future.

Free and fair access to justice is a primary principle of public governance and is foundational to any social contract. DPGs and justice-related DPI can lead to widespread change in how people perceive and use judicial services. Furthermore, by creating open, secure and transparent systems, justice-related DPI can help reimagine the relationship between a state and its people.

V. RECOMMENDATIONS

This study has reaffirmed that DPI is not a 'nice-to-have'. It is a crucial tool to ensure that digital improves public service delivery, and catalyses economic, social, and broader human development. Its return-on-investment and multiplier effects are potentially enormous – with the successful implementation and scaling of DPI having scope to transform the lives and livelihoods of millions of people around the world.

Although this analysis only quantified the potential of DPI in three sectors - economic growth in finance, support to climate adaptation and mitigation efforts, and increased access to justice – DPI can play a considerable role in many other sectors, and across all 17 of the Sustainable Development Goals set out in the 2030 Agenda. Recognising this, UNDP has identified the below cross-cutting recommendations to support governments, civil society, funders, and multilateral institutions in exploring the potential of DPI in the above three areas – and more broadly.

Shape a local digital ecosystem to drive the development of DPI. DPI cannot sustain or flourish in a vacuum, it requires the combined efforts of the public and private sectors – and civil society. Governments should shape an enabling environment of policies and regulation to encourage digital development, whilst the private sector (and other innovators, including in academia) should be supported to build the skills, knowledge, and connections to develop DPGs. Open-source solutions, including those accredited as DPGs, are the modular bricks DPI rests upon. If there are too few, it limits choices for governments, and this makes proprietary solutions favourable. If the community around the existing open-source solutions is too shallow, there will not be sufficient expertise to ensure the solutions are implemented responsibly. And if the solutions are not adequately supported and funded, governments might not trust they will be there for the long-term. Therefore, to support DPI within sectors, we must support downstream development until the business models of open-source solutions have matured.

Strengthen the capacities and capabilities of the public sector for implementation and scaling of DPI within sectors. The above downstream support is important to ensure there is an ecosystem of applications to choose from. But technical solutions are not enough if there are not informed adopters. DPI requires national strategies and actions to develop digital government services that are based on principles of openness, interoperability and inclusivity. In addition, governments need capacity and skill to reduce their dependence on proprietary solutions delivered by IT vendors and move over to open-source solutions. We must develop government ICT and project management capacity so countries can effectively study, use and amend open digital solutions to fit the national context. More broadly, it requires reshaping processes, workflows, and other approaches to embrace the potential offered by open-source solutions.

This includes ensuring procurement practices are aligned with open-source offerings, and that civil servants are trained on areas such as problem definition – and to work collaboratively with the private sector.

Promote increased knowledge sharing and technology exchange among countries. As with anything, setting the right team is crucial. The most competent people are often those who have recently worked on the digital transformation of a particular sector, and they have essential bilateral, technical insights to share. However, this kind of knowledge sharing is intermittent in digital development. To accelerate the uptake of DPI, we need increased coordination between countries, technical communities, donors and multilateral organizations. This will help to scale up code and software, and foster partnerships and communities of expertise that allow us to carry the learnings from each successful implementation from country to country – including identifying what has, and has not, worked. In addition, knowledge sharing should also be promoted within countries. Innovators are often unfamiliar with the intricacies and realities of the public sector (and struggle to build relationships due to the churn of civil servants) - whilst civil servants may not be alert to the commercial and other drivers of private-sector innovators. Finding oportunities to shape this collaboration is crucial.

