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BUILDING THE FUTURE OF QUALITY INFRASTRUCTURE

T20 JAPAN 2019

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About the T20

The T20 is one of the G20's engagement groups, where representatives of different civil society stakeholders take their demands and proposals to G20 countries. It gathers think tanks and leading experts from around the world to produce concrete policy recommendations. During 2019, the T20 was co-chaired by the Asian Development Bank Institute (ADBI), the International Institute for Monetary Affairs (IIMA), and the Japan Institute for International Affairs (JIIA).

More information here: https://t20japan.org.

Introduction

Infrastructure is crucially important to foster economic development and prosperity of countries. It contributes to higher productivity and growth, facilitates trade and connectivity, and promotes economic inclusion. Infrastructure is also a key driver to achieve the Sustainable Development Goals (SDGs). For example, the expansion of electricity distribution networks will improve access to energy in urban and rural areas. Transport infrastructure will connect people, facilitate the movement of goods, support trade, thus contributing to a country's economic growth. Water infrastructure will improve people's health through better access to clean water and by managing scarce resources in a suitable manner.

In line with the increasing trend of population growth, migration, and urbanization, the demand for infrastructure development is also rising. McKinsey has reported that from 2016 to 2030, there will be a need to invest on average $3.3 trillion annually to keep pace with projected growth, of which, 60% is accounted for by developing countries. Furthermore, the Asian Development Bank has estimated that $1.7 trillion is required every year to maintain rates of growth sufficient to alleviate poverty in the Asian region, including investment needs for climate change mitigation and adaptation. As the population of developing countries keeps growing, it is imperative to build high-quality infrastructure that is sustainable and resilient, increases business activities, creates new employment, empowers gender participation, narrows income disparities, and ensures universal participation in the successful implementation of the SDGs.

Based on this recognition, all stakeholders, including the Group of 20 (G20) member countries, have been working together and are committed to provide quality infrastructure to meet the global infrastructure demand. The G20 believes that equal emphasis should be placed on the importance of closing the infrastructure finance gap and assuring quality infrastructure investments, which could boost economic activities and create positive spillover effects in neighboring communities and regions. Such infrastructure investments should also contribute to strengthening resilience against climate change, natural disasters and disasters caused by humans, as well as existing infrastructure obsolescence.

Building on this momentum, under Japan´s G20 presidency in 2019, Think20 (T20) addressed a broad range of issues to contribute to the G20 policy discussions within T20's Task Force 4: Economic Effects of Infrastructure Investment and its Financing. T20 policy briefs were produced based on rigorous analysis and discussions during the task force meetings.

Three major themes encompass the work presented in this collection of policy briefs and discussion held at the T20 summit and its associated events.

- Maximizing the impact of quality infrastructure investments by addressing the concerns of sustainability in terms of financing, the rate of return to stakeholders, and economic efficiency

- Preserving and enhancing natural capital in the development of quality infrastructure to support the 2030 Sustainable Development Goals, the Paris Agreement, and the Aichi Biodiversity Targets
- Developing resilient strategies for infrastructure development, especially in transport-related infrastructure

Countries need policy and institutional frameworks to deliver on sustainable infrastructure. Such frameworks should include coherent growth strategies and well-articulated investment plans, comprehensive infrastructure plans, sound project prioritization frameworks, and procurement policies that integrate sustainability criteria. This is analyzed by Bhattacharya, Nofal, Krueger, Jeong, and Gallagher in *Policy and Institutional Framework for Delivering on Sustainable Infrastructure*. The G20 countries should build a robust upstream policy and institutional framework for delivering on sustainable infrastructure. Support from development finance institutions is needed to build sound platforms to bring together all relevant stakeholders to help attract and evaluate investments in sustainable infrastructure.

The demand for infrastructure keeps increasing in the era of urbanization. The policy brief, *The Infrastructure Nexus: From the Future of Infrastructure to the Infrastructure of the Future* by Buchoud, Douglas, Gastineau, Koning, Mangin, Poinsot, Silvain, and Soubelet, points out that recoupling economic growth and social progress is critical, ahead of a resource-intensive upcoming "global infrastructure tsunami." The policy brief proposes to foster a fast-track approach connecting infrastructure development, urbanization governance, Earth System theories and corresponding research programs, and large-scale distributed research infrastructure. It raises a pathway for "infrastructure for growth" investments to support systemic change through the valuation of natural capital and ecosystem services.

Addressing infrastructure needs in Asia, Sawada's policy brief, *Infrastructure Investment Needs and Sources of Financing,* suggests that governments can increase public investment in infrastructure by raising more revenues, reorienting spending, borrowing prudently, as well as adopting innovative approaches such as "land value capture." Also, expanded private financing of infrastructure investments is indispensable. Particularly, public–private partnerships can help fill the financing gap by allocating risk to the party best able to manage it. The success of this approach depends on how governments can select the corresponding projects, on the engagement of qualified private partners, and instituting appropriate processes.

Runde's policy brief, *Pursuing Quality of Infrastructure for Sustainable Growth* presents proposals on how to bridge the infrastructure financing gap. He urges G20 countries to mobilize their domestic resources to finance their infrastructure needs. For that, countries should prioritize investments to meet local needs and review the procurement processes accordingly. In this regard, international guidance is needed to set up renewed universal standards with the help from multilateral development banks.

Addressing the vulnerabilities of climate change and the importance to preserve natural capital, the policy brief, *Building Resilient Infrastructure Systems* by Evans, Godart, Krieger, Kovarik, Mimram, and Palhol explains how citizens, cities, and regions, the business sector, and governments should avoid exacerbating threats to infrastructure systems, especially in transport infrastructure. In order to ensure availability, quality, safety, and security of transport infrastructure and networks, a long-term development strategy is needed, along with the ability to build on adverse events.

Transport system owners and operators are compelled to integrate growingly complex challenges within decision-making processes. This includes the impacts of climate change and extreme weather, natural disasters and disasters caused by humans, as well as cyber threats and the structural aging of infrastructure facilities. The policy brief proposes (i) developing systematic resilience strategies for infrastructure and transport systems at the G20 level; (ii) establishing policies and mechanisms for exchanging knowledge and experiences among the G20 countries; (iii) promoting a sociopolitical-based approach to resilience to facilitate the acceptability of infrastructure projects at local and global scales; and (iv) setting-up a common methodology for measuring the success of resilience strategies.

The policy brief, *Quality Infrastructure Investment: Ways to Increase the Rate of Return for Infrastructure Investments* by Yoshino, Hendriyetty, and Lakhia, suggests that the infrastructure financing gap issue can be solved if countries can quantify the positive spillover effects of infrastructure development and use it as a leverage for project development. To maximize the spillover effects, projects should fulfil high-quality infrastructure criteria, be well designed, connected to the sources of the economy, and supported by public policies that enable new businesses to be created and benefit from the infrastructure. The positive spillover effects can be measured through the increase (incremental) of tax revenues from the affected regions or areas of infrastructure projects. This incremental value can then be proportionally shared between the government and infrastructure investors.

The policy brief, *Sustainable Infrastructure to Secure the Natural Capital of the Amazon* by Barros, McKenney, Bhattacharya, Nofal, Nobre, Gallagher, Krueger, and Lovejoy notes that sustainable infrastructure should assess the importance of the preservation of the natural capital. Large-scale traditional infrastructure could be a major driver of deforestation and ruin critical natural capital, such as forests and biodiversity. The brief proposes that sustainable infrastructure policies and guidelines fully incorporate social and environmental costs for project selection and preparation to promote conditions for quality and sustainable infrastructure investment by: (i) advancing research and commitments for deforestation-free development models; (ii) promoting upstream planning that fully incorporates social and environmental risks and costs into project pipeline development and consider the role and value of ecosystem services and nature-based solutions; (iii) establishing common financing principles, standards, and frameworks that minimize ecological footprints through land and water conservation, biodiversity enhancement, and healthy ecosystems; and (iv) developing portfolios of small-scale, nature-based infrastructure projects in the Amazon that support local development and poverty alleviation, with conservation.

In the policy brief, *Disaster Mitigation Social Resilience: From Humans to Infrastructure*, Yamanaka urges that preventive diplomacy plays a more significant role in preventing further damage from natural disasters and avoid human casualties. Therefore, preventive actions for less human error should be taken. The policy brief proposes that infrastructure should be designed as a disaster mitigating facility, and at the same time, use it for other purposes, such as for tourism.

As mentioned in the G20 Osaka Leaders' Declaration, it is important to maximize the positive impact of infrastructure. In doing so, it also necessary to integrate environmental and social considerations and build resilience against, for example, natural disasters, into the infrastructure development.

Furthermore, business as usual regarding infrastructure for growth and development is no longer viable in an era of rapid urbanization, unsustainable levels of natural resources consumption, and systemic transformations of the climate or biodiversity. These concerns, in particular the need to refine infrastructure financing and diversify infrastructure sources of investments while addressing systemic change affecting growth opportunities, were also reflected in productive task force discussions.

In addressing the problem of the financing gap for infrastructure investment, governments can look into assets such as land to provide new financing leverage. Yakunin, Kotegawa, Ava, Cruz-del Rosario, Psarrakis, Chkoniya, Vilisov, Xin, and Barbero in the policy brief, *Economic Effects of Infrastructure Investment from Land-based Financing* propose that land-based financing is used as an investment tool by governments to generate income from private land and then redistribute it through private actions with stakeholders. However, reforms in many areas including taxation and decentralization are needed.

The task force experts have converged in assessing that infrastructure is a key driver to achieve the SDGs. Therefore, in preparing infrastructure projects, the goals and benefits of each infrastructure project should be in line with the SDGs, such as access to clean water. SDGs are global targets that should be achieved by nations. However, the achievement of the SDGs at the country level should be regularly monitored and evaluated. Appropriate process and ramp-up indicators should be designed to stimulate the motivations of countries and stake holders. This topic is discussed by Oki in his policy brief, *Global Targets on Drinking Water.*

Infrastructure finance is a topic that has been high on the G20 agenda and other major forums for over a decade. The problems are not only the availability of funding itself. Project preparation, assessment of a project's viability, land acquisition, change of politics and lack of governance, poor or fragmented evaluation procedures, lack of ex ante assessment of natural disasters, and climate change impacts are many critical factors. The G20 Osaka Leaders' Declaration endorsed the T20 comprehensive recommendations to develop quality infrastructure. We view as a priority for the T20 in the future to further value the potential of infrastructure development and investment to build a greater convergence between the G20 agenda and the SDGs' Agenda 2030, and narrow finance gaps accordingly.

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CHAPTER 1

POLICY AND INSTITUTIONAL FRAMEWORK FOR DELIVERING ON SUSTAINABLE INFRASTRUCTURE

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Abstract

We propose that the Group of 20 countries build a robust upstream policy and institutional framework for delivering on sustainable infrastructure. Specifically, such a framework should include coherent growth strategies and well-articulated investment plans, comprehensive infrastructure plans, a sound project prioritization framework, and procurement policies that integrate sustainability criteria. Additionally, the Group of 20 countries should work with development finance institutions to build sound platforms to bring together all relevant stakeholders to help attract and evaluate investments in sustainable infrastructure.

Challenge

Infrastructure has been a central agenda item of the Group of 20 (G20) due to its key role for economic growth and development. The efforts of the G20 in 2018 focused on mobilizing infrastructure financing such as through the *Roadmap to Developing Infrastructure as an Asset Class*. Despite the cruciality of scaling up financing, equal attention is required to ensure the quality of infrastructure investments given their large economic, social, and environmental impacts. In addition to locking in greenhouse gas emission patterns for decades, infrastructure can degrade natural lands, drive deforestation (thus accentuating climate change), place greater demands on water resources, and contribute to the deterioration of ecosystem services. Managing these impacts while scaling up investments is the central challenge of infrastructure investments. In the Amazon, 95% of all deforestation occurs within 5.5 kilometers of a legal or illegal road. For example, new roads in central Africa have been linked to a loss of two-thirds of all forest elephants (Laurance and Burges 2017; Barber et al. 2014). Development trends for energy, mining, agriculture, and urban expansion could cumulatively impact 20% of remaining natural lands globally, doubling the extent of land converted in Latin America and tripling it in Africa (Oakleaf et al. 2015).

The social impacts of poorly planned infrastructure projects also threaten sustainable development. Some infrastructure projects have an adverse impact on people by not providing access and benefit-sharing of infrastructure projects, and can entail relocating large populations of people from their homelands. Indirectly, losses in ecosystem services can threaten their livelihoods and trigger social conflict. In a study of social conflict around infrastructure projects in Latin America, the Inter-American Development Bank (IDB) found that degradation of ecosystems tied to local livelihoods was responsible for 72% of all the cases of social conflict around such projects. Not only is social inclusiveness paramount because it is a pillar of the Sustainable Development Goals (SDGs), but infrastructure projects that are not inclusive can be costly. The same IDB study of 200 social conflict-effected infrastructure projects, found that 198 of them were eventually closed (36) or faced significant delays (162) (IDB 2018).

Getting infrastructure investments right is challenging because of their inherent characteristics. Infrastructure investments are long term and require large upfront investments, but generate cash flows after many years. They are subject to high risks, especially in the initial phases. Infrastructure investments are typically complex, involving many parties. This makes infrastructure investments vulnerable to

policy and political risks and requires appropriate regulation, since they are often natural monopolies such as in transport, water, and power distribution. Spillover effects and positive externalities and social benefits of the investment may be large but difficult to measure, and negative externalities also. Consequently, markets alone cannot provide effective and sustainable infrastructure services.

Development finance institutions (DFIs) such as the multilateral development banks (MDBs) and national and subregional development banks are thus essential for helping to steer private sector financing into infrastructure, and infrastructure finance in general toward broader SDGs. However, DFIs deploy a wide variety of environmental and social criteria in their infrastructure investment planning, with some attempting to calibrate their project selection and design toward social and environmental outcomes and others deferring such frameworks to host country systems. Recent work has shown that the lack of common goals and approaches may lead to an expansion of environmentally and socially impactful projects with those DFIs that have not calibrated their infrastructure planning in a sustainable manner (Ray, Gallagher, and Sandborn 2018).

To tackle these challenges, sound upstream policy and institutional frameworks and platforms for project preparation are essential. A robust policy and institutional framework enables increased infrastructure investment as well as ensures high quality projects. Platforms for project preparation contribute to scaling up the delivery of sustainable infrastructure through providing bankable and sustainable projects. Despite this importance, they have received less attention compared to financing. This brief proposes the G20 countries build a more systematic and integrated upstream policy and institutional framework and platforms for delivering on sustainable infrastructure.

Proposal

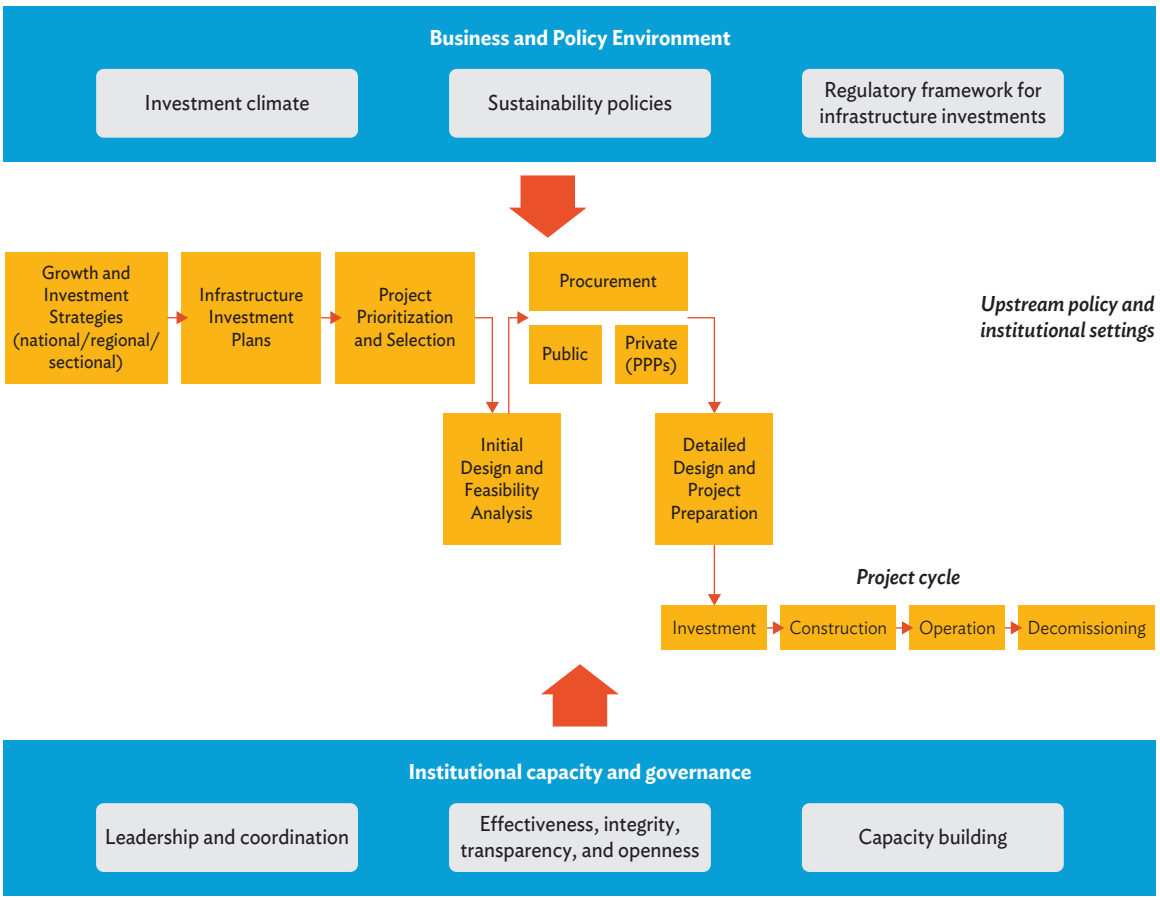
1. Revamp the upstream policy and institutional foundation to deliver on sustainable infrastructure

The policy and institutional underpinnings for delivering on infrastructure projects are complex, encompassing upstream planning and project prioritization, sound frameworks for procurement and public–private partnerships, institutional capacities and governance, and sound business and policy environment (Figure 1.1). Meeting the sustainable infrastructure challenge requires moving decision-making upstream to integrate policy objectives across sectors and to optimize for social, economic, and environmental outcomes. Each element of upstream policy and institutional planning should incorporate sustainability to ensure the quality of projects.

This upstream planning approach, encompassing spatial planning, offers multiple benefits, including the potential to accelerate the project review and approval process, reduce the risks of conflict and litigation, and facilitate offset design and implementation (McKenney et al. 2016). The IDB study (IDB 2018) of 40 years' worth of infrastructure investments found that the lack of upfront planning to anticipate and address social and environmental impacts, usually around local communities' access to natural resources, was a major driver of infrastructure-related conflict, often resulting in substantial delays and costs (Watkins et al. 2017). Conversely, a recent analysis of the potential hydropower

buildout of the Magdalena River in Colombia found that optimizing the potential investment portfolio for sustainability by screening out the most socially- and environmentally-damaging projects had the financial effect of nearly doubling the internal rate of return on investment-worthy projects, while holding capital expenditures and energy generation constant (Opperman et al. 2017). By saving time and money, upstream planning can de-risk infrastructure investments and increase project value—while improving outcomes for preservation of natural capital and ecosystem services (HLEG 2018). In addition, upstream planning can identify opportunities for natural infrastructure to take the place of traditional built solutions. For instance, natural infrastructure, or hybrid solutions that combine natural and "gray" infrastructure (such as seawalls, dams, levees, and wastewater systems), is often the most cost-effective option for reducing flood risk, while delivering a host of other benefits such as improved water quality, healthier fish and wildlife habitat, enhanced aesthetics, recreational opportunities, and quality of life (Nature Conservancy 2015; Narayan et al. 2017).

Figure 1.1: An Upstream Policy and Institutional Framework to Deliver on Sustainable Infrastructure



PPPs = public–private partnerships.

Source: Prepared by authors.

Despite the utility of these upstream approaches, many countries do not have a sound, credible, and integrated policy and institutional framework for sustainable infrastructure. Although numerous policies and institutions exist, their quality varies greatly among countries; they often poorly integrate sustainability objectives, and they are often not well-coordinated to avoid conflicts among sectors. Most countries do not have coherent growth strategies or well-articulated investment plans that recognize the imperative for greater sustainability and resilience. Upstream spatial and landscape-scale planning is essential to optimize the deployment of physical and natural capital (Barros et al. 2019), yet it is rarely undertaken in a systematic way by governments.

Many countries have infrastructure plans, but the quality of the plans also varies greatly. Project pipelines or guidelines for the appraisal of infrastructure projects are missing in many infrastructure plans. Procurement policies only partially address sustainability criteria, and many governments face challenges to implement sustainable procurement policies such as the perception that green products and services are more expensive than non-green ones, public officials' lack of technical knowledge, and the absence of legislation and monitoring mechanisms to evaluate the performances of green procurement system (OECD 2015; Nofal 2017).

The failure to address environmental and social risks at the start of the project cycle threatens project sustainability, performance goals, and financial return (Watkins et al. 2017). This results in smaller pipelines of projects and unnecessary depletion of natural capital (the world's stock of natural resources). At the project level, environmental impact assessments are the primary tool for governments to review sustainability components of major projects, but here too, accountability is often weak, the assessment is too late in the project cycle, and mitigation requirements are not required or not enforced. Lacking the information from upstream planning processes, an environmental impact assessment cannot effectively address long-term and cumulative impacts.

Policy proposals for the G20

(1) The G20 countries should establish coherent growth strategies and well-articulated investment plans, which integrate sustainable development objectives, and should coordinate them with other sustainability strategies and policies such as Nationally Determined Contributions and biodiversity commitments. This requires a whole-of-government approach with integrated and coherent strategies and frameworks of action. At present there is a fragmentation of efforts with finance ministers often focused on the growth agenda, development and line ministers on the SDGs or on specific sectors, and environment ministers on climate and/or other environmental issues.

(2) In alignment with growth strategies and investment plans, the G20 countries should build comprehensive infrastructure plans including core elements such as long-term visions and goals, credible pipeline of projects, and the roles of the public and private sector. These plans should include spatial planning at a strategic scale to identify and resolve potential points of conflict between development and critical natural capital.

(3) To ensure the selection of sustainable projects, the G20 countries should establish a sound project prioritization framework, which includes all the dimensions of sustainability—economic and financial, ecological and climate resilience, social, and institutional sustainability—as preselected criteria for evaluation of projects. A well-articulated methodology should be developed for evidence-based evaluation of projects in terms of effectiveness, sustainability, and feasibility.

(4) The G20 countries should better integrate all the dimensions of sustainability into their regulatory framework for procurement. The laws, regulations, processes, and institutional responsibilities related to procurement need to be developed, implemented, and managed to ensure both efficiency and sustainability of infrastructure projects at the same time as good governance, integrity, and transparency.

2. Scale-up project delivery through platforms

Better institutional structures are required to scale-up and enhance the quality of projects at global, regional, and national levels. Platforms, at the country and global levels, will be essential to bring together all relevant stakeholders and help attract investments in sustainable infrastructure. With government support, platforms can be catalytic agents of change, helping move beyond project-by-project approaches and really take efforts to scale. They can ensure a shared understanding of what is meant by sustainable infrastructure, on how to tackle policy and institutional impediments with shared tools and benchmarks in key areas of action, and on setting up common platforms to scale-up project preparation with adherence to high-quality standards.

A shared understanding of sustainable infrastructure is a base for building platforms. It would enable a more concerted approach by providing clear goals for projects and helping to identify key actions at each stage of the project cycle to bring together various stakeholder groups in a concerted and coordinated way. Many approaches have been taken to develop a shared definition of sustainable infrastructure, but the concept of sustainable infrastructure is still not clearly understood or agreed among stakeholders. Multiple approaches to quality of infrastructure have even created some confusion and have been a barrier to attract investments.

Recent years have seen an increasing number of standards and tools to quantify and assess the sustainability of infrastructure for instance, through high-level principles, safeguards and good practices, reporting guidelines, database and benchmarking, and infrastructure sustainability rating systems. Infrastructure sustainability rating systems specifically focus on infrastructure, providing a comprehensive set of indicators. However, these rating systems have some gaps in addressing sustainability, especially economic and financial sustainability, and the use of them tends to be limited to the country where they were developed and neighboring areas rather than being global (Bhattacharya, Contreras, and Jeong forthcoming).

In order to develop bankable, investment-ready projects, numerous project preparation facilities (PPFs) have been created, but their contributions to the progress in infrastructure investment have been modest. Many PPFs do not have a clear and long-term strategy, and distribute their funds without systemic prioritization (World Economic Forum 2015). They rarely leverage private sector expertise to improve project development, and rely on public funds rather than developing a sound mechanism to recover expenses.

An effort to fill this gap led to the creation of SOURCE, a joint global initiative for advanced project preparation. SOURCE is a global platform for national and subnational governments to help prepare their infrastructure projects. It enables all the stakeholders including MDBs, DFIs, investors, consultancy, contractors, and lenders to work together under the common goal of bridging project preparation and development requirements of the public and private sectors. After two years of operation, SOURCE currently hosts the preparation of 256 infrastructure projects covering all the areas of infrastructure investments, and supports about 2,100 users across 47 countries, having provided 82 trainings in different countries.

Policy proposals for the G20

(1) The G20 should work with MDBs and other stakeholders to reach an agreement on a common understanding of sustainable infrastructure. Building on existing work, the Brookings Institution, the Inter-American Development Bank, Harvard University, the Public–Private Infrastructure Advisory Facility, and the Nature Conservancy have been developing a common framework for sustainable infrastructure including the definition and attributes of sustainable infrastructure (Bhattacharya, Contreras, and Jeong forthcoming; IDB and Brookings 2019). This work can be used as a basis for wider discussion among the G20 and stakeholders to reach a broad agreement on what is sustainable infrastructure.

(2) The G20 countries should work with the multilateral, regional, and national development banks to create global sustainable project preparation and guarantee facilities that are managed at the country level, anchored by the development banks (Studart and Gallagher 2018). The regional and multilateral development finance institutions would provide technical assistance to enable countries to conduct cross-sectoral and large-scale infrastructure planning. The project development fund would be used to help national development banks search for potential sustainable projects, scale-up existing ones, promote a project pipeline to monitor the development and impact of projects, and to minimize the risks involved in sustainable investments.

(3) The G20 should work with the MDBs to reform and streamline PPFs. PPFs should have a clear strategy, which will enable an optimal allocation of resources to support project preparation, and should build a sustainable financing model, which recovers a significant portion of their costs from project owners.

(4) The G20 countries should work with MDBs and other stakeholders to ensure the best operationalization of standards and tools and to ensure that infrastructure scaling is calibrated toward our common social and environmental development goals. Existing standards and tools need to be improved with better incorporation of sustainability attributes, and the use of them should be expanded.

(5) The G20 countries should establish mechanisms for monitoring, transparency, and accountability to ensure that project execution goes as planned. Indicators, monitoring, and performance requirements, combined with digital technologies, should be further developed and applied to ensure that the end product delivers the outcomes that were planned.

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CHAPTER 2

THE INFRASTRUCTURE NEXUS: FROM THE FUTURE OF INFRASTRUCTURE TO INFRASTRUCTURE OF THE FUTURE

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Abstract[1]

This Think20 (T20) policy brief is a response to the call to *recouple* economic growth and social progress, at the dawn of a global infrastructure tsunami. It highlights the lack of a definitive model of urban/metropolitan sustainability and research on its impacts for global infrastructure and multilevel governance needs. It emphasizes that while infrastructures are forming a growingly boundless system, piecemeal approaches to developing urban sustainable agendas and projects are still prevailing, overlooking the systemic impacts of urbanization on biodiversity and ecosystem services, which are also boundless. The first paper of a series that is to be continued during the upcoming T20 Saudi Arabia, Italy, and India, complementing the T20 Japan policy brief *Building Resilient Infrastructure Systems* (Evans et al.), it advocates for a new generation of science-to-society and knowledge-to-policy connectivity to reposition infrastructure investments and value chains. In an era of rising resources limitations and urban growth, the paper outlines the underestimated role of research infrastructures in infrastructure for development policies and it proposes new priorities for a more comprehensive urban agenda within the G20, including biodiversity, with a specific focus on critical regions such as the Amazon and the Arctic.

Challenge

What infrastructures for a world of 1,000 metropolises?

In the past 20 years, the role of infrastructures to promote and sustain economic growth has been acknowledged (Calderon and Seven 2004). After the 2008 financial crisis, infrastructure investments have been pushed as drivers for economic recovery and growth (Lin and Doemeland 2012). Sustainability has made its way in the debates between post Keynesian ecological economics and neo classics (Holt, Pressman, and Spash 2010). The need for sustainable, low carbon, and green infrastructure[2] has been emphasized (Prieur et al. 2019), such as climate friendly railways and waterways, clean and renewable energy projects, etc. (ADB and ADBI 2009; Bielenberg et al. 2016; OECD 2018).

Along with climate change, biodiversity reduction and digitalization (WBGU 2019), urbanization is another contemporary transformative mega-trend (WBGU 2016). It goes with metropolization, a less studied but nonetheless impactful feature of global policy making (Katz and Bradley 2013;

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2 Green infrastructure refers to interventions to preserve the functionality of existing green landscapes (including parks, forests, wetlands, or green belts), and to transform the built environment through phytoremediation and water management techniques and by introducing productive landscapes. This can be termed blue infrastructure if aquatic ecosystems are concerned (Prieur et al. 2019).

Ahrendt et al. 2015; Gomez et al. 2017). Contrary to the vision of a prosperous post-Cold War world of global cities (Sassen 2001) our world is of more than 4,000 cities with over 100,000 inhabitants and 1,000 metro areas with over 500,000 inhabitants across the globe (UN DESA 2019). This complex and conflicting intertwining of local and global scales is both an issue of macro- and microeconomics. Many metro-regions surpass countries' gross domestic product, and yet, there is no corresponding multi-level governance (Snower and Engels 2018; Snower 2019).

With over 70 million more people living in urban areas annually (UN DESA 2019), investment gaps are widening, inequalities are rising (OECD 2018), and territorial and social cohesion is at risk (Fleurbaey et al. 2018). Moreover, land-use policies are massively ailing (Seto et al. 2012; Angel et al. 2016) and the ecological footprint of human activities is rising faster than ever before (Boulding 1966; Meadows et al. 1972; Wackernagel 1996; Rockström et al 2009; Sachs 2015). This is the new normal for infrastructure investments, only that solid evidence about future cities—and corresponding infrastructure systems—is still to be built up.

In the absence of a clear pathway regarding optimal cityshape ensuring equality, sustainability, and growth (Salat 2011; Ahfeldt 2017), communication about off-grid local experiments or about the investments in designated smart urban mega projects tends to be overemphasized. In developed countries, the management costs of existing infrastructures are soaring, citizens' reluctance or resistance to new projects is growing along with the sensitivity to their potential negative environmental impact. In low and middle income countries, the lack of infrastructures and infrastructure finance threatens long-term growth (Floater et al. 2017), while uncontrolled infrastructure development might severely affect critically important local and regional ecosystems (Sloan et al. 2019).

Following over a decade of loosely coordinated action and policy making at combined micro-, metro- and macro-scales (Buchoud and Phan 2019), we have reached a turning point. As illustrated by the Nationally Determined Contributions (NDCs) to reach the Paris agreement and the Voluntary National Reviews of the Sustainable Development Goals to reach the 2030 Agenda, the call for cross-sectoral approach to urbanization and infrastructure development is getting higher on local, regional and global agendas (IISD 2017; AFD, CAF, and IDB 2018). It still is to be transformed into applicable policies.

In the transition towards the decoupling of economic growth from carbon emissions (Snower and Engels 2018), a new approach to infrastructure projects is emerging, connecting *hard* and *soft* infrastructures, infrastructure finance and users' behaviors, civil and financial engineering, changing industry processes (WEF 2017; Kelly 2019) and the development of inclusive infrastructures (Bielenberg et al. 2016; AFD, CAF, and IDB 2018). Yet, two problems are not being addressed correctly.

The first one is a confusion between *urbanization* and *urban infrastructures*. Cities and metros need infrastructures, be it about energy, mobility, etc. But infrastructures serving interconnected urban areas are metropolitan, national, regional, continental, or even global. They go far beyond city limits yet with no corresponding *urban* governance at those combined scales. Hence, the quest for autonomous off-grid settlements on the one hand (Lemoine and Benchimol 2013), and the development of new *geopolitical infrastructures* on the other hand, such as the "One Belt One Road" initiative led by the People's Republic of China, with little left in-between.

The second problem is a chronic deficit of knowledge aggravated by lacking science-to-policy interface regarding what *a global future of cities and metros* means to citizens, governments, or public and private investors. It took 30 years for the International Panel on Climate Change (IPCC) to build knowledge and evidence about climate change but the focus on urbanization only came lately in 2018 (IPCC 2018). At the same pace, we would have to wait until 2050 to foster new knowledge in the field of urbanization, whereas the priority to tackle informality, urban planning and design, green and blue infrastructures is immediate (Seto et al. 2018). As we are already touching upon limitations of natural resources and the regeneration of ecosystems is questioned (Silvain et al. 2018; Bhattacharya et al. 2019), 2050 is way too far a horizon. Furthermore, building knowledge bricks without a corresponding science-to-policy interface will leave citizens and public and private decision makers out of the equation (Furman et al. 2019).

Rethinking the Combined Governance of Infrastructures and Urbanization

The shift toward a predominantly urban world has been formally assessed around 2005/7 (Peirce et al. 2008; Buchoud 2008) but it took over a decade to start building multilateral regulatory frameworks.[3] Meanwhile, local and regional governments, a wide range of stakeholders and interest groups from the civil society and the private sector have grasped change much more firmly than national governments. Urban growth has stirred unprecedented market-driven development opportunities in sectors such as smart cities, real estate development, creative industries which, up to a point, has blurred the lines between the general interest and the promotion of embodied interests (Peck and Tickell 2002; Larner and Laurie 2010; Raco 2013).[4] The formation of new knowledge out of interdisciplinary strategies has been comparatively very slow (Espey and Revi 2018) and weak.

[3] The adoption of the United Nations Agenda 2030, including the Sustainable Development Goals (SDGs) and SDG11 on "sustainable, safe and resilient cities and communities" took place in September 2015. The Paris 21st Conference of the Parties (COP) of the United Nations Framework Convention on Climate Change (UNFCCC) setting up new goals to mitigate climate change and curb CO_2 emissions also took place in September 2015. The Habitat III Summit which issued the New Urban Agenda took place in Quito a year later in 2016. The rise of a global agenda on biodiversity is only happening now, with the 15th meeting of the Conference of the Parties to the Convention on Biological Diversity (COP15) to be hosted by the People's Republic of China in 2020.

[4] Real estate markets should account for more than $4.3 trillion by 2025 (Grand View Research 2018) and yet the affordability gap is ceaselessly growing, estimated at more than $650 billion per year in 2014 (McKinsey 2014). Depending on sources, the global smart cities markets should account for more than $2 trillion per year (Frost & Sullivan 2018) to $3.5 trillion per year (Research and Markets 2017) by 2025. Yet, there is little evidence that internet 3.0, IoT, industry 4.0, etc., are self-help drivers for inclusive territorial development (Eubanks 2018). While in cities and regions across the globe, citizens are struggling with congested mobility systems, social networks, design, television and cinema, literature, including cartoons and mangas, are boiling with anticipation and science fiction, all about cities and their future virtual and physical infrastructures. Creative industries as a whole shape global (urban) imaginaries worldwide with a market of more than $2 trillion per year (WCCE 2017).

Since the turn of the millennium, many cities have engaged in long-term visioning exercises, with infrastructure planning as a key. From New York to Tokyo, Sydney to London, Moscow to Shanghai, Singapore to Paris, Abu Dhabi to Riyadh, such *grand* plans have led to the adoption of multibillion dollar investment packages. A number of cities in India, Southeast Asia, or Central Asia are now following the way. Despite the lack of reliable and internationally comparable data and the routine presence of lagging indicators (Leff and Petersen 2015), the *Greater Paris* or *Greater Moscow*, the *New York* or *London Plan*, etc., have fueled a new literature about *Mayors Ruling the World* (Barber 2014) and nurtured an overall impression of progress under control.

Yet, the promotion of innovation and the development of new large scale mobility systems have not prevented a global systemic decline in housing affordability (Kim 2019). The governance of complex metro areas is generally weak (Gomez et al. 2017) and the adverse effects of infrastructure development on spatial inequalities underestimated (Combes and Lafourcade 2011; Fingleton and Szumilo 2019). The connectivity between investments in large-scale infrastructure projects and the building of social capital has been neglected by neoclassics and post-Keynesian economics.[5]

There is a crack in the promotion of compact urban development models.[6] Acclaimed success stories such as the densification of Vancouver downtown in the late 1980s and 1990s which even led to coin the notion of *vancouverism* could not be replicated at the large metro area scale. In fact, contemporary urban growth consumes three times more land per capita than in the 1990s (Angel et al. 2016), which is true in all parts of the world.[7]

Unregulated urban growth is the cradle of urban financial success stories bringing hope but also confusion. According to McKinsey (2017), $110 billion has been invested in mobility startups between 2010 and 2016 with most of it going to startups in the sharing and autonomous vehicle spaces and the bulk of the investment coming out of Silicon Valley.[8] The global venture capitalist community has been looking for the next big opportunity and believed it to be mobility (not infrastructures), causing systemic disruptions in urban governance, infrastructure finance and planning models.[9]

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5 A recent survey in 347 districts of England and Wales shows that while multi-billion pound investments in high-speed rail increased averages wages by 2% in the region, its impacts on districts was quite heterogeneous and sometimes negative (Fingleton and Szumilo 2019).

6 Despite the invention of Transit Oriented Development (Calthorpe 1993), the number of motorized vehicles and especially private cars in the world, is expected to reach 1.5 billion in 2020, out of 675 million in 1990 (Sperling and Gordon 2009).

7 There is a high probability (>75%) that large areas of the European continent totaling approximately 77.500 square kilometers, that is the equivalent of the total surface of Belgium and the Netherlands together, will be or have been converted to urban areas between 2000 and 2030 (Seto et al. 2012).

8 Investments are also coming from the People's Republic of China and Southeast Asia now.

9 Uber had raised a total of $24 billion in over 22 rounds before it went public at New York stock exchange in May 2019. But the company has challenges. The total valuation at the stock exchange was $79 billion, below the expected $100 billion. The company is burning cash (in the second quarter of 2018, it lost $891 million) and is facing increased competition due to low barriers to entry. Cities are also starting to question their offer of *"let us fix your urban mobility problems."* New York was the first major city to limit the number of vehicle licenses after a study reported that Uber was contributing to traffic. In Germany, Uber was briefly banned in 2014, and currently only operates in Berlin, Munich, Düsseldorf, and Frankfurt. Uber's vision is to be the world's first private multimodal operator moving commuters by bike, car, air taxi and autonomous vehicle in the future. Whether this is a vision shared by the public and cities alike, only time will tell.