VI. ANNEX

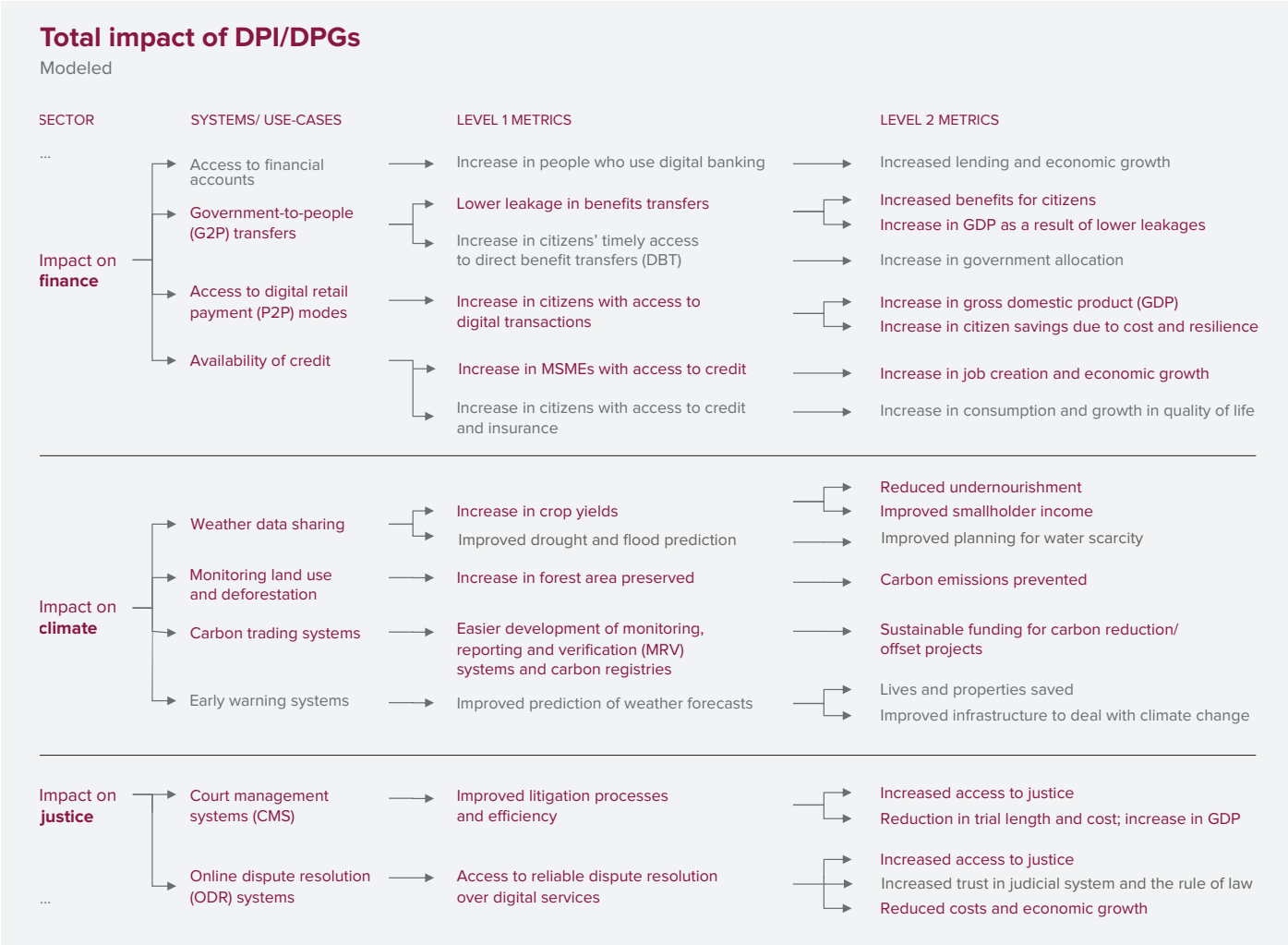
Methodology

The overall modelling applies a mixed-methods approach. The research team used bottom-up estimation methods for deriving the impact figures and a top-down approach for triangulation. The model makes use of impact pathways. Each represents the logical series of steps, or mechanisms, through which a DPI or DPG intervention creates real-world impact. Depending on the impact pathway, the estimates span a wide range of economic, ecological, social and human-centric metrics. These include growth to GDP, improved access to credit for MSMEs, reduced carbon emissions, improved access to justice, increased income for smallholder farmers, and better nutritional outcomes, among others.

Model objectives: With this exercise, the study aims to model the incremental impact of taking an open and inclusive approach compared to the next-best plausible alternative (proprietary and closed systems) for the LMICs until 2030. In sectors such as finance, the next-best alternative includes digitally delivered services (for example, real-time point-of-sale payment systems such as those enabled by Mastercard). For justice, the next-best alternative is more likely to be business-as-usual systems and processes (mainly offline, or in some cases, specialized dispute resolution services provided by companies such as SAMA in India or Consumidor.gov in Brazil).

Model constraints: The study aims to estimate the incremental impact of sector-related DPI over non-sectoral solutions. But the estimates are limited by the current availability and use of DPGs. DPI is also recent and, in some cases, not rigorously evaluated. This further limits the available evidence. To address this, the research team used reasonable proxies to estimate the parts of the market where DPI has yet to be deployed, and presents the potential DPI has for impact. For example, findings suggest that approximately one in five individuals who face a civil legal challenge and do not go through the formal legal system will still look for legal advice.[60] Thus, these individuals are assumed to be potential adopters of ODR. Due to similar limitations in the availability of evidence, two explicit choices are made: (i) the study avoids false precision by excluding nuances not backed by evidence, and (ii) when evidence is limited, the research team identified a lower threshold for assumptions, to ensure the estimates are conservative. To develop the model, the team deployed a four-step process.

Exhibit 1:
Impact pathways for sectoral DPI (non-comprehensive)



Step I

Identify and prioritize sector-specific impact pathways

For each of the three sectors, the study identifies a long list of potential impact pathways (Exhibit 1). These pathways are rooted in existing and well-established literature and are widely recognized by subject matter experts.

For example, easier G2P payments can translate into macroeconomic benefits. This happens through social protections and services that are less costly to administer, more accessible and delivered more effectively. These improvements to administering social safety nets are essential during crisis and economic shocks that require rapid and reliable response from public institutions. Similarly, adopting DPI-based national ODRs for civil litigations can expand access to justice to people who are excluded from the formal judicial system, while providing a faster and cheaper alternative to others. These changes are likely to deliver better systemic judicial outcomes as well as macroeconomic impacts for all.[61] Likewise, linking carbon markets using a DPI-based platform can create consistent and transparent carbon accreditation. This, in turn, can spur greater cooperation in carbon markets and carbon offset projects, and unlock additional climate financing.[62]

From this longer list of impact pathways, eight systems or use cases are selected for further modelling (Exhibit 2). This choice of use cases was based on three factors: (i) their impact potential, (ii) the presence of real-world examples that would enable assumptions that are rooted in evidence, and (iii) the directness and attributability of impact to the digital solution (a greater degree of separation implies more assumptions and therefore less reliability).

Exhibit 2:
List of sectoral use cases based on the three prioritized sectors

FINANCE	CLIMATE	JUSTICE
Government-to-people (G2P) payments	Agriculture and early warning systems (EWS)	Court management system (CMS)
Retail (P2P) payments	Forest watch	Online dispute resolution (ODR)
Access to credit	Carbon credits trade	

Step II

Build detailed models for eight use cases

The study conducts four types of analysis to develop models for the shortlisted use cases.

First, the research team defined a logical mathematical relationship between the DPI and the impact to be estimated. For example, to estimate the impact of easier retail payments on GDP growth the study used the following:

Exhibit 3:
High-level mathematical formula for estimating the GDP unlocked through retail payment related DPI

Interpretation: Three key levers drive the increase in GDP through DPI in the retail payments space. The increased economic activity is enabled by an increased volume of transactions. The savings is enabled by reduced transaction costs. The increased income is due to greater resilience to economic shocks (easier access to savings and remittance). All three levers can be expressed as a function of retail payments adoption until 2030. The next step describes this adoption in greater detail.

The study then forecasts the estimated impact from 2022 to 2030 based on an adoption curve for the DPI within sectors. The study uses a time series of the expected growth trajectory. This is based on the likely speed and scale of adoption of the DPI by unaddressed beneficiaries. Sigmoid functions are applied to mimic an S-shaped adoption curve for individuals and institutions (Exhibit 4). This is because the adoption of new technologies mimics an S-shaped curve.[63] The study assumes similar behaviour among

countries and institutions (such as judicial systems). This is further driven by reduced barriers to adoption and the network effects of digitalization. The research team looked to relevant proxies to estimate the duration required to achieve population scale adoption for these technologies. These proxies cover adoption by **individuals** (e.g., adoption of internet and digital payments, services such as UPI in India and PIX in Brazil), **businesses** (e.g., growth in Net-Zero emission pledges), and **governments** (e.g., growth in e-governance).