The stock exchange value of ride-hailing companies now often exceeds some of the largest infrastructure investment packages across the globe.[10]

Subsidized public transit has long been a preferred way to move large flows of people at low levels of pollution and congestion per capita. Many promising mobility models now reflect an individualization of travel (Schwanen 2016) with *apps* and *fleets* of cheap light electric vehicles and devices to move people as effectively at much lower costs.[11] In the United States, public transit ridership figures are already declining. Should cities forego massive infrastructure spending and repurpose roads and parking bays for new free-floating fleets? To what extent new technologies can replace complex transport infrastructures is unknown as no city has been able to reduce car ownership significantly enough to test the hypothesis.[12]

Many changes in infrastructure development and management are under way, from integrated multimodal infrastructures (Ambrosino, Nelson, and Romanazzo 2003) to multirole infrastructures combining mobility and energy systems (Hautière, De La Roche, and Jacquot-Guimbal 2013; Cirimele, Freschi, and Mitolo 2016, Crozet and Koning 2019). Intelligent transport systems (ITS) are promising ways to review infrastructure pricing and favor clean transport (Harris, Wang, and Wang 2015; Cramton, Geedes, and Ockenfels 2018; Schuitema and Steg 2018; Koning, Combes, and Coulombel 2019).[13] Yet, the upscaling of such sets of solutions require multi-level urban governance systems which are missing. As of today, divided urban systems are commonplace, in lieu of harmoniously networked *urban mangroves* as advocated by architect David Mangin back in 2016 (Mangin and Girodo 2016).

In Japan, as well as in many other areas of the globe, the need for *quality infrastructures* (Runde 2017; Nakamura et al. 2019) to respond to climate change mitigation and adaptation and meet with societies needs is much asserted. Yet, the obstacles on the way to sustainability have silently piled up.

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[10] As of 2018, the total market value of the world's largest global ride-hailing companies was about $100 billion, a calculation is based upon the market value of the companies Lyft, Grab, GoJek, and Uber as of December 2018. Uber's stock exchange market value alone was worth $71 billion in 2018, which is more than the combined total investment costs for the London Crossrail project and the Grand Paris Express metro network serving the Greater Paris metro area by 2030, two of the world's largest metropolitan transportation infrastructure projects.

[11] The demand for public transport in the United States (US) continues to decrease as citizens prefer to spend time in their car alone than use mass transport. Transit ridership fell in 31 of 35 major metropolitan areas in the US in 2017 (Siddiqui 2018).

[12] Paris, which has low car use, has 150,000 parking bays at street level that could potentially be repurposed into lanes for new mobility (Héran and Ravalet 2008; Gössling et al. 2016).

[13] Alternatively, integrated infrastructures may support the implementation of "quantity based regulation." Assume that each citizen or economic agent is endowed with a given amount of "mobility permits", defined consistently with the maximal volume of transport-related negative externalities to be emitted (e.g., greenhouse gases or local pollutants quotas), but also with social considerations (e.g., people living in depraved areas, far away from the city center, receive more permits). An integrated and ICT-based interface between the users and the transport infrastructures could be an efficient way to implement and to monitor the system (your permits' account will be debited differently if you're using subways, bikes or cars; for 1 kilometer (km) or for 10 km), as well as to organize a market where economic agents who have an excess volume of permits could sell them to those who need to travel (and to pollute) more.

Since the turn of the millennium, multilateral frameworks about climate, cities, development, and sustainability, came up as deep transformations of the economy, the society, and the environment were already well on their way.[14] This calls for a revised approach of infrastructure development as a means to support sustainable growth (Global Commission on the Economy and Climate, 2015, 2016; Yoshino, Helble, and Abidhadjaev 2018).

Reviewing Research Infrastructures as a Cornerstone for the Future of Infrastructures

A "global infrastructure tsunami" (Laurance 2018) is bound to expand around the world as urbanization continues, with more than 25 million km of new roads by 2050. As of today, the Earth's surface is split into more than half a million patches. With investments in development and new infrastructures squeezing biodiversity (Ibisch 2016), we are way behind the targets set up by at the Aichi 2010 world conference on biodiversity (Silvain et al. 2018; IPBES 2019).[15]

Only a small number of studies have really quantified the relationships between biodiversity and various ecosystem services over time (Laurance et al. 2017; Choi et al. 2018).[16] The private sector shows a growing interest in biodiversity offset policies but the process remains complex (Levrel et al. 2012; IUCN 2019).

[14] Proposals such as the reinforcement of the *Anthropocene* approaches (Crutzen 2002) and the success met by the *Planetary Boundaries* (Rockström et al. 2009) offer new horizons for a more holistic approach to current global transformations though they have remained mostly conceptual and connected to policy transformations.

[15] An unprecedented spate of road building is happening, with around 25 million km of new paved roads expected by 2050, according to a global comprehensive survey disclosed in 2016 and led by Pierre Ibisch at Eberswalde University for Sustainable Development, Germany. He attempted to map all of the roads and remaining ecosystems across Earth's entire land surface. Its headline conclusion is that roads have already sliced and diced Earth's ecosystems into some 600,000 pieces. More than half of these are less than 1 square km in size. Only 7% of the fragments are more than 100 square km. A quick look at OpenStreetmap also shows that cities are far better mapped than hinterlands. For instance, in the Brazilian Amazon, Ibisch's colleagues recently found 3 km of illegal, unmapped roads for every 1 km of legal, mapped road. (The Global Road Building is Shattering Nature. The Conversation. December 2016).

[16] According to a global survey of the latest research literature on biodiversity in 2018 (Silvain 2018), few studies have explored the spread of invasive species in relationship to the transportation network. Our understanding of alien species distribution at large spatial scale in combination with spatial modelling procedures is weak. There are also key research gaps regarding the impact of infrastructures related to tourism and recreation. This is particularly true in most biodiverse countries of the Global South where new infrastructures accelerate deforestation and forest degradation (Laurance et al. 2017) contributing to global changes. On coastal areas, artificial coastal infrastructures are developed in response to land reclamation and sea level increase while their impact on wetlands and aquatic ecosystems is poorly understood (Choi et al. 2018). Speaking of concepts such as "biodiversity-friendly designs" or "urban green infrastructure" or "working with nature" (PIANC), research must be continued to set up solid bio-indicators of ecological status and accountable metrics to indicate fragmentation, connectivity, and isolation of populations at different scales. On this matter, bio-indicators at the scale of community or ecosystem are generally more accurate than focusing on selected populations of rare or endangered species.

The strategic features of environmental impact assessments (EIAs) such landscape fragmentation mitigation remain weak. *Strategic environmental assessments* (SEAs) and *strategic land-use planning* bring some advantages over EIAs but they are far from being the new normal (Laurance and Burgués Arrea 2017).

We know little about the design of cities, roads, and other infrastructures to minimize their ecological footprint. Finding the best development patterns to limit the adverse impacts of urbanization on ecological connectivity is crucial. Harmonized regional and global scale analysis to measure the *co-benefits* between biodiversity and the sustainable design and management of infrastructures is missing (Soubelet, Silvain, and Delavaud 2019).

Large-scale and long-term big data analysis and modelling are the only way to anticipate the impacts of ecosystems' degradation and biodiversity losses, to build urban environment plans at local and global levels, including biodiversity tradeoffs, to limit the risks of infrastructure failures.

The contemporary global biodiversity crisis highlights the deficit of globally coordinated research infrastructures (Silvain 2018; Barot et al. 2018), whereas the gradient of systemic complexity is exponentially rising from infrastructure development issues, to urbanization, to Earth System (Cornell et al. 2012).

Change factors exist. Research can help understand how infrastructures can be beneficial for biodiversity in an Earth System perspective. Research on urban metabolism and circular economy (Fernandez 2013; Van Timmeren 2015) is changing infrastructures impact assessments. Within the G20, several countries are implementing new comprehensive national research strategies focusing on Earth System (Cornell et al. 2012; Biermann 2014; Latour 2017). Yet, the collaboration among national systems remains prone to chronical instability due to short project-finance cycles and to the lack of cross-sectoral research on biodiversity and urbanization.[17]

The reinforcement of a global agenda on biodiversity could be durable game changer in research with numerous impacts in the economy (Soubelet, Silvain, and Delavaud 2019).

Recommendations for T20 Japan Legacy

Regional and cross-continental integrated and smart infrastructures systems are emerging such as with power grids built on long-term forecasts by 2040 (ENTSO-E 2018), 2050, or beyond. This provides an interesting model for the development of a new generation of scientific and research infrastructures, as centralized and distributed networks working at micro- and macro-scales on combined physical installations and virtual connections.

[17] An overview of the 95 mega projects selected under the current H 2020 program by the European Union shows that none of them, though, has targeted urban related issues as a designated focus area.

The focus of the international community on large scale research infrastructures is nothing new (OECD 1992, 2008, 2010; Belmont Challenge 2016) but it has to be broadened. In the 18th century, major endeavors such as the Great Northern Expedition mobilized hundreds of scientists from different countries. Reusing existing mapping, they nurtured the creation of new routes and new knowledge and contributed to the formation of modern science.

To address the pressing knowledge gaps of the 21st century highlighted in the present paper, we propose to include in T20 priorities a focus on large-scale research infrastructures[18] and to foster a fast-track approach connecting infrastructure development, urbanization governance and Earth System theories and research programs.

We recommend to enrich and deepen the T20 infrastructure agenda by:

- connecting with the emerging IPCCcities and with the Urban20 engagement group of the G20
- building a dialogue between long term research strategies across G20 members
- reflecting on key proposals such as the creation of a global fund for biodiversity, complementing climate finance, or the creation of a global pact for urbanization.

The development of the United Nations Sustainable Development Solutions Network, the One Planet Summits, the Global Pact for the Environment project (2018), the preparation for the 2020 International Union for Conservation of Nature, and the 2020 COP15 Biodiversity in Beijing could serve as catalysts.[19]

In that context, we view the transformation and development of the Amazon (Barros et al. 2019) as well as of the Arctic and circumpolar regions as issues for the T20 infrastructure agenda in the near future.[20] If the combination of a natural and geo-science focus with an infrastructure and urban focus is not managed properly, the risk is that such critically changing regions become areas of ruthless competition only, in lieu of places to cooperate for the long-term management of our urbanizing planet.

[18] Tomorrow, the focus on large scale research infrastructures could also include space.

[19] Recent literature on sustainable finance, impact finance, responsible finance, finance and the SDGs, climate finance, and infrastructures, etc. account for massive estimates, that is of global investment needs to achieve the Agenda 2030 of $5 trillion to $7 trillion per year with a gap of about $2.5 trillion per year, and over one-third of it for Africa alone.

[20] So far, a very limited number of institutions have managed to launch and to sustain advanced research programs connecting urban and regional development to environment and climate change through actual evidence and data collection based upon physical research facilities and large scale research infrastructures. The example of the transformative role of the Trans-Siberian Scientific Way developed by the national research Tomsk State University could serve as a benchmark for such initiatives. It connects a mega-profile ranging from Central Asia to the Arctic Circle and a circumpolar network of research bases.

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CHAPTER 3

INFRASTRUCTURE INVESTMENT NEEDS AND SOURCES OF FINANCING

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Abstract

Developing Asia must mobilize $1.7 trillion annually to meet its infrastructure needs. Governments can increase public investment in infrastructure by raising more revenues, reorienting spending, and borrowing prudently, as well as adopting innovative approaches such as "land value capture." Also, expanded private financing of infrastructure investments is indispensable. Particularly, a public–private partnership can help fill the financing gap by allocating risk to the party best able to manage it. The success of the approach depends on governments identifying the most suitable projects, engaging qualified private partners, and instituting the right process.

Challenge

While Asia has been the engine of global growth, continued investments in infrastructure are indispensable for keeping the growth engine active. Also, over 400 million Asians live without electricity, 300 million without safe drinking water, and a staggering 1.5 billion without basic sanitation. According to ADB (2017a), developing Asia will need to invest $26 trillion from 2016 to 2030, or $1.7 trillion per year, if the region is to maintain its growth momentum, eradicate poverty, and respond to climate change. This estimate incorporates the costs of climate change mitigation (in particular, for more efficient and cleaner power generation and electricity transmission), and adaptation (in particular, for "climate proofing"), mainly in transport and water by making infrastructure more resilient to the impacts of climate change. Without these climate change mitigation and adaptation costs, $22.6 trillion will be needed, or $1.5 trillion per year (baseline estimate) (Table 3.1).

Table 3.1: Infrastructure Investment Needs, 2016–2030 ($ billion in 2015 prices)

	Baseline		Climate-adjusted	
	Total	% of GDP	Total	% of GDP
Central Asia	492	6.8	565	7.8
East Asia	13,781	4.5	16,062	5.2
South Asia	5,477	7.6	6,347	8.8
Southeast Asia	2,759	5.0	3,147	5.7
The Pacific	42	8.2	46	9.1
Asia and the Pacific	**22,551**	**5.1**	**26,166**	**5.9**
Annual Average	**1,503**		**1,744**	

GDP = gross domestic product.

Sources: 2030 population projections from UN Population Division; others are ADB estimates.

Currently, the region annually invests an estimated $881 billion in infrastructure (for 25 economies with adequate data, comprising 96% of the region's population). The infrastructure investment gap, i.e., the difference between investment needs and current investment levels, equals 2.4% of the projected gross domestic product for the 5-year period from 2016 to 2020 when incorporating climate change mitigation and adaptation costs.

Asia's infrastructure needs dwarf traditional sources of finance. The infrastructure investment gap should be filled by both the public and private sectors. Accordingly, the two main challenges are: first, to expand fiscal space for larger public investments in infrastructure; and second, to attract and mobilize private resources in financing the gap.

Proposal

1. Innovative approaches to augment public infrastructure investments

Governments can increase public investment in infrastructure by raising more revenues, reorienting spending, and borrowing prudently. Policy makers must evaluate how much fiscal space is available to increase infrastructure investment under various options for reforming public finance. Many countries in developing Asia can increase revenues through tax reform (including improving tax administration). There is also scope to reorient budget expenditures toward public investment by cutting energy subsidies, for example, and by borrowing prudently while keeping debt levels manageable.

Innovative approaches exist to expand government funds available for financing infrastructure development. These include, for example, using "land value capture" to finance infrastructure, or capital recycling (selling brownfield assets and auctioning concessions, and allocating proceeds to finance greenfield infrastructure). At the same time, other actions, like setting user charges for infrastructure services with greater regard to cost recovery will also help.

2. Tapping private investments

While state funds currently finance 92% of the Asia and Pacific region's infrastructure investment, some economies struggle to meet these needs, constrained by high fiscal deficits and deepening public debt. Even factoring in funds saved through public finance reform or received from multilateral agencies, a significant infrastructure financing gap remains. Hence, expanded private financing of infrastructure investments will be indispensable.

Currently, the main sources of infrastructure project finance are equity and debt. Banks have been the largest providers of debt finance for infrastructure projects, both in Asia and around the world. But this is not sustainable. Banks' ability to provide debt financing for Asia's vast infrastructure needs is limited, especially because of the recent changes in bank regulations and capital requirements. Bonds are more desirable, as they allow for long-term financing. But bonds are used only minimally for infrastructure investment financing in Asia.

Especially, public–private partnerships (PPPs) can be an innovative tool to meet Asia's infrastructure needs (ADB 2017b). A suitable project, pursued with qualified private partners, and overseen through the right processes is the surest combination for the efficient and effective delivery through PPPs of public infrastructure and the services they enable. For this to materialize, regulatory and institutional reforms are needed to make infrastructure more attractive to private investors and generate a pipeline of bankable projects for PPPs.

Countries should implement PPP-related reforms such as enacting PPP laws, streamlining PPP procurement and bidding processes, introducing dispute resolution mechanisms, and establishing independent PPP government units. Deepening of capital markets is also needed to help channel the region's substantial savings into productive infrastructure investment.

3. Enhancing the role of multilateral development banks

The role of multilateral development banks is crucial to catalyze and add value to private sector investment to infrastructure assets. The infrastructure financing gap is essentially a risk gap. The large infrastructure gap in Asia coexists with a substantial pool of long-term savings that can be mobilized if offered the appropriate balance of risk and return. Credit enhancement mechanisms such as partial credit or revenue guarantees, off-take guarantees, subordinated debt, pooling and tranching, and infrastructure debt or equity funds, can mitigate certain risks from PPPs to make them more attractive to a wider range of capital providers. Multilateral development banks can also facilitate the development of local capital markets.

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CHAPTER 4

PURSUING QUALITY OF INFRASTRUCTURE FOR SUSTAINABLE GROWTH

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Abstract

The developing world is facing an annual deficit of $3.7 trillion in infrastructure investments, critical for its economic growth and sustainable development (Global Infrastructure Hub 2017a). Radical changes to the global infrastructure landscape are required to overcome this gap. In the absence of enhanced infrastructure support, emerging market economies will find their ability to grow severely undermined. This policy brief recognizes the opportunity possessed by the Group of 20 countries at the 2019 Osaka Summit in leading the international community on this topic. Moreover, it presented for their consideration eight key policy recommendations that will help accelerate quality infrastructure development.

Challenge

Infrastructure connectivity is critical for any country to achieve economic growth and sustainable development. The vitality of infrastructure in present-day economic functions can be seen in air traffic navigation, freight movement by rail, roads, and seas, high-speed internet connectivity and uninterrupted electricity supply that powers the global economy, and information and communication technologies that have permanently transformed modern commerce. Many of the developing world economies, however, are unable to fully modernize their economies due to insufficient investment in their infrastructure assets.

Over the past 30 years, the developing world has witnessed heightened levels of economic development (Radelet 2016). Economic reforms undertaken by many of the emerging markets created an enabling environment for private sector growth and private capital inflows, lifting more than 1.3 billion people out of poverty over the past 3 decades (Roser and Ortiz-Ospina 2019). For the first time in human history, more than half the world (nearly 4 billion people) are part of the "middle-class." Meanwhile, wealth to the tune of $61 trillion was added to the global economy between 1990 and 2015 (Kharas and Hamel 2018). But for the world to sustain and expand upon these growth levels, significant amounts of investments are needed in infrastructure assets around the world. Over 1.3 billion people lack access to regular electricity supply, more than 2.5 billion need water and basic sanitation facilities, while 4 billion continue to remain offline from the internet. Radical changes to the global infrastructure landscape are required to overcome these fundamental development challenges and unleash growth in emerging market economies.

Presently, the developing world needs $3.7 trillion (Global Infrastructure Hub 2017a) in infrastructure investments. South Asia and Southeast Asia alone require $1.7 trillion each year to meet their demands (Global Infrastructure Hub 2017b). Meanwhile, the level of foreign assistance that was available in 2018 was limited to $147 billion globally (OECD 2018). These levels have been consistent with the trends of the past few years and are not expected to change significantly in the years to come. Therefore, the key challenge of financing the infrastructure gap is to leverage the limited foreign aid money, resources, and networks of the multilateral development banks (MDBs), and international forums like the Group of 20 (G20) body, to unlock trillions of dollars in domestic and foreign private capital that can be realized through meaningful institutions that govern infrastructure development.

Proposal

The 2019 G20 Summit in Osaka, Japan presented to the G20 member countries **a real opportunity to remake the world**. As the developing world's population and economies continue to expand, there will be a renewed momentum in parts of Africa, Asia, and Latin America to rapidly secure large-scale investments in order to double their infrastructure assets over the next 30 years. In the absence of enhanced infrastructure support, economies in many of the developing countries will find their ability to grow severely undermined.

Japan has played a critical role in leading this issue. Most crucially, it led the members of the Group of Seven (G7) at the 2016 Ise-Shima Summit to adopt the five central principles for promoting quality infrastructure investment (MOFA 2016). In light of the sheer size and scale of the challenge of infrastructure development confronting the international community, it is only appropriate that Japan again led the world at the Osaka G20 Summit and considered the following eight recommendations to enable quality infrastructure development:

Recommendation 1: Mobilizing tax revenue and domestic resources

According to a 2016 World Bank document, domestic tax revenues constitute the dominant share of infrastructure funding in developing countries since infrastructure is a public asset. In Africa, more than 40% of the infrastructure is financed through taxes and public funds, with national governments paying for more than 60% of infrastructure in certain sectors like transport (EM Compass Quick Take 2016; Infrastructure Consortium for Africa 2018). Bilateral and multilateral aid agencies can use their resources strategically to help developing countries reform their tax collection practices, expand their tax net, and strengthen their overall state capacity. The Addis Tax Initiative is a quintessential example of global cooperation to increase domestic resource mobilization, and all efforts must be made to channel the gains of that initiative to finance the global infrastructure gap (Runde and Ramanujam 2018).[1]

Recommendation 2: Investing in local capacity

Financial investments in infrastructure development will be insufficient if it is not matched with investments in local human capital. With local capacity building being a pivotal precondition to achieving quality infrastructure development, the lack of a human capital base that is capable of planning, procuring, implementing, and maintaining multitrillion dollar infrastructure project continues to be one of the main challenges for the emerging markets. Bilateral aid agencies of donor countries like the United States and Japan have a key role to play here in mapping the gaps in human capital needed for infrastructure development in emerging markets. Once the gaps are identified, aid agencies have both the mandate and platform to help governments of recipient countries build local capacity.