Exhibit 4:
General shape of the adoption curve for sectoral DPI technologies among people and institutions

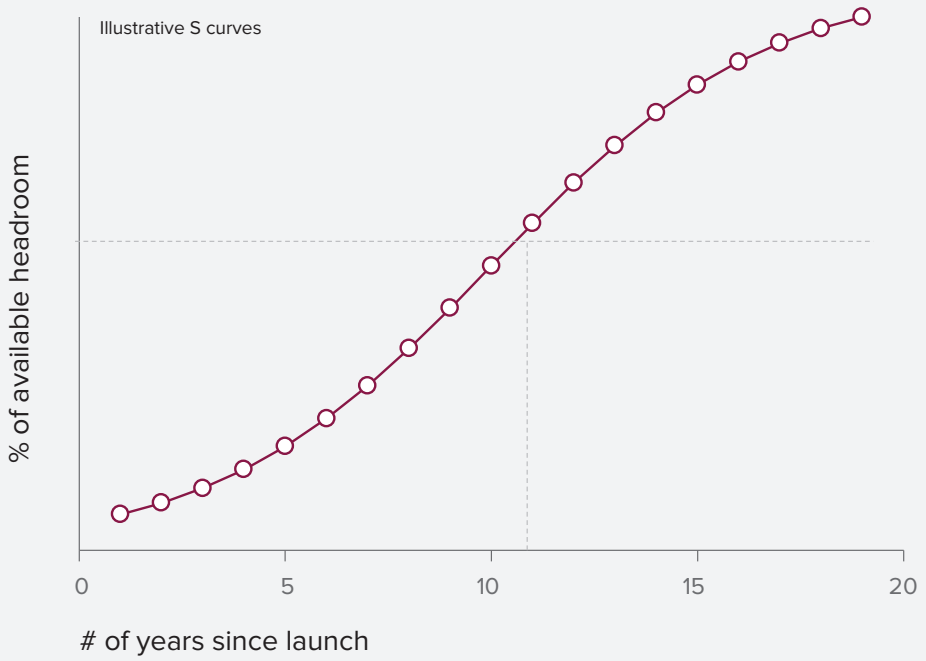
$$Y = \frac{1}{1 + e^{-k(x-m)}}$$

Where;

Y is the adoption level.

k and m are parameters of the curve defined based on number of years required to achieve near saturation for the technology.

Headroom refers to part of the market that is currently unrealized and presents potential for impact by the DPI/DPG.



Third, the incremental impact was estimated, i.e., the impact of DPI vs. that of the next-best plausible alternative. This was achieved using data from real-world proxies for both the DPI and the next-best alternative. For some use cases, such as the use of CMSs, business-as-usual is largely offline, and thus the incremental impact—and the resulting acceleration in adoption rates—can be attributed mostly to digitalization led by DPI approaches. For other sectors, such as in finance, ample proprietary based digital solutions exist. Therefore, the study estimates the incremental impact over and above those existing digital solutions.

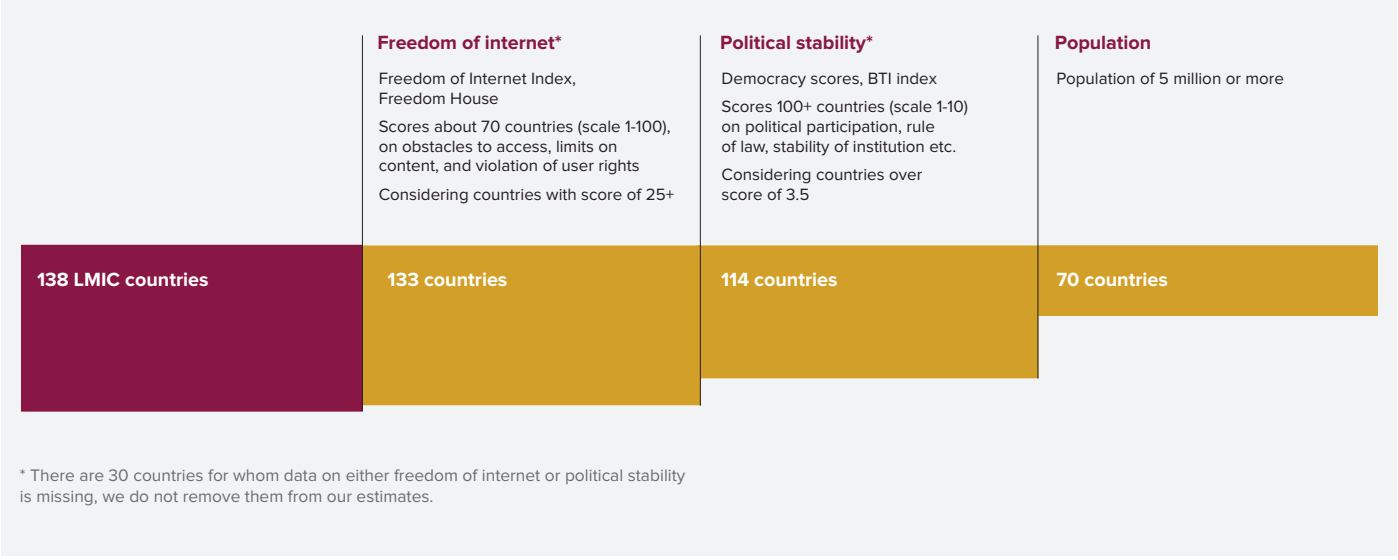
Example 1: To estimate the impact of the DPI that provide credit to MSMEs, the research team calculated the additional number of MSMEs that have access to credit compared to business-as-usual. The research team also measured the resulting improvements in revenue and increases in GDP levels. [64] This improved access to credit for MSMEs also creates subsequent positive externalities, including enterprise and revenue growth. It also has knock-on effects of generating employment opportunities and greater household consumption, as well as increasing overall GDP.