[1] This is a multi-stakeholder partnership that seeks to improve domestic revenue mobilization (DRM) in countries that are a part of it. Initiated in 2015 by the governments of Germany, the Netherlands, the United Kingdom, and the United States, this initiative facilitates the promotion of coherent policy frameworks, institutionalizes resilient governance structures, and boosts political commitments among member countries to modernize their taxation system.

Recommendation 3: Reforming procurement practices

Procurement standards matter an inordinate amount in development, with an average of 15% of the gross domestic product of developing countries going through the hands of procurement officials in the public sector, much of which goes toward infrastructure development (Kim 2016). Historically, these officials have been encouraged to pick the lowest-bid project, in an effort to lower the overall costs associated with infrastructure development. Incapable of assessing the longer-term feasibility and sustainability of the project and lacking a scientific rationale, the practice of procuring cheap infrastructure has proven to be expensive in the long-run to many of the developing countries, with governments paying for the same infrastructure project twice.

Many developing countries, however, lack adequate institutions and qualified bureaucracies that can facilitate their procurement officials to adopt more sophisticated infrastructure procurement practices, one that carries out a "life cycle cost analysis." At the Osaka Summit, it was agreed that members of the G20 must adopt a commitment to train 100,000 public procurement officials—primarily from developing countries in Africa and Asia—in the best practices surrounding the planning and procurement of infrastructure projects. The commitment should seek to train at least 600,000 public officials in the next 10 years, half of which must belong to governments in South Asia and Southeast Asia (Runde and Ramanujam 2018).

Recommendation 4: Establishing global and universal standards

To realize the promise of achieving high-quality infrastructure development globally, there is a need for the global community to adopt a set of universal standards that would provide a more seamless regulatory connectivity across countries. The absence of universal and standardized quality controls has often led to gridlocks in project negotiation, planning, or implementation. Moreover, disparities in the regulatory standards between countries have also created a breeding ground for corrupt and rent-seeking practices to prevail.

The adoption of a more global and universal set of standards will directly and tangibly serve the interests of the stakeholders constituting the global infrastructure development community.
The Osaka G20 Summit can be used as an opportunity to bring countries together and calls for global accreditation of functions and services critical to the implementation of infrastructure projects, including air navigation and security, environmental and energy sustainability, engineering, and information and communication technologies. By building consensus on the protocols and norms governing these functions, a comprehensive and universal accreditation process can be established that will significantly enhance the efforts to achieve transnational and transcontinental infrastructure connectivity.

Recommendation 5: Leveraging multilateral development banks' expertise

The international community has access to a vast reservoir of information and deep pools of resources with the global network of MDBs. Regional MDBs and the World Bank have a diverse and sophisticated network organizational structure that is embedded itself into the functions of local and provincial governments in many of the developing countries that seek to close their infrastructure gap. MDBs, therefore, are centrally placed and can help scale-up the efforts of bilateral aid agencies, provide strategic advice to governments of the developing countries, enforce the universal set of standards adopted by global community (as referenced in Recommendation 4 above), play appropriate roles in enabling access to private capital markets (both locally and internationally), and help support and scale-up the efforts of bilateral aid agencies in building local capacity (as referenced in Recommendation 2 above).

Furthermore, MDBs like the World Bank have at their disposal, datasets and information on countries' capacities and capabilities to finance public–private partnership infrastructure development. By leveraging these datasets (and the analytics they offer) strategically, countries can create an enabling environment that facilitates a greater role for the private sector in infrastructure development. To that end, an interbank meeting is needed as it will serve as an opportunity for the MDBs to increase their interbank collaboration, reduce redundancy of efforts, adopt a burden-sharing mechanism for the various infrastructure development functions that is tailored to each bank's strengths in the subject matter (Runde and Ramanujam 2018).

Recommendation 6: Bringing the People's Republic of China as an inclusive and responsible player

It should come as no surprise that a single donor or entity will not be able to close the $3 trillion global infrastructure gap on their own. The People's Republic of China is playing its part in financing a substantial part of this demand through its aid agencies and the multilateral development bank that it leads. The international donor community must not only welcome the People's Republic of China's role and its resources, but facilitate its adoption of long-standing institutions, norms, and practices that govern donor activity and safeguard both the interests of the donors (who expect their investments to yield returns) as well as the recipient countries (who seek investments that will grow their economies sustainably).

Recommendation 7: Future proofing infrastructure assets

Artificial intelligence, big data analytics, 5G, autonomous vehicles, and other technologies of the fourth industrial revolution are slowly making their way into mainstream economic functions. At the same time, policy communities around the world are bracing themselves for the disruptions expected from these technologies to conventional models of growth and development and are seeking to rework their innovation agenda. The G20 Summit highlighted both the challenge and opportunity presented by these technologies and called for the international community to rethink their conventional infrastructure designs so that they are adaptive and conducive to such changes, while harnessing the disruptive potential for rapid economic growth and development. By allocating a share of the investments toward digital infrastructure such as optical fiber networks and wireless communication infrastructure, countries can insure their larger investments in physical (or hard) infrastructure from becoming obsolete.

These investments will also open up the doors for developing countries to design and implement "smart-city" projects and create digital payment systems that can formalize and optimize their economic functions.

Recommendation 8: Combatting corruption to ensure quality infrastructure

Efforts to fight corruption must not be mutually exclusive to achieving quality and sustainable infrastructure development initiatives. Across the G20 community, corruption in infrastructure procurement and implementation has received significant attention and deserves a solution that is holistic in its approach. At the Osaka Summit, finance ministers of the top 20 economies emphasized the importance of ensuring quality and sustainability at various stages of infrastructure development—including institutionalized governance practices, transparent infrastructure investments, planned project preparation, openness in procurement, and faithful project implementation and maintenance through local capacity development—in encompassing comprehensive efforts to reduce and minimize corruption (MOF 2019).

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CHAPTER 5

BUILDING RESILIENT INFRASTRUCTURE SYSTEMS

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Abstract

The need to provide resilient transport infrastructure systems is fundamental to enhancing the economic, social, and environmental viability of our cities. In addition to population growth, rapid urbanization, and aging infrastructure, cities increasingly face complex challenges due to the heightened frequency and intensity of natural hazards and those caused by humans. Addressing vulnerabilities requires that citizens, cities, regions, the business sector, and governments avoid exacerbating threats to infrastructure systems. In order to ensure the availability, quality, safety, and security of transport infrastructure and networks, a long-term development strategy is needed along with the ability to build on adverse events. Transport system owners and operators are compelled to integrate growingly complex challenges within decision-making processes. This includes the impacts of climate change and extreme weather, natural disasters and disasters caused by humans, as well as cyber threats and the structural aging of infrastructure facilities. Highlighting the issues outlined in the policy brief, The Infrastructure Nexus, the following recommendations are suggested: (i) developing systematic resilience strategies for infrastructure and transport systems at the Group of 20 (G20) level; (ii) establishing policies and mechanisms for exchanging knowledge and experiences among the G20 countries; (iii) promoting a sociopolitical-based approach to resilience to facilitate the acceptability of infrastructure projects at local and global scales; and (iv) setting up a common methodology for measuring the success of resilience strategies.

Challenges

It is recognized that transport infrastructure should encompass not only the operational, but also the physical components of interrelated systems, which provide essential services to enable, sustain, or enhance societal living conditions (Fulmer 2009). Among infrastructure systems, transport networks play a key role in connecting communities, shaping their economies, and supporting the free movement of ideas, people, goods, and services. International, national, and local transport is multimodal by design; it benefits from the interrelationships between ground, maritime, air, rail, and waterways transport networks.

Among multimodal transport systems, road transport infrastructure and services are major contributors to ensuring the accessibility and mobility of users. In low-, middle-, and high-income countries altogether, road transport accounts for more than 80% of all passenger travel and freight movements, where "roads are the first social network" (IDRRIM 2017). By 2030, annual passenger traffic is set to increase by 50%, global freight volumes by 70%, and an additional 1.2 billion cars will be on the road by 2050 (World Bank Group, Sum4All 2017). For these reasons, the "transport and traffic" sector is increasingly being classified as a "critical infrastructure".[1] The lack of quality infrastructure systems will delay the systematic implementation of such services. Low-quality infrastructure and services induce extensive economic, social, and environmental costs for transit authorities and users (e.g., accident costs, travel time, freight delays, vehicle operating costs, and environmental externalities, such as those associated with greenhouse gas emissions, air pollution, noise pollution, water run-off from roads, etc).

[1] Regulation for the determination of critical infrastructure according to the Bundesamt für Sicherheit in des Informationtechnok (BSI) law (BSI Kritis regulation, https://www.bsi.bund.de) (in German).

It is estimated that the amount of global investment required for roads will be $34 trillion between 2016 and 2040, while the current trend of investments for this period does not exceed $26 trillion (Global Infrastructure Hub 2017). In other words, each country should spend more than 1.27% of its gross domestic product (GDP), while current expenditure on average is approximately 1% of its GDP only. Many countries, both emerging and developed, "have paid insufficient attention to maintaining and expanding their infrastructure assets, creating economic inefficiencies and allowing critical systems to erode" (Woetzel et al. 2016). On the contrary, a state of good repair and maintenance of existing infrastructure contributes significantly to increasing "resilience" (see Appendix).

Global-related risks are threatening mobility infrastructure

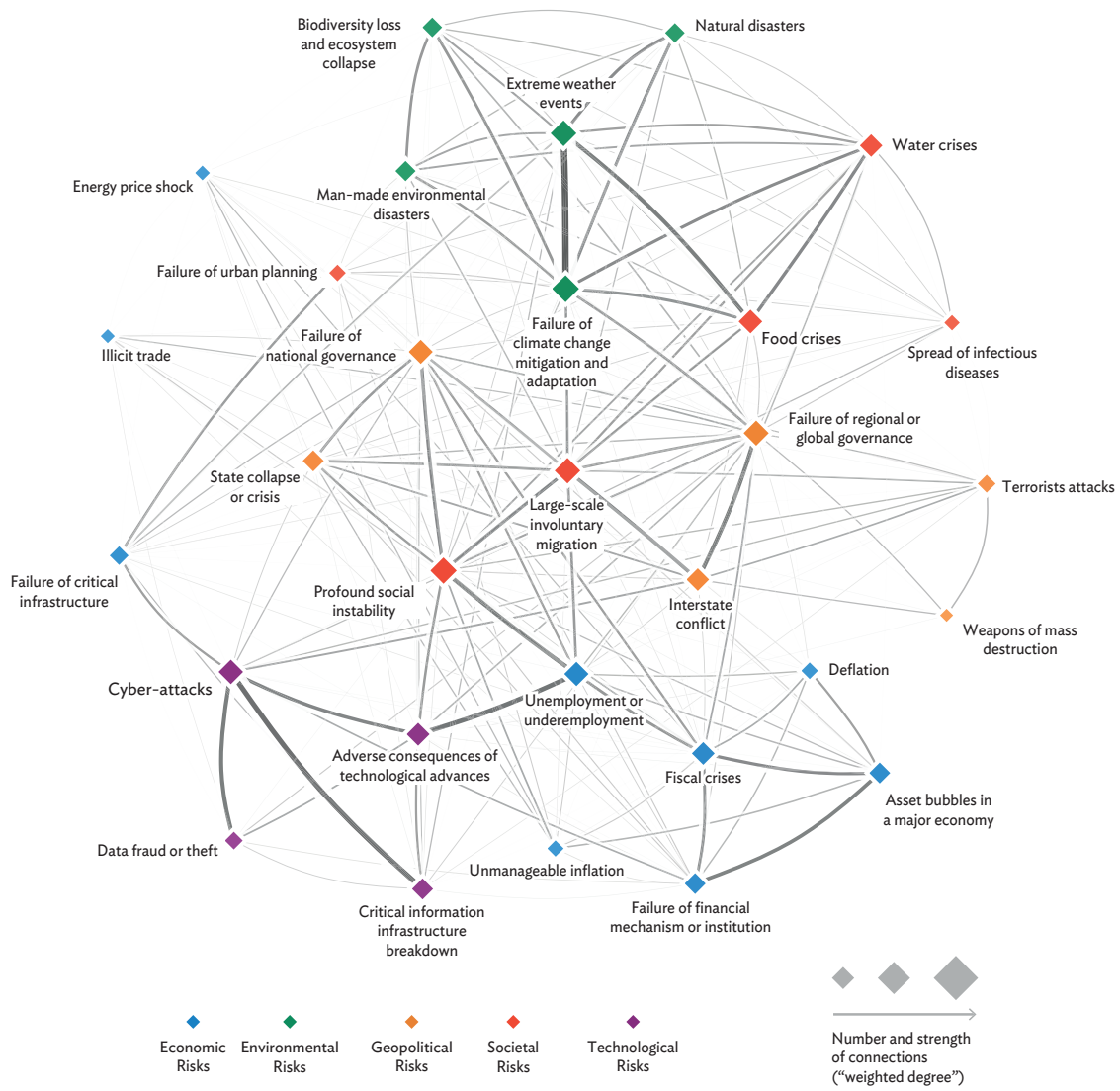
Cyber attacks are ranked fifth in terms of likelihood, with expected increased risks in 2019, leading to more disruption of operations. The World Economic Forum's Global Risks Report (2019) reflects on new instabilities caused by the deepening integration of digital technologies into every aspect of daily life. In the context of the rapidly advancing digital transformation, digital technologies will also play an increasingly important role in the operation of road infrastructure, whereby the aspects of cybersecurity, physical security, and cyber resilience will play a decisive role in the future. As shown in Figure 5.1, global risks are interconnected and the levels of vulnerability are increasing.

Furthermore the functioning of infrastructure systems in a degraded mode (caused by a lack of adaptation to extreme climate events, of maintenance, by disasters caused by humans, among others) will worsen the impacts of these risks on people and territories. Due to rapidly growing urbanization, with two-thirds of the global population expected to live in cities by 2050, more people will be exposed to infrastructure system failures in the very near future.[2] In a vicious circle, urbanization does not only concentrate people and properties in areas of potential damage and disruption, however it also exacerbates those risks, for example, by destroying natural sources of resilience.

The importance of more resilient design, construction, and maintenance of infrastructure cannot be understated. This is obvious in high-income countries where the number of infrastructure disasters has increased in recent years—causing severe economic, environmental, and social consequences. The recent collapse of a bridge in Genoa, Italy, on 14 August 2018 claimed 43 lives and caused huge spending on repairs, insurance to damage, properties, buildings, machinery and stocks, and at a regional scale, lowered companies' profits. In this context, both a state of good repair and maintenance and suitable design approaches for new and existing infrastructure facilities, taking into account relevant vulnerabilities and criticalities, are basic prerequisites for building resilient infrastructure systems.

[2] See the TF4 *Infrastructure Nexus* policy brief for the outline of current urbanization issues and their impacts on infrastructure development.

Figure 5.1: Global Risks Interconnections Map



Source: Word Economic Forum (2019).

Climate change and the associated increased number of extreme weather events are a major global concern

These include temperature changes, floods, rising sea levels, storm surges, increased hurricane and cyclone intensity, landslides, drought, and bushfires. Over the last 20 years, the reported economic losses due to extreme weather events has risen by 151% compared to the 1978–1998 period, reaching $2,245 billion (UNISDR 2017). Similarly, during 1998–2017, the global gross national product increased by approximately 200%. As such, a connection can be formed between the increase in population and the increases in damage costs due to climate change exposure. The effects of extreme or highly variable weather on infrastructure is of increasing significance to the transportation community.

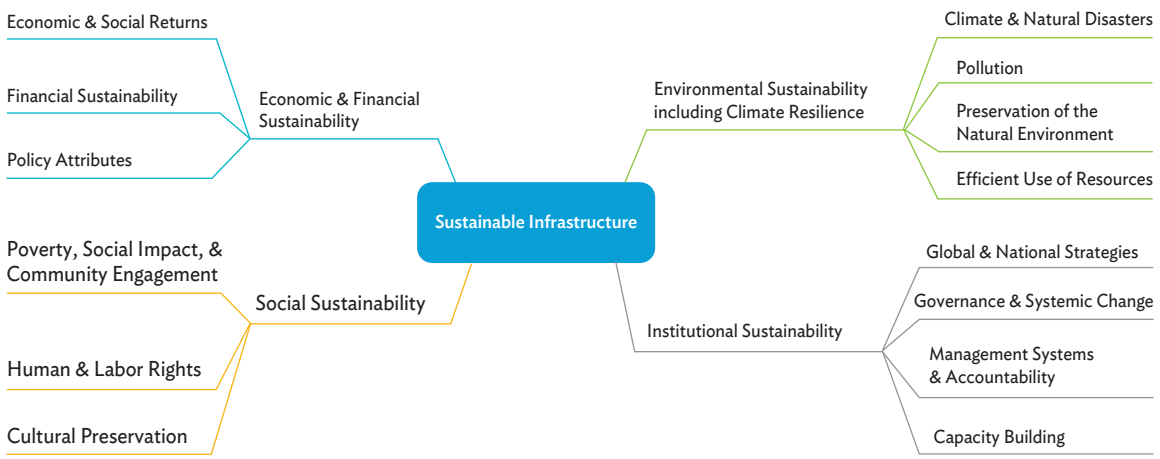
For example between 2010–2013, *El Niño* and *La Niña* combined effects caused major damage to the Queensland road network in Australia. As a result, 8,741 kilometers of the state-controlled network required full or partial reconstruction, with a reconstruction budget of approximately $4.5 billion (Queensland Government 2016).

The cost of redesigning and retrofitting key road infrastructure elements, such as upgrading roads to add more resilient adaptation measures, elevating bridges, or relocating roads, can be costly and requires a strategic risk-based approach for investment decisions. Upgrading road infrastructure to improve resilience includes a risk management challenge that will require national and local governments to (i) identify climate change impacts (e.g., sea level rise, extreme precipitation events, etc.), which are most relevant to their infrastructure; (ii) ascertain how those impacts are likely to manifest themselves (e.g., coastal flooding, flash flooding from storm surge, wild fires, etc.); and (iii) identify which infrastructure assets are the most vulnerable and cause the greatest risks linked with inaction or delay action (TRB 2019).

Governments and transportation agencies can draw on the experience from partners in other professional fields such as seismic protection agencies, which have a matured risk-based resilience approach in a number of countries (e.g., Japan and the United States). The transportation agencies in these countries have decades of experience with upgrading their infrastructure systems to withstand seismic events. They have been proactive in evaluating the lessons learned from significant hazards, developing solutions, and implementing improved design, as well as retrofitting guidelines and standards for their infrastructure systems.

The development of a holistic risk-based approach to climate change resilience of transport infrastructure will require the translation of available scientific climate projections into engineering guidance and standards that practitioners can use when planning and designing future infrastructure projects (Stahl et al. 2016; GAO 2015). This involves consideration of a multidimensional approach of sustainability (Figure 5.2).

Figure 5.2: IDB's Four Dimensions of Sustainable Infrastructure



IDB = Inter-American Development Bank.
Source: IDB (2018).