Example 2: The impact of reliable localized weather forecasts on food security and smallholder income was calculated based on estimates of improved agricultural yield. Most farmers in LMICs, and especially smallholder farmers, do not have access to reliable weather forecasts for their location. When available, these forecasts are often limited by the quality and capacity of the meteorological stations in the area and the forecasting algorithms used. The lack of accurate short- and long-term forecasting information restricts farmers from maximizing their productivity. To estimate the impact of weather monitoring and information systems, the team compared business-as-usual growth for cereal crops against growth measured following the introduction and adoption of local weather monitoring DPGs. With DPGs and similar open and inclusive solutions, farmers can better plan their crop cycles and protect against pest cycles and weather shocks.[65, 66] This may increase yield, improve food security for populations facing undernourishment and lead to growth in income for smallholder farmers.

Example 3: The impact of DPI on ODR mechanisms is determined based on the additional number of individuals who access ODR systems through a nationally provided ODR. This increase is created by easier access, lower costs and the greater trust instilled by national ODR DPI as compared to proprietary and siloed ODR systems. To estimate this impact, we measured the adoption of ODR systems in the business-as-usual scenario (i.e., without the presence of a nationally provided ODR powered by DPI) to make our comparison against. We used a year-over-year growth rate that reflects the historical growth rates for available ODR platforms. This compound annual growth rate (CAGR) will likely decline over time, but given the small starting base, we assume it will remain at this rate throughout our short-to-medium term forecast horizon of eight years. Alternatively, in the scenario with a nationally provided ODR DPI, we assumed a likely target segment for the ODR system: those who face a civil challenge and do not currently go through a formal legal system but actively look for legal advice.[67] It is important to note the absence of any real-world implementation of ODR at a national scale. This therefore calls for an educated and supported assumption about the number of individuals who may eventually use ODR systems.

Lastly, the study combines the output from the preceding steps and projects impact across the LMICs. To achieve a reliable projection, a shortlist of 70 countries from 138 LMICs[68] were identified using three criteria: (i) freedom of internet, (ii) socio-political stability, and (iii) a reasonable population base (Exhibit 5). This smaller set allows for greater reliability of our assumptions.