Transport infrastructure is vulnerable to a wide range of threats, including events caused by humans

In the last decade, direct intentional attacks on infrastructure users and/or cargo have increased (Theocharidou, Galbusera, and Giannopoulos 2018). Transport infrastructure systems and services are an attractive target for radical activists and terrorist groups, who often act with the explicit intention to disrupt transport flows and harm passengers and people. Other motivations can be to make a political statement, or to make economic profit by blackmailing the affected country. For this reason too, transport and energy infrastructure is increasingly being classified as a "critical infrastructure" (Engdahl 2016).

As a consequence, the management of transport infrastructure should include security considerations at all levels ranging from the infrastructure's strategic importance and criticality, its different uses, and its proximity with, and access to, other assets and public spaces. The extent of the impact of the loss of, or damage to, a targeted transportation network depends, of course, on the degree of resilience built in the underlying infrastructure.

How to mitigate negative impacts and how to adapt and improve the resilience of transport systems?

The answer lies in the interconnection between several professional spheres of operation, including planning and design, asset management, materials science, structural engineering, emergency procedures, investment, and others. Resilience management and resilience engineering are suitable ways to tackle the above-mentioned challenges.

Owners and managers of transport infrastructure systems play a major role in fostering resilience. Their investments in mitigation (through risk-based design and construction) and incident planning (through proper operations) are key to minimizing risks and improving infrastructure resilience. Given the growing number of extreme events caused by humans, transport infrastructure owners and operators need to include security issues among their top priorities. Embedding and managing security as part of business-as-usual becomes mandatory. This requires dedicated budgets and new collaborative processes between government, infrastructure owners, managers, and operators.

The affordability of resilience for infrastructure systems is set to become an increasingly important issue. Robust risk financing strategies will be required, both to fund investments in adaptation and to pay for recovery when failures occur. At present, the total funding of post-hazard recovery is globally almost nine times higher than prevention. Reaching an appropriate balance will require dialogue and planning between all the stakeholders.

Proposals

> Infrastructure planning must be improved at all levels of government to create pipelines of sustainable infrastructure projects aligned with long-term climate and development objectives. Priority actions include: … Make resilience the norm to limit vulnerability to climate damages … (OECD, World Bank, and UN Environment 2018, p. 29).

It is suggested that strategies be established that include a unified and holistic risk-based approach for the assessment, quantification, and investigation of the possibilities for improving the resilience of infrastructure, in general, and transport systems, in particular.

Develop resilience strategies for infrastructure and transport systems at G20 level

It is recognized that an integrated systems approach connecting all levels and scales is required, which focuses on emerging markets and clients in urbanized and regional locations. This involves the development of internationally consistent strategies to ensure that appropriate planning is in place to address disruptions to road infrastructure and operations. Road assets must therefore be able to adapt to future events and the most economically efficient investment options must be used. These objectives will require determining when and where the most appropriate adaptation measures are required and how much this would cost for specific infrastructure systems and assets. This includes identifying the economic benefits of improving the ability for transport systems to withstand events using life-cycle costing, adaptation pathways, and other approaches. The *Audit of the French State Roads Network and its Maintenance Policy* (IMDM and Nibuxs 2018) was inspired by such a concept.

The resilience policy that could be developed within the G20 should take into account existing resilience strategies as well as face new challenges such as combined changing demographics, security risks, and weather events. This includes more emphasis on additional vulnerability introduced to transport systems, such as the application of automated solutions. Automated transport will influence the management of emergency situations, hence there is a need to take on board those associated influences in the development of holistic resilient strategies.

One such example is the World Road Association's (PIARC) (2015) *International Climate Change Adaptation Framework for Road Infrastructure*, which was developed to guide road authorities through identifying relevant assets and climate variables for assessing, identifying, and prioritizing risks, developing a robust adaptation response, and integrating findings into decision-making processes. Another example is the *ASCE Manual of Practice on Adaptive Design and Adaptive Risk Management* currently being developed by the American Society of Civil Engineers (Committee on Adaptation to a Changing Climate).

A key focus is to consider asset management in terms of a "whole of organization" approach to creating and maintaining assets which deliver services valued by an agency's customers in the most cost-effective and efficient manner. In such an organization, the needs of road users and expectations are defined in the context of both community, stakeholder, and organizational objectives (see for example, Austroads Guide to Asset Management 2018).

Policy options

- Develop strategies at state level for resilient (road) transport systems that could make a significant contribution to solutions in the future, such as to create the foundations for proactive and holistic resilience engineering/resilience management.
- Introduce educational initiatives that focus on comprehensive resilience-centered operation, maintenance, and adaptation of (road) infrastructure, including risk-based elements and cost-benefit analyses.

Establish policies and mechanisms for exchanging knowledge and experiences related to the resilience efforts for the infrastructure and transport systems among G20 countries

Adopting resilient infrastructure systems requires planners, asset designers, owners, and operators to communicate and determine the following resiliency factors:

- maintain infrastructure, rather than just build more;
- promote a flexible development of new services to rehabilitate and existing infrastructure;
- identify assets likely to suffer from future events and potential vulnerabilities (exposure and sensitivity);
- assess and prioritize risks according to the level of risk probability (likelihood of future impacts on the asset) and severity (consequence of the impacts on the asset);
- identify those assets that are approaching the end of their design life;
- adapt existing transport infrastructure to the consequences of climate change and the associated increases in extreme weather events; and
- retrofit or build new resilient infrastructure.

It is essential to determine how to ensure that these strategies have a real holistic positive impact—or spillover effect (Yoshino, Taghizadeh-Hesary, and Nakahigashi 2018)—and do not produce any negative side effect to the territories (biodiversity, accessibility, or social inclusion). Relevant stakeholders and G20 members may work together to establish a framework for a communication structure with regard to resilient infrastructure and transport systems. This structure would report systematically on adverse events that have a significant impact on the availability, safety, and security of transport systems. In addition, training initiatives may be initiated that focus on resilience-centered approaches and that include risk-based elements into cost-benefit analysis, and other economic valuation approaches.

Policy options

- Assist low- and medium-income countries in the long-term strategic planning of road infrastructure and in the implementation of efficient and cost-effective road development and maintenance measures, through their taking part in knowledge-sharing measures and through actual implementation of remedial measures on roads.
- Develop a post G20 Summit strategy to monitor and coordinate policies and initiatives with regards to resilient transport systems, e.g., the international conference agenda (International Transport Forum, World Road Congress, Intelligent Transport System World Congress, World Congress on Railway Research, among others).

Promote a sociopolitical-based approach to resilience to facilitate the acceptability of infrastructure projects at local and global scales

Transport infrastructure systems always involves a political dimension, either openly addressed or hidden behind the technological frontscreen.

Infrastructure projects engage in political and geographical relationships with communities. There are different engineering and architectural traditions among G20 countries, such as Japan's "above-of-the-ground model" for transport infrastructure, or France's traditional requirement for a proper "excavation-and-backfill balance", or Germany's "low flyheight" that dates back to the first *autobahnen*. These techniques all shape different responses to the same problem: how to connect infrastructure with the landscape? Be it geographical, political, or sociological, all infrastructure systems imply an element of discrimination, and this is often a hardened, long standing issue. For project planners, architects, engineers, practitioners, and even politicians, it is necessary to cross the borders shaped by infrastructure, to share experiences and best practices, to build places where people can live in, and transform infrastructure drawbacks into a common good. These are important prerequisites for achieving infrastructure resilience. This collaboration can also provide a stronger base to enable future investment decisions to be made.

Policy options

- Advocate the need that transport infrastructure systems should be closely tied with territories. This will address more than the functionality of systems, but will also encourage the development of a proposed "knowledge-sharing academy", involving inputs from engineers, architects, urban planners, economists, and social and human scientists.

Set up common methodology for measuring resilience success

This approach seeks to build on the outputs of internationally recognized organizations in their worldwide knowledge-sharing mission, such as the World Road Association (known as PIARC), "100 Resilient Cities," the International Federation for Structural Concrete, the World Business Council for Sustainable Development, the International Association for Bridge and Structural Engineering, the American Society of Civil Engineers, and International Council for Local Environmental Initiatives (ICLEI), among others. G20 members should validate, improve, and disseminate approaches for evaluating the success of resilience indicators and resilience solutions.

Policy options

- Establish mechanisms for the collection and evaluation of efficient and cost-effective solutions.
- Improve interaction between policy makers and owners and operators of road infrastructure to raise awareness with regard to resilient road infrastructure.
- Encourage the adaptation of existing technical guidelines and standards to integrate resilience into infrastructure (design, building, operation, maintenance).

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Appendix

Resilience plays a key role in maximizing the economic, social, and environmental aspects of transport infrastructure and network operations and has multiple definitions. There are a number of levels encapsulated in "resilience". It spans the ability of infrastructure to plan and prepare, withstand, recover, and adapt according to a cyclical, proactive, and holistic risk management system.

Important aspects include:

- robustness—the inherent strength, or resistance, to external damage without degradation or loss of functionality;
- redundancy—system priorities that allow for alternative options, choices, and substitutions under stress;
- resourcefulness—the capacity to mobilize needed resources and services in emergencies; and
- adaptability and ability to recover quickly—the speed with which disruption can be overcome and safety and services restored (Bruneau et al. 2003).

Resilience can therefore be considered as follows:

> Resilience is the ability to repel, prepare for, take into account, absorb, recover from and adapt ever more successfully to actual or potential adverse events. Those events are either catastrophes or processes of change with catastrophic outcome which can have human, technical or natural causes (Scharte et al. 2014, p. 17).

Increasing the resilience of an infrastructure network requires:

- to better predict the intensity and frequency of the actions to which the infrastructure network can be subjected, be it "climate" actions (wind, snow, flood, ground movements) or traffic loads (increase in road traffic, passage of truck convoys, increase of weight);
- to evaluate at best the resistance of the structures under the effect of these actions, considering the aging of the materials constituting these structures;
- to strengthen surveillance and possibly use real-time instrumentation of the most vulnerable infrastructure to detect any major failure in time; and
- to prioritize maintenance and reinforcement work by using the most relevant technical solutions to optimize short- and medium-term expenses.

Facing a critical event or a modification of its environment, a resilient infrastructure system will have to resist the crisis, to absorb the constraints and recover while diminishing its inherent vulnerability. Resilience should therefore be seen as holistic combining the robustness at both the infrastructure and organizational level.

CHAPTER 6

QUALITY INFRASTRUCTURE INVESTMENT: WAYS TO INCREASE THE RATE OF RETURN FOR INFRASTRUCTURE INVESTMENTS

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Abstract

Infrastructure is crucially important to foster a country's economic development and prosperity. The demand for infrastructure development is high. However, the financing side still cannot fulfill this demand. To address this gap, this paper points out the importance of high-quality infrastructure investment where quality is measured by how much economic and social value can be created by infrastructure projects in a region. Simultaneously, the values created by the infrastructure could be utilized to address the financing gap of infrastructure investment. High-quality infrastructure will create high spillover effects, which will be reflected in the increase of the growth rate and tax revenue in the affected areas. Traditionally, the increase of tax revenue has been retained by governments. This study reveals that if part of the tax revenue can be directly distributed to infrastructure shareholders, including investors and landowners, the financing gap problem would diminish, and the construction time could be shortened. Building quality infrastructure does not refer to simply physical infrastructure, but also reforms, and setting up the correct legal and institutional framework for infrastructure development. New models are being proposed for these reforms such as city infrastructure, hometown trust funds, and the promotion of small and medium-sized enterprises and start-up businesses, along with the changing the face of educational and land trusts for land acquisition.

Challenge

Infrastructure is crucially important to foster a country's economic development and prosperity. Investments in infrastructure contribute to higher productivity and growth, facilitate trade and connectivity, and promote economic inclusion. Recognizing this critical role, Japan has attempted to revive the infrastructure agenda under its Group of 20 (G20) presidency.

High infrastructure demand. McKinsey (2013) has reported that from 2016 to 2030, there will be a need to invest $3.3 trillion annually on average to keep pace with the projected growth, of which 60% is accounted for by developing countries. Furthermore, the Asian Development Bank has estimated $1.7 trillion will be required every year to maintain rates of growth sufficient to alleviate poverty in the Asian region (ADB 2017).

Financing gap for infrastructure development. Although a lot has been accomplished, challenges remain regarding this agenda. To find the source of funds in closing these financing gaps, countries cannot rely on public financing and multilateral development banks. Both of them only account for approximately 45% of the global infrastructure financing needs (EDHEC 2016). Private investors are the potential source of funds for the remaining infrastructure financing needed. Public–private partnerships (PPP) have been putting in an effort to promote the narrowing of this gap as well.

Infrastructure investment is less attractive for private investors. In developing countries, the involvement of the private sector is low. There are several reasons why there is less appetite for private investors to invest in infrastructure:

- Long-term investment and banks' asset liability mismatch. In developing countries, the capital market is shallow and more volatile, therefore, people tend put their money in bank deposits, which is usually short- to medium term in nature. This causes banks' assets to always have shorter tenor compared to the long-term financing needs of infrastructure. This mismatch is likely to constrain the lending in countries where risk hedging instruments are less developed. Furthermore, the banks extending many long-term loans leave themselves open to liquidity risks. On the other hand, from the point of view of the project development itself, if a long-term project can only be financed by short-term bank credit, it also means the company faces refinancing risks, which results in increased uncertainty, regardless of at what price the project can continue to be refinanced.
- The expected rate of return in developing countries' infrastructure investment is relatively high, due to the high-risk exposure faced by investors and the lack of viability of long-term contracts in emerging markets. The exposures include the role of government agencies and the perceived instability of public policies with regards to infrastructure. Some technical risks are also considered such as regime change, cost increases, unexpected revenue decreases, unexpected expenses, and delay in land acquisition (Yoshino, Helble, and Abidhadjaev 2018). Similar to most direct foreign investment concerns, foreign infrastructure investors also consider macroeconomic risks such as taxation or the ability to work with local partners (as part of risk exposure).
- Failure of PPP and low yield problem. Despite this high-risk exposure, the infrastructure projects cannot provide decent returns to their investors. This is mainly because the return of the project is coming mostly from the operating revenue or usage price such as toll fees or train fares. This return is relatively low compared to the risk that investors face during project construction and at the development phase. For projects with low-economic value, the government becomes involved to cover the risks through viability gap funding using public–private partnerships (PPP). However, this PPP funding mechanism can burden both local and central government budget through increasing accumulated debts.
- Land acquisition is one of the difficulties in infrastructure investment. When the construction of a road is planned, city officials have to negotiate with landowners. Large amounts of time and money mobilization is required at the early stages of infrastructure construction.

Proposal

Introduction

In line with the requirement of quality infrastructure, the completion of physical infrastructure is not the only measurement for successful infrastructure projects. A high-quality infrastructure investment should have a positive economic value that can stimulate job creation, enhance foreign direct investment, and improve productivity and tax revenue in the end.

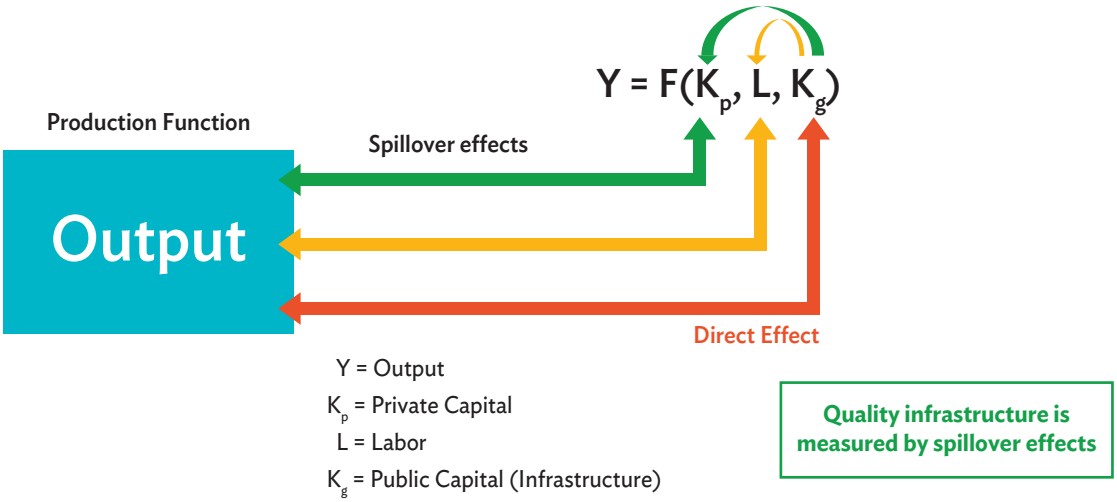
The connectivity among regions and rural communities is important to boost economic value. Therefore, the development of railways, roads, and highways is crucial. Such comprehensive infrastructure projects should have the ability to support communities and build business opportunities, including improving agriculture and/or farming. Farmers will be able to transport their harvest conveniently and readily access markets outside their region supported by these infrastructure facilities. In other words, market accessibility and trade networks can be greatly expanded if quality infrastructure thrives in a country. Furthermore, the connectivity will also lower the production cost and shorten the distance between buyer and producer, eradicating the "middle person" concept. This allows room for farmers and other villagers to start small and medium-sized enterprises (SMEs), building the entrepreneurship capacity of farmers.

Based on the challenges above, this paper addresses the importance of creating high-quality infrastructure investment measured by how much economic and social value can be created by infrastructure projects in a region, while the strategy is also relevant to addressing the financing gap in infrastructure investment.

Spillover effects of infrastructure projects

There are two effects in infrastructure development: direct and indirect. Direct effect means when private firms can increase outputs without changing inputs, while indirect effects occur when private firms want to further increase output by changing the amount of inputs in order to maximize profits. This indirect effect reflects the benefits of infrastructure investment for the economic activities of private firms, which consequently increases capital inputs and employment resulting from infrastructure investment. The indirect effect is assumed to be equal with the spillover effects, as explained by Figure 6.1.

Figure 6.1: Direct Effect and Spillover Effects



Source: Prepared by authors.

This spillover effect could be described by the increase of regional gross domestic product (GDP) (Y), which is affected by the change of regional development created by infrastructure investment (Kg). The increase in regional development (Kg) will drive new business opportunities (Kp) and create new employment (L).

This concept is explained in the equation:

$$\frac{dY}{dK_G} = \eta K_G \frac{Y}{K_G} + \eta K_P \frac{\eta K_G \eta K_P + \beta K_G}{\eta K_P (1 - \eta K_P) + \beta K_L} \frac{Y}{K_G} + \eta L \frac{\eta K_G \eta L - \beta K_G}{\eta L (1 - \eta L) + \beta K_L} \frac{Y}{K_G}$$

As new businesses start production, hotels and restaurants are expected to open near railway stations and roads. Those new businesses will create new employment. Furthermore, property prices will also rise, which will increase property tax revenue. New business activities will also increase corporate tax revenue. New employment will increase, and income tax revenue and sales tax revenue will also start to rise (near locations of the infrastructure investment).

The increase of tax revenue is described in the equation:

$$\Delta T_{it} = \alpha_i + \phi_t + \beta X_{it} + \delta D_{gt} + \varepsilon_{it}$$

ΔT is the increase of tax revenue of the region impacted by infrastructure projects, α_i is the sum of autonomous affect, and (α) is the time-invariant unobserved region-specific affect, ϕ_t is the year-specific growth effect; X denotes time-varying covariates (vector of observed variables), D is the binary variable indicating whether the observation related to the affected group after the provision of the project, and ε_{it} is the error term, assumed to be independent over time.

The increase in the tax revenue of infrastructure project using this method has been applied to Manila's highways. It shows a significant increase of tax revenues after 4 years of operation (t+4). Tax revenues in Batangas City went up to ₱1,209.61 million, compared to the period before construction of the highway, as seen in Table 6.1.

Table 6.1: Calculated Increase in Business Tax Revenues for the Beneficiary Group Relative to Nonbeneficiary Group 4 (₱ million)

Years	T–2	T–1	T	T+1	T+2	T+3	T+4
Lipa City	134.36	173.50	249.70	184.47	191.81	257.35	371.93
Ibaan	5.84	7.04	7.97	6.80	5.46	10.05	12.94
Batangas City	490.90	622.65	652.83	637.83	599.49	742.28	1,209.61

Source: Yoshino and Pontines (2018).

Based on the explanation above, the economic value of infrastructure development is reflected in the rise of the growth rate or the increase of total tax revenue. The growth is reflected in the total GDP including value added from industries impacted by the projects in surrounding areas. The total tax revenue could be in the form of personal and corporate income taxes or property and sales taxes. Yoshino and Abidhadjaev (2016b, 2017) use the difference in "difference approach" to quantify the additional economic value of infrastructure projects in Kyushu, Japan and Uzbekistan using tax revenue and growth rate, respectively. Their studies found that the growth and tax revenue in the regions rise in line with the economic development of the areas.

Policies proposed

In the conventional system, the increase of economic value in the form of incremental tax revenue (as a result of the spillover effect of infrastructure) is retained by the government. There are no direct incentives for infrastructure investors except the usage charge, which is often lower than expected. With the challenges that the governments face to finance their infrastructure development, a new design of dividend policy for private investors and the salary system of the infrastructure operating entity is important. The incremental tax revenue received by government could be used for the next infrastructure development or other public facilities. Yoshino and Abe (2019) also propose that the incremental tax revenue that also links with the fixed amounts of public subsidies could be used for the new design.

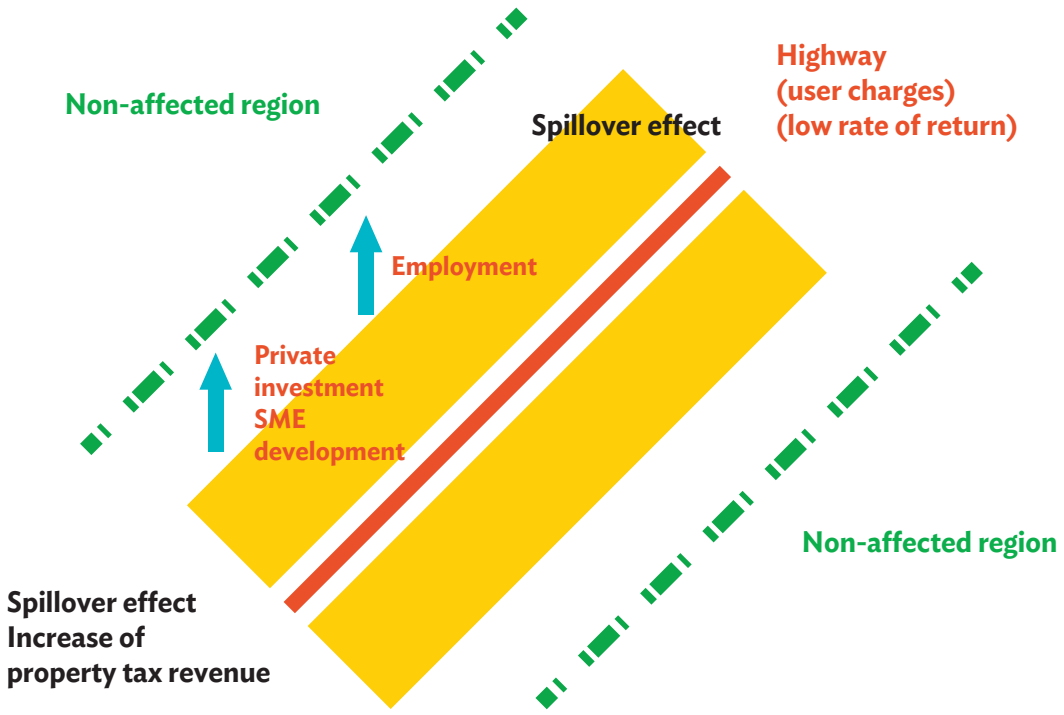
With our concept, we propose the sharing of spillover in infrastructure development with infrastructure stakeholders, including investors and landowners. In line with the progress of economic development, regional development will lead to higher tax revenues. If part of these increased tax revenues were returned to the investors in infrastructure, their rate of return will keep on increasing for many years keeping pace with the development of the region.

To effectively implement this concept, governments should provide a conducive regulatory and policy environment that allows private investors and operators to have trusts and be able to capture the benefits of this indirect effect. On the other hand, the private sector needs to be proactive in its effort to create more economic value and reduce the costs of infrastructure projects (Yoshino and Abe 2019).

Spillovers to infrastructure investors

The economic spillover effects derived from infrastructure projects could be utilized to incentivize investors to have a better return and at the same time stimulate creativity to make the infrastructure projects more economically functional and productive. For example, in Japan, Kyushu's rapid railway train company increased the tax revenues in the area during construction, but then the revenue reduced when the operation commenced. However, when the railway connected to large cities, the tax revenue increased significantly. This shows that stimulations expecting high returns is not always successful. With motivation for a better return, investors and governments will find ways to come up with projects that yield higher returns.

Figure 6.2: Spillover Effects of Transport Infrastructure



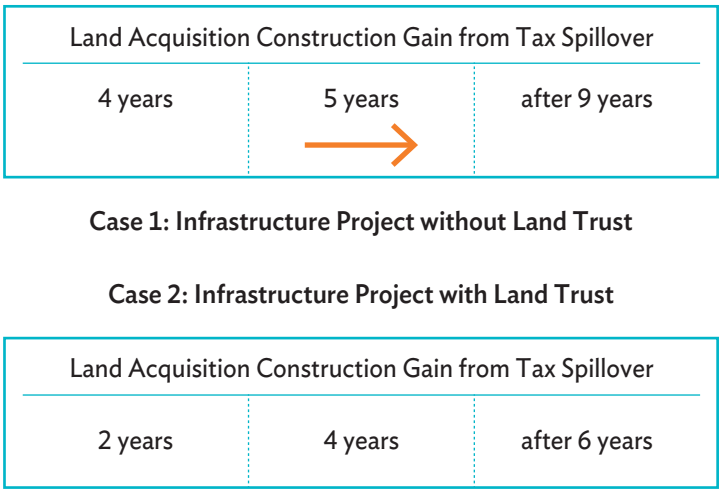
SME = small and medium-sized enterprise.
Source: Yoshino, Abidhadjaev, and Nakahigashi (2018).

Spillovers to landowners

A similar concept could be applicable to landowners whose land is used for infrastructure projects. Landowners play an integral role in deciding the allocation and development of infrastructure projects (Irwin 2017). In many developing countries, land acquisition is one of the major obstacles in infrastructure development. Using the spillover from the infrastructure concept, the economic value distributed to landowners could be in the form of rent with a long-term leasing contract. The sources of rent payment could be from the spillover of tax revenue or additional economic value from projects.

Sharing spillovers from infrastructure investment with landowners in the form of rent payment proves that shortening the construction time of infrastructure projects (Figure 6.3) will be beneficial. The acquisition of land is often difficult in infrastructure development, since the land owners feel they will lose the opportunity to gain greater economic value in the future. By applying this concept and providing them with recurring economic compensation in the form of rent, the landowners will have sustainable income over the years.

Figure 6.3: Land Trusts Shorten the Completion Time of Infrastructure Projects



Source: Yoshino et al. (2018).

Recommendations

In developing infrastructure, we cannot investigate infrastructure projects in isolation. There are many areas that require careful design in order to build quality infrastructure projects. Most regions in Asia struggle with digital connectivity, hampering the process of information dissemination to large populations in a short period of time. Encouraging quality infrastructure investments to address this problem will lead to greater access of skill-based education through digital mediums, thus positively impacting people's welfare.

In order to positively impact productivity, growth, and tax revenue, it is imperative that reforms be well implemented in infrastructure development. Creating an institutional framework with poor implementation may lead to more problems than solutions. Therefore, we propose suggestions to facilitate better implementation of the sharing of spillover infrastructure projects.

City infrastructure

When developing infrastructure, many countries, policy makers, builders, and contractors overlook the city-planning aspects. City planning is imperative for the construction of sustainable infrastructure. This can ensure a positive spillover effect from infrastructure investments. Traditionally, infrastructure has been considered only from the *construction* perspective. However, it goes much further than simple construction. It is pertinent to address the capability of the proposed infrastructure to *develop* the region, cascading the benefits to multiple communities. Such projects should allocate areas or zones for markets, shops, residences, and manufacturing industries. This kind of zoning will help create a good city.

Hometown trust funds to promote SMEs and start-up businesses

The authorities should think beyond "building infrastructure." It is also important to encourage businesses to grow in the region impacted by the infrastructure. Even if the infrastructure is available, most SMEs find it difficult to receive financial support for their start-ups. Banks and financial institutions are often reluctant to lend money to start-ups, due to the inherent high risks. This is where the "hometown investment trust funds" (HIT) can play an integral role. The basic objective of HIT funds is to connect local investors with projects in their own locality in which they have personal knowledge and interest (Yoshino and Taghizadeh-Hesary 2017). Furthermore, an HIT fund can also improve the inclusiveness in the region. Due to the nature of SMEs and start-ups, female participation in labor markets can be encouraged by providing HIT funds.

Enabling digital literacy for better education

The level of education among infrastructure stakeholders also determines how big the economic value of the spillover effects (of the project) can get. Stakeholders include investors, government, landowners, farmers, and business people (both from SMEs and start-ups). Yoshino and Abidhadjaev (2016a) show that secondary and university education together will lead to a higher GDP in the region infrastructure investment estimated using data of 40 different countries.

The modern education system can be introduced using mobile phones and the internet. Technological progress and innovations are very important in the education system, especially in science, technology, education, and mathematics (known as STEM) education. Traditionally, to receive quality education, students had to attend exclusive private schools, which have a very competitive admission process in Asia. With the expansion and advancement of technology, it is convenient for young students and even for those keen to study further, to listen to lectures and learn from the foremost professors and academicians through the internet and smartphones, irrespective of their geographical location. It is important for governments to provide facilities with quality technology and encourage students and school leavers to make use of these facilities for personal growth.

The relation of education and technology to the region's economic growth could be expressed in the production function as: $Y = A\ F(K_p, L, K_g)$ where Y = regional GDP, A = technological progress, K_p = private capital, L = Labor, and K_g = infrastructure. If the technological progress (A) advances, the regional output created by the infrastructure investment will also rise. Human capital development (L) will enhance regional output induced by spillover effects.

Therefore, this paper suggests that Asian countries should start including digital education services for all levels from secondary school to university. Professors and lecturers can deliver lectures online that can be broadcast all over the country afterward. This technique will be beneficial for students and people in various regions and villages. People can learn basic technical skills and languages and gain knowledge to further pursue industrial and vocational training courses.

Land acquisition by creating land trusts

Land trusts could be an intermediary between landowners and government for managing the spillover effects of infrastructure. Land trusts were created in Japan many years ago and accordingly, owners are able to keep ownership of their land. Furthermore, they can lease the land under a long-term contract, for instance for a period of 99 years. By doing so, the owner can earn a reasonable income over many years.

Under the land trust concept, landowners entrust their land to trust banks, and the trust banks manage the land. For instance, in the case of agricultural land, the trust bank aids a young farmer who wishes to farm on large consolidated land to enhance their economies of scale. The landowners will receive the profit as dividends. The consolidation of land leads to higher profits for landowners. The proposed framework allows for the usage rights allowing owners to maintain their ownership rights, while increasing their profit by leasing land for infrastructure and development projects.

The stages of this method are: (i) to consolidate assets owned by individuals, (ii) entrust them to the trust banks, and (iii) make better use of the assets. This concept has a similar function to a trust fund. Pooling the fund and then investing that on more effective operations is similar to consolidating assets owned by individuals who are not able to maximize the utility of their assets themselves, or do not have the know-how. Entrusting them to the trust bank can increase the use of the assets.

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CHAPTER 7

SUSTAINABLE INFRASTRUCTURE TO SECURE THE NATURAL CAPITAL OF THE AMAZON

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Abstract

Sustainable infrastructure for the Amazon requires a recognition of the region's vast natural capital and unique importance for the world. The Amazon stores 120 billion tons of carbon, supports rainfall systems that are critical for regional economies, and provides habitat for one-third of the world's species. Investments to secure the Amazon's natural capital are an essential step to supporting sustainable infrastructure. We propose that the Group of 20 and the development finance institutions promote conditions for quality and sustainable infrastructure investment by: (i) supporting international public and private commitments and funding mechanisms to bolster Amazon countries' progress in conserving forests, securing natural capital, and promoting sustainable development; (ii) supporting sustainable infrastructure policies and guidelines that fully incorporate social and environmental costs for project selection and preparation; (iii) establishing lending principles that infrastructure investment must be compatible with land, water, and forest conservation and healthy ecosystems, necessary to maintain the Amazon's natural capital; and (iv) developing portfolios of small-scale, nature-based infrastructure projects in the Amazon that support local development, poverty reduction, and conservation.

Challenge

The Amazon has vast natural capital[1] that is of unique importance to the world. The Amazon's natural capital is at risk under traditional approaches to infrastructure development. Globally, traditional infrastructure development is often falling short in meeting economic development, inclusive growth, and climate goals (New Climate Economy 2018). In response, the call for sustainable infrastructure continues to grow. Sustainable infrastructure is defined as "infrastructure projects that are planned, designed, constructed, operated, and decommissioned in a manner to ensure economic, financial, social, environmental (including climate resilience), and institutional sustainability over the entire life cycle of the project" (IDB and IDB Invest 2018). A range of new infrastructure investment initiatives, project preparation facilities, and government reform efforts are supporting the movement for sustainable infrastructure (Mercer and IDB 2017; NDC Invest; OCED 2016).

Sustainable infrastructure requires improved planning and development processes in ways that increase the pipeline of quality infrastructure projects, leading to higher levels of infrastructure investment (New Climate Economy 2016). In Latin America, this approach could help close a large and persistent infrastructure investment gap, estimated to be about $120–$150 billion a year, or equal to an additional 2.0%–2.5% of GDP.[2] Moreover, sustainable infrastructure could break the long history of infrastructure

[1] Natural capital refers to the stock of natural assets from which people derive a wide-range of benefits and services, including food, drinking water, and fuel, and less visible services like climate regulation, carbon storage, and the natural flood defenses of forests, pollination of crops by insects, and cultural and biodiversity values (World Forum on Natural Capital).

[2] The gap is defined in terms of the infrastructure that countries need to meet a target growth rate, improve services to a target level (e.g., percentage of population with access to water and sanitation), and/or to achieve an infrastructure stock similar to a benchmark group of countries (Serebrisky et al. 2015).

project-related conflicts in Latin America. Conflicts due to social and environmental concerns have resulted in project delays, cost overruns, reputational damage for governments, investors, and the private sector, and adverse social and environmental impacts. A recent analysis of 200 conflict-affected infrastructure projects in Latin America found that conflicts resulted in project delays (81% of cases), cost overruns (58%), project redesign (42%), and project cancellations (18%), with an average project delay of 5 years and average publicly reported cost overrun of $1.2 billion, or 69% of the average original budget (Watkins et al. 2017).

Sustainable infrastructure investments in the Amazon must address the challenge of maintaining the region's natural capital—securing the Amazon's forests, rivers, and healthy ecosystems. The Amazon stores 120 billion tons of carbon—about 10 times more carbon than humans release into the atmosphere each year, supports rainfall systems that are critical for agriculture, hydropower, and regional economies, and provides habitat for one-third of the world's species. The nine Amazon countries have made substantial progress in protecting forests and reducing deforestation to secure the region's natural capital. But deforestation continues and has increased in recent years. The Amazon system is nearing a tipping point of 20% deforestation, at which point the hydrological cycle could shift in ways that cause large forest regions to transition to non-forest ecosystems (Lovejoy and Nobre 2018), with potentially disastrous repercussions for the region's climate, agriculture and economy.

Large-scale infrastructure is a major driver of deforestation in the Amazon, both through direct impacts and by opening up new areas of the basin (RAISG 2012; Ahmed et al. 2013; Barber et al. 2014; Finer et al 2008; Lees et al. 2016). The impacts of these projects could undermine the Amazon's natural capital, and correspondingly undercut national and global goals for sustainable development, poverty reduction, climate, forests, biodiversity, and the rights of indigenous peoples.[3] Planned infrastructure investments in the Amazon could total up to $70 billion by 2020 (FGV, EAESP, and IFC 2017). Roads, railways, dams, and transmission line projects, in support of new transportation routes and energy and mining development, are among the major potential threats to Amazon sustainability.

For instance, from 2000 to 2015, the perimeters of international development finance institution (DFI)-financed infrastructure projects in the Andean countries of Ecuador, Peru, and Bolivia experienced tree cover loss at a rate of over four times the average in comparable areas without projects in these countries. That infrastructure-associated tree cover loss is equivalent of the annual emissions of Colombia, Chile, and Ecuador combined, with an estimated social cost between $2.1 billion and $10.5 billion. Such degradation is due to the direct impacts of the projects as well as indirect impacts such as illegal mining that can follow official opening of the forest (Ray, Gallagher, and Sanborn 2018).

[3] Commitments of Latin American countries include: the United Nations Framework Convention on Climate Change (UNFCCC) Paris Agreement and Intended National Determined Contributions to reduce national greenhouse gas emissions, Sustainable Development Goals under the 2030 Agenda for Sustainable Development, Convention on Biological Diversity, 2014 UN Climate Summit's New York Declaration on Forests, and the United Nations Declaration on Rights of Indigenous Peoples.

Proposal

Effective policy and institutional frameworks for conserving the Amazon's forests and natural capital are an essential step for supporting sustainable infrastructure. Rather than a traditional project-by-project approach, sustainable infrastructure requires more comprehensive planning early in the infrastructure planning process at the scale of the Amazon system, and this should be carried out in ways that consider the services and benefits of natural capital and fully account for the social and environmental costs of projects. A precautionary approach is needed that seeks to avoid impacts on natural capital and the services it provides. For example, a true accounting of environmental and climate risks may prove that relocating projects to sites with less impact will have a better return on investment. Given the unique global and regional importance of the Amazon as well as its significance to the individual nations, and the increasing pressures on the basin, the international community can play a critical role in supporting the nine Amazon countries by facilitating conditions for sustainable infrastructure.

We propose that the Group of 20 (G20) and the DFIs promote conditions for quality and sustainable infrastructure investment by: (i) supporting international public and private commitments and funding mechanisms to bolster Amazon countries' progress in conserving forests, maintaining natural capital, and promoting sustainable development; (ii) supporting sustainable infrastructure policies and guidelines that fully incorporate social and environmental costs for project selection and preparation; (iii) establishing lending principles that infrastructure investment must be compatible with land, water, and forest conservation and healthy ecosystems, necessary to maintain the Amazon's natural capital; and (iv) developing portfolios of small-scale, nature-based infrastructure projects in the Amazon that support local development, poverty alleviation, with conservation.

1. Supporting international public and private commitments and funding mechanisms to bolster Amazon countries' progress in conserving forests, maintaining natural capital, and promoting sustainable development

Forest protection has been a major policy priority for Amazon countries, supported by overseas development assistance programs over the last 30 years. In the early 1990s, the G7 plus Japan committed hundreds of millions of dollars in funding to Brazil to support government capacity at both federal and subnational levels in order to increase and strengthen protected areas and conservation in the Amazon. Through cooperation with the United States, the United Kingdom, and Germany, this support was extended to other Amazon countries and continues. In 2008, Norway led the establishment of the $1 billion Amazon Fund as the largest funding mechanism to protect tropical forests under the Climate Change Convention. The fund has been managed by BNDES, with 20% of the funding flowing to other Amazon countries (de le Mata and Riega-Campos 2014). The fund helped support a significant decrease in deforestation rates until recently, when rates began to climb again due to market pressures and fiscal and austerity reforms that have affected government capacity to advance forest conservation and local development (Assuncão, Gandour, and Rocha 2015; Moutinho, Guerra, and Azevado-Ramos 2016).