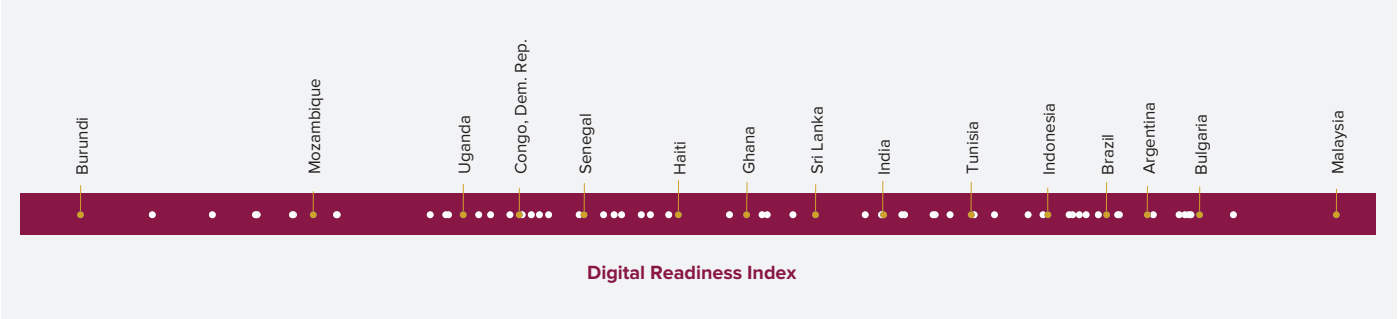
Exhibit 5:
Shortlisting of 70 LMICs for impact modelling



* There are 30 countries for whom data on either freedom of internet or political stability is missing, we do not remove them from our estimates.

The study pinpoints three sector-specific segments for these 70 prioritized countries. These segments are based on overall readiness for DPI, as well as a combination of **digital readiness** and **sector-specific criteria**. Digital readiness ensures the availability of necessary infrastructure required to adopt a DPI-based technology (for example, access to the internet may be required for sharing data on weather patterns and pest cycles with smallholder farmers). Similarly, sector-specific criteria assess whether there are adequate enabling conditions for the country to successfully adopt and benefit from the DPI. For example, a country actively making efforts to reduce its carbon footprint is more likely to link carbon markets using a DPI-based platform than is a country that is not making these efforts. As a result, the segments represent a relatively homogenous group of countries that will likely have similar adoption rates for DPI (Exhibit 6 presents countries based on their digital readiness index). These groupings are used to scale the estimated impact in the LMICs in that sector:

Exhibit 6:
Selected LMICs based on their digital readiness criteria



For example, **Category A** countries have supportive ecosystems for the DPI, indicating a likelihood of fast adoption. However, in many cases, these countries may already have advanced proprietary solutions that are deeply embedded and limit the potential for growth. On the other hand, **Category B** countries include those that have enabling ecosystems along with a few non-sector specific solutions. These present greater opportunities for growth in DPI within sectors. However, the speed of adoption in these countries could be slower than for those in Category A. **Category C** countries present the highest potential for growth of DPI within sectors. However, the adoption here could be slowest due to limitations in the enabling digital ecosystem.

Our readiness criteria was defined using composite indexes. **Digital readiness** was based on ecosystem metrics, people and citizen related metrics, and business-related metrics. Similarly, among sector readiness metrics, **financial readiness** includes access to and growth in individuals with bank accounts. **Climate resilience** included CO_2 emissions (per unit of GDP), state policies on renewable energy, and agricultural productivity. **Justice effectiveness** included access to civil justice, availability of dispute resolution mechanisms outside of the state justice system, and the effectiveness of criminal adjudication.

Step III | Refine assumptions and triangulate results

Finally, to ensure the quality and reliability of the model, the study refers to numerous studies, white papers, and reports by multilateral and bi-lateral organizations. It also draws from more than a dozen in-depth expert interviews. The team then began the process of refining by **stress-testing the logic and framing of impact pathways.** We then moved on to multiple rounds of **refining our assumptions** to ensure they are rooted in real-world evidence or are developed from established sources. In cases where no prior evidence exists, the research team considered a reasonable proxy instead, and assumptions are verified by subject-matter experts. Finally, **the team triangulated the overall estimates** by sense-checking the values using (i) findings from independent studies and (ii) input from sectoral experts. These steps allowed us to establish the impact of DPI across the listed impact pathways with a high degree of confidence.

Key notes

The study quantifies the benefits of developing and adopting DPI within sectors along eight separate pathways across three sectors for 70 LMICs, as compared to baselines defined by their current trajectories. This analysis and methodology allowed the research team to estimate the incremental impact of DPI within sectors by 2030 across a series of impact metrics. These begin with the more efficient and effective delivery of public services, and end with the reduction of undernourishment and carbon emissions while growing LMIC economies. The results demonstrate both meaningful improvements in the lived experiences of some of the poorest and most vulnerable segments of society and the tangible benefits of cooperation and collaboration across countries and communities in advancing DPI.