Commitments by Amazon countries to reduce deforestation and improve the provision of public services in the basin could be bolstered by additional international support, public and private, under the leadership of the G20. We propose that the G20 and DFIs support the development of funding streams that advance deforestation-free development models, as enabling conditions for sustainable infrastructure. Consistent with agriculture sector commitments, we also propose that the G20 and DFIs foster infrastructure deforestation-free commitments by the infrastructure sector and a working agenda that supports avoiding, minimizing, and offsetting forest impacts (Amsterdam Declaration 2015; Trase 2018).

2. Supporting sustainable infrastructure policies and guidelines that fully incorporate social and environmental costs for project selection and preparation

Achieving sustainable development requires new thinking about how to provide infrastructure services without further depleting the Amazon's natural capital. The failure to address environmental and social risks at the start of the project cycle—in national infrastructure planning and project selection—not only leads to unnecessary impacts and the loss of natural capital, it threatens project sustainability, performance goals, and financial returns (Watkins et al. 2017). The result is smaller pipelines of quality infrastructure projects. The primary tool that governments use to review sustainability components of major projects is the Environmental and Social Impact Assessment (ESIA). But the ESIA review generally comes too late in the project cycle for sustainability considerations to inform project alternatives and selection (Ritter et al. 2017).

The G20 countries and the DFIs should support Amazon countries in establishing a project prioritization framework that is applied at the national level at the start of the project cycle. This should include improving sector planning procedures and efficiencies and upgrading feasibility assessments as a critical step of project preparation. This will support sustainable infrastructure planning and project selection based on technical criteria and public consultation procedures. Currently, these actions are taken at the project licensing phase, which, while a key decision point for infrastructure development, is too late in the project cycle to adequately support sustainable infrastructure planning and project selection.

The project prioritization framework should be developed based on sustainability guidelines and criteria (IDB and IDB Invest 2018) and leading standards, such as the IFC Performance Standards (World Bank 2012). To support decision-making, the framework should require: (i) region-scale spatial planning information for the Amazon to identify and map potential points of complementarity and conflict for infrastructure development and natural capital, (McKenney et al. 2016); (ii) inclusion of the full environmental and social impacts and costs of potential projects; (iii) the assessment of options to meet infrastructure service needs outside and inside the Amazon; (iv) public consultation procedures; and (v) integration of all sustainability dimensions in the regulatory framework for public procurement at the national and regional level (Battacharya et al. 2019; Nofal 2017). This policy and institutional framework can be used to strengthen the evaluation of alternatives and trade-offs at the start of the project cycle, providing a more informed basis for delivering sustainable infrastructure and securing the Amazon's natural capital.

3. Establishing lending principles that infrastructure investment must be compatible with land, water, and forest conservation and healthy ecosystems, necessary to maintain the Amazon's natural capital

Consistent with lending principles to maintain natural capital, the G20 and the DFIs should support Amazon countries in establishing infrastructure investment plans that integrate sustainable development objectives and coordinate them with Amazon sustainability strategies and national policies, such as those for a low-carbon economy, biodiversity commitments, and sustainable development goals. This requires integrated plans for action that include Amazon-scale spatial planning information to identify and resolve potential points of conflict between infrastructure development and natural capital. In support of these plans, the G20 countries should work with multilateral, regional, and national development banks to increase sustainable project preparation and guarantee facilities that are managed at the country level and anchored by the development banks. The G20 and the DFIs should also develop specific and explicit environmental policies for investments in the Amazon in recognition of the region's unique importance for the world and the urgent need to maintain its natural capital. These policies should include requirements to assess options to meet infrastructure service needs outside the Amazon and ensure potential projects incorporate their full environmental and social costs.

4. Developing portfolios of small-scale, nature-based infrastructure projects in the Amazon that support local development, poverty reduction, and conservation

We propose that the G20 and DFIs promote the development of a portfolio of small-scale, nature-based infrastructure projects (OECD, World Bank, and UN Environment 2018) to meet local demands for universal services, such as energy, mobility, and transportation. Local energy systems (e.g., solar PV, wind, in-stream turbines, mini power plants) and river navigation can promote local green development that also supports standing forests and free-flowing rivers. This infrastructure can support local forest-based economies and markets in sectors such as food, cosmetics, medicines, and materials (Nobre and Nobre 2018).

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CHAPTER 8

DISASTER MITIGATION AND SOCIAL RESILIENCE: FROM HUMANS TO INFRASTRUCTURE

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Abstract

In order to mitigate disasters, all countries must be prepared with enabling laws, raised awareness, and stout infrastructure before a disaster happens to make "social resilience" stronger, meeting the needs of the people according to geography, climate, history, and scientific prediction of various natural disasters in each community and country. The theory of "preventive diplomacy" can be applied to the prevention of natural as well as human-induced disasters. By providing education, lifelines, and infrastructure support, we can make a difference to "human security" regardless of differences in race, religion, skin color, or nationality. We must actively seek out "common interests to avoid conflicts and wars, especially in the context of cyber and space domains including the natural resources of Arctic and Antarctic. These examples underline the urgent need to spread the concept of protecting "common interests" to everyone who does not yet realize its importance for more stable and resilient world community.

Introduction: Ensuring social resilience

A simple glance at the world map of conflicts leaves most of us speechless. At the same time, natural disasters such as earthquakes, droughts, floods, avalanches, volcanic eruptions, landslides, wildfires, hurricanes, tornados, cyclones, typhoons, and tsunamis are increasing every year.

In 2017 alone, losses caused by natural disasters amounted to $306 billion according to Swiss Re (2007). Therefore, we must consider how to ensure the resiliency of society from humans to infrastructure. The theory of "Preventive Diplomacy" can be applied to the prevention of natural, as well as human-induced disasters.

Preventive Diplomacy

Given these realities, if we are to have any hope of changing the world's dependence (historically speaking) on war to resolve disputes, it is important to revisit the concept and value of Preventive Diplomacy. The prevention of both natural and human-induced disasters should be rooted in Preventive Diplomacy and predicated on nonviolent means applied to resolving international conflicts, and these methods should be used whenever possible as a first resort.

In the case of natural disasters, the application of such Preventive Diplomacy also provides a platform for countries willing to cooperate with the global community—regardless of conflicting politics and ideologies—on behalf of their own people who live in local villages and towns, and suffer from disasters that are beyond their control. Therefore, I believe that natural and human-induced disaster prevention should be based on the same principles as Preventive Diplomacy.

In its simplest form, Preventive Diplomacy can be best explained by breaking it down into four stages:

(1) Preventing conflicts from breaking out

(2) Preventing conflicts from expanding

(3) Promoting ceasefires that stop the conflict to enable recovery

(4) Preventing the resumption of hostilities (44% of current conflicts in the world are recurring)

This same concept can be perfectly applied to natural disasters by:

(1) Preparing for natural disasters before they happen

(2) Rescuing victims quickly

(3) Recovering from the disaster

(4) Focusing on reconstruction that reduces risk in the event of another disaster

I believe in the Japanese saying, **"Be prepared and you will have no regrets."**

Proposals

I would like to propose three issues regarding people and infrastructure, which can contribute to disaster mitigation.

Proposal 1: Enabling laws

Japan suffered immensely after the Great East Japan Earthquake and Tsunami of 2011.
By 10 September 2018, the number of the deaths reached 18,432 and 2,536 people were missing. The cause of death for 90.6% of the people (14,308) was drowning. Furthermore, about 73,000 people are still displaced, and 402,704 houses and buildings collapsed. However, Japan may have suffered even more after the Great Hanshin Awaji Earthquake in 1995 (6,434 deaths, 76% of them crushed to death) due to legal restrictions. We learned a lot about the legal bindings from this natural disaster. As an elected member of the Japanese Diet, I worked hard to improve various laws and regulations. Some of the cases I worked on were:

Quarantine of detection dogs

An emergency rescue team from the United Kingdom arrived in Kobe with detector dogs 24 hours after the Great Hanshin Awaji Earthquake. However, the dogs could not be used because the law required them to be quarantined for 6 months. After the Great East Japan Earthquake and Tsunami on 11 March in 2011, on the other hand, 46 detection dogs from nine countries (Australia, Germany, the Republic of Korea, Mexico, the Netherlands, Singapore, Switzerland, the United Kingdom, and the United States) were unleashed immediately and returned to their own countries by 27 March 2011 after the mission was completed (MAFF 2011).

Foreign doctors' medical practitioner's law

Many medical doctors from overseas came to Japan to help the wounded, but because they did not have Japanese medical licenses, they could only serve as support staff. At the same time, offers of sending medical teams from the governments of Bangladesh, the People's Republic of China, Cuba, Greece, the Republic of Korea, Poland, Slovakia, Thailand, the United Kingdom, Yemen, and Yugoslavia were rejected because only doctors who possessed a medical doctor's license of Japan could provide medical treatment. With this, the Ministry of Health, Labour and Welfare immediately announced the acceptance of those nations' offers as "special and exceptional cases" on 23 January, 5 days after the disaster. Furthermore, after the 2011 Great East Japan Earthquake and Tsunami, medical units from Israel, Jordan, the Philippines, and Thailand immediately accepted, while 40 nations offered to send medical units (Tazunoki 2011).

Road Traffic Act

This law keeps private cars off the roads in an emergency or disaster. After the Great Hanshin Awaji Earthquake, there were many fires, especially in Kobe, because the earthquake happened while people were preparing breakfast. Many fire engines and ambulances from neighboring prefectures could not reach the disaster area because the roads were jammed with private cars trying to leave Kobe. The laws were amended and applied before the Great East Japan Earthquake and Tsunami 16 years later.

In addition to the laws above, **the earthquake-resistant building standards** were upgraded to withstand greater earthquake intensity; from intensity 5 to intensity 6. By 2017, 95.6% of elementary and junior high schools in Japan had been upgraded to these standards (Ministry of Education, Culture, Sports, Science and Technology 2015).

Every country must review its disaster-related laws.

Proposal 2: Awareness raising

After the Great East Japan Earthquake and Tsunami in 2011, men were much more likely to commit suicide than women. Therefore, we must encourage male friends and colleagues as well as female friends and colleagues to be more resilient in times of disaster.

These were **the problems pointed out** just before the Great East Japan Earthquake. In 2010, I introduced these warnings at the International Disaster Prevention Conference in Berlin as a keynote speaker. Unfortunately, these warnings were not heeded before the disaster occurred in 2011:

(1) People forget how **devastating tsunamis are as the years pass**.

(2) People **get used to warnings** and tend to ignore them.

(3) **Major breakwater seawalls built along the coast make residents complacent.**

We should keep these issues in mind, not only in relation to tsunamis, but also for other natural disasters. We must educate the public and take preventive and mitigative measures before they strike.

In Japan, elementary schools teach children how to protect themselves from disasters, especially earthquakes.

Proposal 3: Infrastructure

Multipurpose seawalls

To mitigate disaster, we need infrastructure, but its functions and purposes should be revisited.

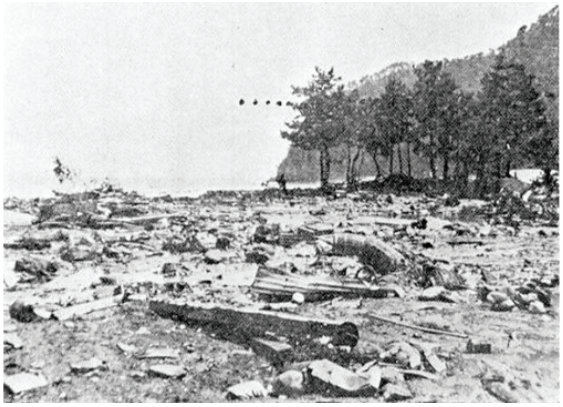
Figure 8.1: "Rainbow Deck" on the Atami Coast Completed in 1999

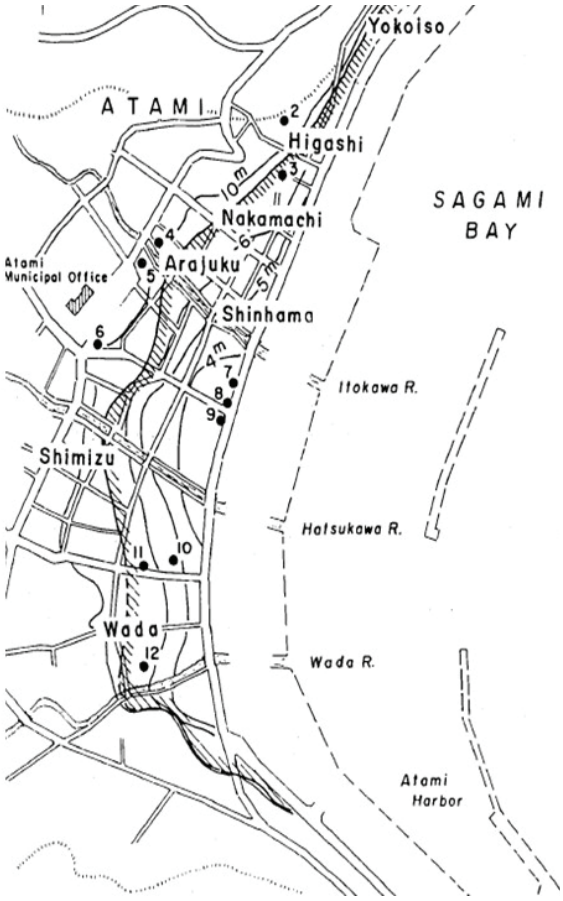
Source: Shizuoka Prefecture.

Seawalls in tsunami areas, for example, are usually high concrete walls that prevent people from enjoying the scenery. But the multipurpose seawall in Atami attracts tourists and is a successful example. Atami suffered from the Great Kanto Earthquake in 1923, with a tsunami estimated to be 12 meters high (Figure 8.2) (Hatori 1983). Since the booming growth period from 1955 to 1973 when Atami was well known for its *onsen* (hot springs), Atami's economy has worsened drastically and it has been referred to as the "forgotten *onsen* area."

However, the economy has recovered today due to the new multipurpose seawall that stretches along the seacoast, which Shizuoka Prefecture planned in cooperation with Atami City and related ministries of Japan (from 1989 to the present) (Figure 8.1).

Figure 8.2: **Atami Coast, Completely Destroyed by a Tsunami after 1923 Kanto Earthquake, Japan**





Source: Hatori (1983).

In 2017, the third engineering district was completed.[1] Each district has a specific theme. The theme of the third district is San Remo, Italy, a sister city of Atami, and the theme of the fourth and last district is the Aegean coast in Greece (Ministry of Land Infrastructure and Transportation 2017).The multipurpose seawall in Atami contributes to the citizens' multilateral activities (Figure 8.3). The wall attracts tourists as well as citizens during the annual fireworks festival. People can take a walk on the wide wooden deck attached to the seawall (Figure 8.3C) on the seaside. There is also an event space with an outdoor stage behind the seawall on the town side (Figure 8.3A), and performances are carried out attracting many people. The seawall also provides a footpath in braille, a wheelchair slope, and a public car park under the three-layered seawall.

[1] This project was planned with four engineering districts from the beginning. The first engineering district was completed in 1996 and the second district was completed in 1999. Then, the seashore park was constructed in 2005. The third engineering district was completed in 2017, and the fourth engineering district is currently under construction.

Figure 8.3: Close-up of Multipurpose Three-layered Seawall along Atami Coast

Note: (A) upper deck, (B) middle deck, (C) lower deck made of wood.
Source: Shizuoka Prefecture.

The cost of construction was much higher than for an ordinary seawall. However, the cost performance is good and the ripple effect of being able to take walks, have an ocean view, parking, and attracting tourists not just from neighboring areas, but also from overseas is of great value for the citizens. A beach and yacht harbor are also a part of the long-term plan.

The most important element of the success of this long-range overall seacoast building plan is explained in the following three points. First, Shizuoka Prefecture provides questionnaire surveys periodically for the citizens and policy evaluation by the related ministries. Second, is the transparency of information and data. Third, is an analysis of cost-effectiveness. For example, the cost-use benefits for the Nagisa area is ¥65.1 billion and for the Taga area is ¥7.6 billion, which comes to a total of ¥72.7 billion. The traffic congestion benefits in the Taga area is ¥1.8 billion. Therefore, the cost benefits of the overall seacoast building plan is ¥8.31 billion, the Ministry of Land, Infrastructure and Transport announced in May 2009 (Ministry of Land Infrastructure and Transportation 2009).

Infrastructure should be designed and established based on a long–term multipurpose development plan considering the future for communities, villages, towns, and cities overall. To achieve this, municipal budgets should be combined with the financial support of the relevant ministry.

Smart City

A Smart City is an urban area that efficiently manages the use of data collected by the internet of things' technologies. The concept of a Smart City started from the effective use of power grids for renewable energy sources through smart meters and an online control system. Now, it includes electric consumption by power meters, traffic flow rates by velocity sensors, the amount of garbage in containers, as well as weather and water levels. The data collected from the various sensors can be used for prevention and mitigation during a disaster as well (Figure 8.4). For example, the system of a Smart City can make evacuation recommendations for people based on real-time data of the water levels. When a disaster strikes, drones used for the maintenance of infrastructure can be launched to take pictures of the various areas of a city to get a clear look at the situation. A Smart City is also capable of the efficient use of limited resources in the recovery phase, along with providing information of shelters and transportation teams.

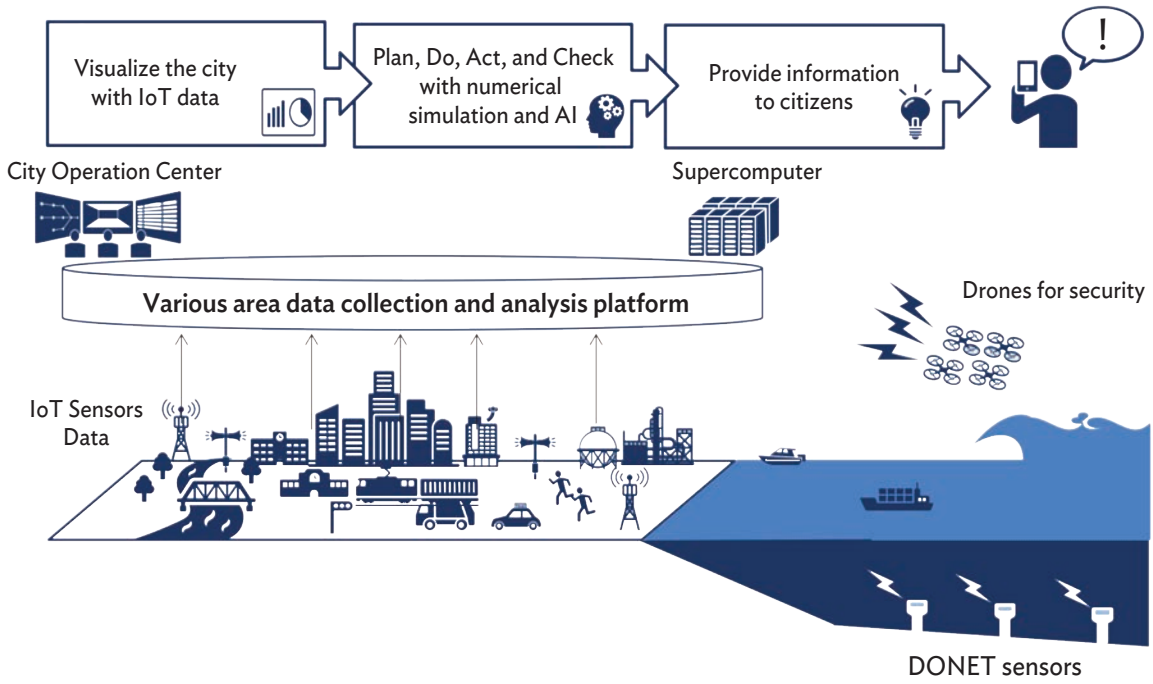
The rapid growth of computational power and the development of the numerical code of the tsunami-wave propagation system will help with an evacuation as follows:

(1) Start simulations of wave propagation immediately with information of the earthquake parameters (epicenter and magnitude), which will obtained by the measurement of seismographs and other sensors located on the seafloor.

(2) The results of the prediction of the tsunami height (better than 1 hour accuracy) and the arrival time (less than 1 minute) in various places will come out much earlier than the first wave from the actual tsunami would arrive.

(3) The predictions and evacuation recommendations will be sent to the people in the affected area through off-the-shelf ICT technologies, such as smartphones.

Figure 8.4: "Smart City" Framework Connecting City Operation Center with Various Sensors



AI = artificial intelligence, IoT = internet of things.

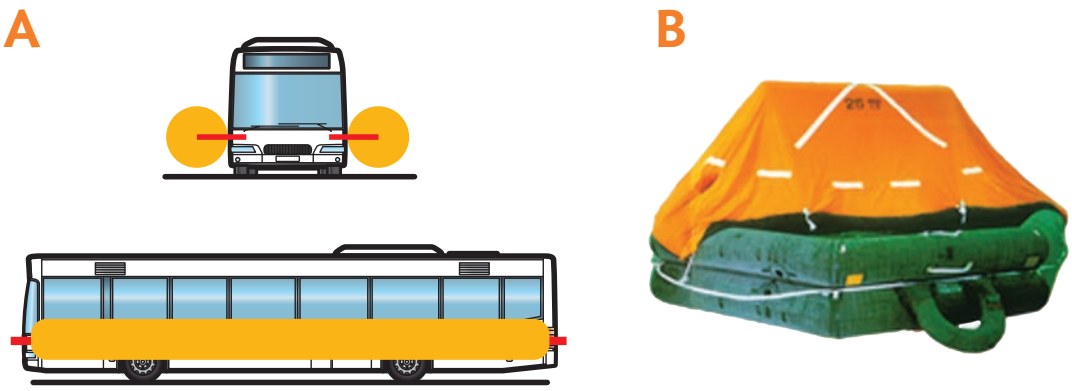
Note: Sensors include drones over the sea, seismometers on the seafloor, connected to a supercomputer. The data are immediately transferred to individuals via ICT devices, such as smartphones.

It will help with evacuations and the prioritization of countermeasures for infrastructure. Such numerical simulations are also effective to sound the tsunami alarm earlier to trigger rescue activities. Citizens will be safer if we can combine numerical simulations and Smart City solutions.

Floatable vehicles

Most (93%, 14,680) of the deaths (15,786) caused by the tsunami in the 2011 earthquake off the Pacific coast of Tohoku were drowning (Japan Police 2012). The ARCA project, a project to develop floatable vehicles, is aimed at saving people from drowning during a tsunami as in Noah's Ark in the bible. ARCAs will have the capacity to protect people from being crushed by debris and low temperatures, and the ability to survive up to 72 hours before rescue arrives (Figure 8.5). One candidate for the ARCA project is a bus (Figure 8.5A). If a bus can stay afloat for several days less able people (i.e., infants, sick and old people, and pregnant women) and the people left behind can get on the remodeled bus and survive in the most severe conditions of a tsunami. The additional cost of remodeling a floatable vehicle can be as low as 10% of the original cost of the bus. On the other hand, families who are living near the coast can have inflatable rescue boats prepared (compact and in storable form) in their houses. They can be inflated in 30 seconds, which will serve as ARCAs for families when a tsunami arrives. A rescue boat for five people in which minor changes are made from those used on ships, can be supplied at a price less than ¥450,000 (equivalent to about $4,000).

Figure 8.5: Examples of Floatable Vehicles



Notes: (A) A bus becomes floatable if floats are attached on both sides. (B) Families living near the coast can prepare an inflatable rescue boat in their houses.

Source: https://www.fujikuracomposites.jp/lid/jp/ship/detail01.html.

Conclusion: Addressing common interests

In order to mitigate disasters, all countries must be prepared with enabling laws, raised awareness, and stout infrastructure before a disaster happens to make social resilience stronger, meeting the needs of the people according to geography, climate, history, and scientific prediction of various natural disasters in each community and country. Regarding construction funds, although everybody claims a shortage of funds, we must use our own wisdom to find various ways to fulfill the purpose. Atami's case is a good example of why there should be a long-term plan and the result of the collaboration of various ministries through projects as well as prefectures and cities to meet the goals of multipurpose plans of cities and/or coast building is a positive one. Another way is to set a special tax for the purpose of disaster mitigation. If a city or town wants to invite large-scale enterprises, these private sector entities can invest in the area and operate as part of their corporate social responsibility. Crowd funding is another possibility if the scale of infrastructure is not too big.

We must actively seek out common interests to avoid conflicts and wars, especially in the context of cyber and space domains, and through our shared interest in the world's fragile natural resources including the Arctic and Antarctic regions. The Arctic is melting at an alarming rate as a result of climate change, and the Antarctic Ocean is a focus of fierce competition against the backdrop of a 99-year moratorium on commercial development protecting seabed resources that will run out soon. These examples underline the urgent need to spread the concept of protecting "common interests" to everyone who does not yet realize its importance.

We must cooperate and work together to build a much safer world community. By providing education, lifelines, and infrastructure support, we can make a difference to human security, regardless of differences in race, religion, skin color, or nationality.

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CHAPTER 9

ECONOMIC EFFECTS OF INFRASTRUCTURE INVESTMENT FROM LAND-BASED FINANCING

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Abstract

The challenges of the modern world, such as urbanization, and the urgent need to increase access to infrastructure are forcing many countries to look for new solutions to support economic growth and a sustainable development agenda. Meanwhile, there is the problem of the infrastructure investment gap, when state development institutions are in dire need of money to implement the long-term infrastructure projects. According to the *Global Infrastructure Outlook*, the demand across 50 countries and seven sectors to 2040 for investment resources could reach $97 trillion (Oxford Economics 2017). To solve this problem, the active participation of private companies is proposed through the framework of public–private partnerships. In July 2016, the Group of 20 (G20)/Organisation for Economic Co-operation and Development Task Force on Institutional Investors and Long-term Financing provided a supporting note to the Guidance Note on Diversification of Financial Instruments for Infrastructure and SMEs to the G20 Finance Ministers and Central Bank Governors and the G20 leaders. Land-based financing was indicated among innovative financial approaches; its mechanism uses land jointly with financial and/or tax instruments (such as tax increment financing), so that infrastructure investment spurs growth in the economic sector as a whole. At the same time, there are a number of challenges when applying this tool that should be resolved for practical successful implementation.

Challenge

Land-based financing (LBF) is an investment tool used by governments to generate income from private land and then redistribute it through private actions with stakeholders. We can see a promising side of the land-based approach in developing countries, since land can become a profitable asset with proper management and tax measures, and the national currency will be used to protect against risks. Let us draw attention to the complex aspects that require collective decisions.

Investors may experience complex difficulties

Some of these difficulties are associated with raising capital and investor confidence, while others are dictated by unformed money circulation tools. Key concerns include a possible land asset bubble, misunderstanding of how “unlocking” land value may work, risks, lack of interaction policies, among others (UN-Habitat 2016).

Governments do not know what to do and how

The policy of government participation and coordination with private capital should be formed with the consideration of account tax, managerial, and sociocultural factors. The key task is also to explain how public authorities can exchange land assets for infrastructure assets. This understanding should inspire governments to provide the necessary institutional, legislative, taxation, and other measures (OECD and World Bank 2018).

Tax instruments may still be unpopular

Tax policy has been and remains a sensitive issue, especially as developed-country models cannot be replicated in the context of developing countries. At least six land-based financing taxation tools exist, each with its own pros and cons. Tax uncertainty, thus, forces governments to choose between excessively high or insufficient rates, opportunities, and risks (UN-Habitat 2016).

Decentralization is considered an inappropriate step leading to loss of control

Decentralization is an important decision, as it allows cities to grow, therefore infrastructure should not be too centralized either. However, this step is difficult for governments that must transfer the management of vital assets to cities. On the other hand, cities cannot use effective tax, management, or other measures, because they simply have no rights to do so (OECD 2017).

Working to solve this complexity of problems (which can include dozens of different objections and controversial points) can help stakeholders start land-based financing and earn revenues.

Proposal

Various solutions can be proposed for more effective implementation of the LBF tool.

The first step is a systematic approach and long-term participation

Designed solutions from time to time return us to the basic concepts related to investment, taxation, and institutional approaches. The first solution can be a systematic approach, acting across disciplines in all areas, to obtain the most effective results. A systematic approach involves investing in cities as a whole, but not in individual projects, which is why land-based financing involves such complex (i.e., “core”) measures as legislation, municipal management, taxes, and even reforms. Analyzing the highlighted difficulties, we suggest the following measures.

What needs to be done:

- creation of unified tax, legislative, enforcing policies
- sharing opportunities between the public and private sectors
- focus on long-term expectations and stable land management

Long-term participation implies that the processes last long, are complex, and require certain changes or upgrades. The creation of infrastructure and the respective economy that appears around it and generates income takes a long time. Ultimately, such a large-scale problem as the provision of clean water in developing countries requires the largest amount of investment, as well as needing effective measures.

This is, therefore, not a project that investors and governments can start merely gathering enough capital. While using a long-term (systemic) approach, countries can also solve the missing-middle problem by introducing private capital to public funds (UN-Habitat 2016).

Launching decentralization and transferring rights to municipalities

Institutional reform is a must for the implementation of land-based financing. Whether there is a meaningful intermediary government between the national government and the local government, it is often the case that the central authority must adopt enabling legislation, creating the legal framework for the land-based financing instrument. The local government must then adopt a local ordinance implementing the instrument and setting out the details for its administration within the local context. Municipalities will be able to gain the institutional capacity to manage debt or a portfolio of built assets. This will open the way to balanced capital management. Central and local authorities can be involved in a dialogue to build win-win frameworks, when decentralization becomes an effective measure, not a risk, from a financial point of view, among others (OECD 2017).

From this perspective, we can see reform as an opportunity to exchange municipal provision of services for public–private partnerships, which improve the quality of services delivered. Grant financing of municipal infrastructure can be replaced by debt financing. Finally, cities will be able to get quality services, operating with capital and developing infrastructure, which is the basis of economic development. However, before giving municipalities elevated rights, it is necessary to understand that they can come to a certain financial stability. Municipal revenue streams can be improved by rational fiscal policy; in other words the stability of own-source revenues.

In developing countries, the government can be far from the people, and grant projects do not provide effective results, especially systemic ones. But decentralization makes the government closer to society. Decentralization as a set of policies and frameworks delays revenues where it works, elected officials become more responsible, and the development of local government capacity increases.

Land shows advantages by generating revenue

Public and private participation in land-based financing changes the outlook on what land can give. By selling or leasing publicly-owned land, economies receive income for infrastructure investments. Economies, guided by the opinion of specialists, should provide that the expectations from land financing should not be overstated, but rather rational. The obtained revenue cannot be used in the operational budget, but must work to developing the complex infrastructure.

The other related question is: How does the value of private and public wealth compare? Is it possible that public action and/or investment can lead to increased private wealth? Public actions can increase the well-being of all who are connected with the land. There are many tools, such as partnerships and joint participation of the public and private sectors, but another side is adherence to the policy by users of services.

Parties receive income that can be further invested and capitalized. Common goals bind the parties and lead to a common result, such as infrastructure development.

Land financing can be used to:

- cover the cost of providing public goods
- cover the cost of providing public infrastructure investments
- stimulate the efficient use of land
- receive state compensation for the private use of land owned by the party-state
- cover the costs of managing private construction
- increase tax revenues
- create a land registration system

The parties must also understand that land is a unique asset. That is why sociocultural norms highly value land and can be perceived as a difficulty if we are not sensitive to them. People must know in advance what kind of land can be used, how it relates to the people, and what are the possibilities to develop it.

Taxes are becoming a living tool for infrastructure development

Properly selected tax measures, in combination with an understanding of the land-based tax regulation at all levels, can play a key role in the infrastructure financing process. Recurring taxes on land and buildings can serve as follows:

- finance local infrastructure costs
- provide benefits in public finances
- lead to land value sharing

It is also important to consider the following factors:

- Compatibility of tax policy with the traditions of property management and/or taxation in the country.
- Creation of a fiscal cadastre linking real estate with taxpayers. This allows parties to track all existing communications with a certain land.
- Tax policy should be formed taking into account modern realities. If markets are ready to introduce certain rates, then it can be set.
- Administrations should participate in the creation of tax policy and propose their measures, literally influencing the process of infrastructure development in real time.

Tax policy should be the subject of active discussion in every country. Many tools can be reviewed and applied regardless of how they worked in developed countries since the market specifics vary greatly from region to region. Annual property taxes may be revised and other tools reinstated. Betterment levies, especially when collected as special annual assessments, can increase attractiveness for private investors.

Developer exactions can mitigate the expected negative effects of development

The objectives with which this tool may be used are region specific. The infrastructure of each country may have its own characteristics. But, for example, developer exaction (one-time fee paid up-front by developer as a precondition for public approval to develop land) may offset the municipal costs associated with larger water and wastewater lines building, demand for vehicle access, public spaces, among others.

Parties should contribute to establishing developer exactions at many levels, such as legal, planning, engineering, and administration levels.

This tool has its negative sides, such as high prices, which are returned to users of services. Therefore, fees should be considered with caution, in a system of comprehensive measures to ensure infrastructure projects and systemic reforms.

Investors should not be afraid "to enter this plot of land"

Private capital still assesses the risks of investing in developing countries. There are several systemic measures that can be taken by states and implemented at a broad level:

- supporting the institutional capacity of municipalities
- creating a monitoring and reporting system to control decentralization
- implementing measures related to debt financing
- regulating the introduction of infrastructure
- the public sector still has to provide important parts of the projects
- governments should focus on dialogue with the private sector

Finally, the debt must be expressed in the local currency, since foreign income is limited in this sector. The use of the local currency also prevents the risks associated with fluctuations in exchange rates and solves many issues of private investors.

It is also worth making it clear to investors that land is an excellent source of income, besides the fact that it may be a traditional little-used state asset.

Land has many advantages:

- the management of land is more transparent; land is in a fixed place
- land financing may allow subnational governments to gain independence
- taxes related to land ownership are generally less risky for the tax system as a whole, compared to other types of property

Many studies highlight the link between the level of urban infrastructure and economic growth, poverty reduction, and the quality of life. According to Mathur, 9% to 10% of economic growth depends on how a city's infrastructure is developed (Mathur 2018). Transport is one of the most important areas for working in this space. Although the mechanism for obtaining benefits from transport infrastructure is more like cost recovery, it is a necessary step to build an effective economic chain at all times, and taken at a higher level.

Creation of consistent policies

Consistent policies imply a holistic work of the land-based financing mechanism. Parties should also receive information on the detailed plans and projects directly, taking into account the systemic approach. Data on land, parties, partnerships, and legislation should be communicated to the parties and publicly disclosed.

Important points to note are:

- registration of land, identification of connections—land cadastre
- systemic legislation—each norm of which is in agreement with another norm
- support for processes involving state participation

It is also possible that social policy is a lost moment, and specialists ought to pay attention to other negative effects associated with the growth of economies in developing countries. The infrastructure will serve as a basis for solving the set tasks, but social analysis may also play an important role.

However, there is still an extremely important condition to be mentioned. All these solutions to reduce the infrastructure gap will only work in developing countries with growing economies. It cannot be done in crisis situations or in total poverty. In conditions of severe poverty, starvation, or unemployment, infrastructure development will most likely not be considered a priority field. That is why the first thing a government should do is stabilize the national economy, and most preferably create conditions to support constant growth. Thus, countries are the stakeholders, on which the development of infrastructure also depends. Governments representing the will of the whole country can find an opportunity for dialogue with the private sector, municipalities, developers, and civil society to provide quality services, without which further growth and investor profits will not be possible.

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CHAPTER 10

GLOBAL TARGETS ON DRINKING WATER

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Abstract

The Millennium Development Goals (MDGs) have passed their target year, and are followed by the Sustainable Development Goals. One of the achieved MDG targets was halving the proportion of the population without sustainable access to safe drinking water. In the course of the MDGs, how and why was the target achieved, and what contributed to the achievement? It was revealed that the major contributors to the achievement of the target were the People's Republic of China and India, and that the increase in the proportion of the population with access to improved sources of water was closely associated with economic development in most nations between 1990 and 2015.

Challenge

The Millennium Development Goal (MDG) Target 7C in terms of drinking water, "Halve, by 2015, the proportion of the population without sustainable access to safe drinking water", was achieved for the first time in the long history of global targets on drinking water, partly because the targeted water coverage was set at a less ambitious level. It should also be noted that significant progress in the People's Republic of China and India associated with their rapid economic growth accounted for halving the proportion of people without access to improved water sources, while the other half of the proportion was left behind.

It should be also noted the target on "safe" drinking water was not *literally* achieved—the proportion of the people with access to "improved water sources" reduced from 24% in 1990 to 11%, less than half (Fukuda et al. 2016). In 2010, however, the indicator of "improved water sources" overestimated the coverage level of "safe" drinking water.

These are the reasons why Sustainable Development Goal (SDG) Target 6.1 was set as "universal and equitable access to safe and affordable drinking water for all." SDG Target 6.1 is the most challenging target in the history of global safe drinking water targets, because it aims to leave no one behind, and the monitoring indicators are more specific and demanding. Providing service to accessible (located on premises), available (whenever needed), and safe drinking water (free from fecal and priority chemical contamination) to the 2.1 billion people who currently lack such access, and achieving it by 2030, is ambitious.

Proposal

How and why MDGs were achieved and should be reviewed

As we enter the new era of the SDGs, it is meaningful to understand how and why the MDG targets (or its monitoring indicator) were achieved or not achieved, in order to derive experiences that could be potentially useful to promote the challenges to accomplish the new SDG drinking water target. A wide variety of factors should have contributed to the achievement of the MDG targets, such as 1A on poverty, 7C on water, and 7D on slum dwellers, political factors, the flow of funds, and internal efforts of individual countries. A better understanding of the causal relationships among these factors and the achievements of the global goals should contribute to more effective and efficient policy making.

In particular, whether the synergetic relationship between drinking water access and economic development will be consistently true during the SDGs period should be further studied.

Target level of global goals should be carefully crafted

The MDG-target set for water—"to halve the proportion of the population without access to safe drinking water"—was criticized for widening the disparity between the rich and poor countries and leaving behind the most vulnerable groups. Since governments and donors tend to invest in the less vulnerable groups to more easily make progress, this was ironically called "picking low-hanging fruit." That is the reason why most of the SDG targets are set based on the idea of "no one will be left behind," and "achieve universal and equitable access to safe and affordable drinking water for all" was set as SDG Target 6.1. However, this is not the first time that 100% coverage was set in global drinking water targets. The targets have been continually revised over more than half a century, with the targeted water coverage swinging between easily achievable levels and 100% coverage, because the World Health Organization considered that the targets that were too high or too low and would fail to encourage developing countries in their efforts to invest in water service expansion. We should learn from past experiences on how to set an appropriate target that stimulates the motivations of governments and other stakeholders the most (Fukuda, Noda, and Oki 2019).

Appropriate indicators should be designed

Even though it was the first such target ever achieved in the long history of internationally agreed global targets on drinking water, the simplified monitoring indicator could have led to the mistaken conclusion that the MDG target on safe drinking water had *literally* been achieved, because the indicator of improved water sources overestimated the coverage level of safe drinking water. A new indicator for drinking water was introduced for SDG Target 6.1, in order to measure the attributes, such as the quality, accessibility, and availability of drinking water, which could not be measured by the previous indicators. As such, indicators to monitor the progress of achieving the targets should be designed appropriately based on past experiences.

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Appendix

This policy brief does not intend to criticize the MDG drinking water target, as some other studies have, for leaving the most vulnerable behind. The significant efforts made by developing countries and donors toward the MDG drinking water coverage target were rewarded with an official announcement of its achievement, and that should help them to maintain the motivation for pursuing the SDG water coverage target. It should be also reminded that having a challenging target for global water coverage, such as SDG Target 6.1, could be relevant in that such a target stimulates each country's motivation and investments.