The reported results are conservative. As mentioned above, the methodology errs on the side of caution and prefers to make evidence-backed assumptions instead of expanding the scope and number of impact pathways quantified. This ensures that impact statements are specific to the analyzed pathways and limits the degree of aggregation across sectors and countries. Nonetheless, the pathways modelled likely represent the largest proportion of the total potential impact DPI can have in these three sectors as known today. It is unreasonable to predict how these sectors will structurally change with the adoption of DPI. These solutions may spur rapid innovation or unexpected outcomes that differ significantly from the historical trajectories the study has used to inform the forecasts.

This report looks to pave the path for informed deliberation and further analysis of DPI and the changing features of public governance across sectors. The numbers presented are rigorously grounded real-world estimates of the potential of DPI within sectors. The analysis suggests that there is more of an upside to investing in DPI than there are risks. Investment in the three prioritized pathways of open credit, digital retail payments, and penetration of G2P systems can grow LMICs' economies, expand access to formal judicial channels and reduce carbon emissions. If designed and implemented with principles that ensure inclusivity and keep human rights at the centre, these DPI will be integral to successfully transitioning our commercial, social and civic lives.

LIST OF EXPERTS

ORGANIZATION	NAME	DESIGNATION
Agami	Sachil Malhan	Co-Founder
Agami	Keerthana Medaramelta	Curator
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Setu	Sahil Kini	CEO
Setu	Lizann Fernandez	Director, Strategy and Business Operations
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UNDP	Leticia Guimaraes	Climate Specialist
UNDP	Omar Zamrag	Climate Specialist
UNDP	Sharon Wekesa	Climate Specialist
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UNDP	Dany Wazen	Justice Advisor
UNDP	Leanne Mckay	Justice Advisor
UNDP	Sarah Mccoubrey	Justice Advisor
UNDP	Parvathy Krishnan	Data Scientist Lead
UNDP	Swetha Kolluri	Head of Experimentation
UNDP	Aiaze Mitha	Senior Advisor Digital Finance
World Resources Institute	Fred Stolle	Deputy Director, Forests

LIST OF COUNTRIES EXAMINED

COUNTRY

Algeria
Angola
Argentina
Azerbaijan
Bangladesh
Belarus
Benin
Bolivia
Brazil
Bulgaria
Burkina Faso
Burundi
Cameroon
Colombia
Congo
Costa Rica
Côte d'Ivoire
Democratic Republic of the Congo
Dominican Republic
Ecuador
El Salvador
Ethiopia
Ghana
Guatemala
Guinea
Haiti
Honduras
India
Indonesia
Iraq
Jordan
Kazakhstan
Kenya
Kyrgyzstan
Lao PDR
Lebanon
Liberia
Madagascar
Malawi
Malaysia
Mali
Mexico
Morocco
Mozambique
Nepal
Nicaragua
Niger
Nigeria
Pakistan
Papua New Guinea
Paraguay
Peru
Philippines
Romania
Rwanda
Russian Federation
Senegal
Serbia
Sierra Leone
South Africa
Sri Lanka
Tanzania
Thailand
Togo
Tunisia
Türkiye
Uganda
Ukraine
Uzbekistan
Zambia
Zimbabwe

ENDNOTES

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3 The 70 countries examined account for more than two-thirds of the total population in LMICs. The income-level classifications are based on the World Bank's 2022 figures.

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8 Consumidor.gov is an ODR solution in Brazil to support consumer disputes.

9 To improve the precision of our estimates and assumptions, the research team shortlisted countries based on their political stability, access to free internet and a reasonable population base. Please see the annex for a more detailed explanation of our methodology.

10 Finance-related use cases include open government-to-person payment systems, open retail payment systems and open credit networks. In the climate sector, they include open monitoring systems for weather systems, open land-use monitoring systems, and open carbon markets and verification systems. While in the justice sector, they include open CMSs and open ODR mechanisms.

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40 Unlike other systems within the study, a common MRV and trading platform is still under development through the UN Carbon Cooperation platform. It is still too early to accurately estimate the impact that similar DPI could have on climate mitigation

efforts. However, given the importance of creating such an infrastructure, the authors made an informed, but conservative, calculation of its impact based on proxies. When implemented, the platform could unlock even higher impacts than assumed.

41 This assumes carbon prices of $30–$50 per metric tonne till 2030.

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