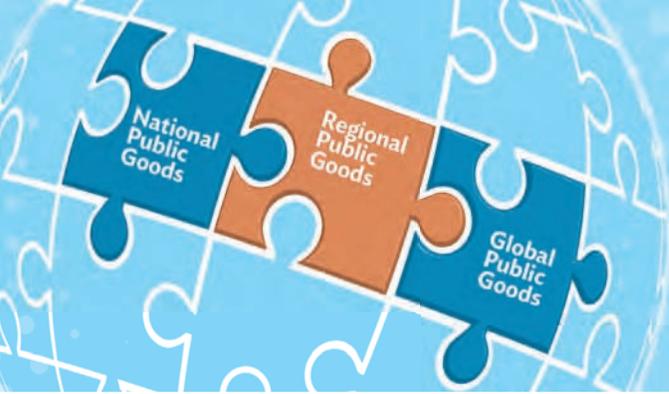




7

**Toward Optimal Provision
of Regional Public Goods
in Asia and the Pacific**



Introduction

Globalization, along with increasing trade, capital flows, movement of people, and rapid evolution of information and communication technology, is generating more cross-border interdependence, spillovers, and externalities of economic activities and policies. In Asia, regional trade and financial linkages have strengthened significantly over the past 2 decades along with globalization.⁵⁰ The evolution of economic growth and development in Asia is therefore characterized by global and regional linkages.

Growing regional economic interdependence and integration has created development challenges that can be most effectively dealt with collectively. Climate change and environmental pressures in the region continue to grow. Increased cross-border flow of agricultural commodities and people raises the potential for the spread of contagious diseases. Financial globalization confers benefits to capital-deficit economies, but also poses risks of financial contagion.

Solutions to these issues are available through the provision of public goods. Public goods play an important role in economic development. For example, investment in social overhead capital often provides important assistance to private capital in building an economy's productive capacity. Such investment may include transportation links, power grids, communication networks, and established property rights—all of which can lay the foundation for infrastructure that sustains development. Extending the benefits beyond one country requires regional perspectives and approaches.

Regional public goods (RPGs) are public goods whose benefits extend beyond a single nation's territory to a well-defined region (Sandler 2013). The case for RPGs embodies the need to harness the opportunities

of regional cooperation and integration (RCI) and to take collective action to tackle challenges shared by neighboring economies. Good examples of RPGs include cross-border infrastructure connectivity as well as efforts to deal with transnational issues such as environmental degradation, the spread of infectious diseases, and the promotion of regional financial stability.

Regional efforts can complement national and global efforts. Regional arrangements can encourage collective action to take on transnational challenges. With fewer nations involved, regional arrangements can reduce uncertainty and help increase mutual trust among concerned economies. They can take advantage of spatial and cultural proximity in supplying RPGs collectively. Repeated long-term interactions among a small group of economies in the region can facilitate compliance with international arrangements. Multilateral developments banks (MDBs) can increase RPG provision via reducing knowledge and financing gaps. MDBs play the role of an honest broker and coordinator to enhance mutual trust and facilitate regional cooperation to help regional economies take collective actions to deal with transnational challenges.

While demand for RPGs has increased as RCI has deepened, a major difficulty in providing regional public goods is the tendency for under-provision due to their properties: the absence of a market for these goods means that consumption by people who have not paid for the good cannot necessarily be excluded. Such incentives to “free ride” can lead to a collective action problem (an extension of the well-known “Prisoners’ Dilemma”) among parties involved and act as a block to adequate supply. Indeed, suboptimal outcomes are the result for all participating countries when each nation acts unilaterally.

⁵⁰ Asia refers to the 48 Asia and Pacific members of the Asian Development Bank (ADB), which includes Japan and Oceania (Australia and New Zealand) in addition to the 45 developing Asian economies.

RPGs are a complex concept due to significant ambiguity in both the “regional” and “public goods” components and the following challenges to measurement of RPGs. Unlike the benefits of national and global public goods (GPGs) that can be seen within certain boundaries and are well identified, it is more difficult to determine the spillover effects of RPGs. The scope of benefits may be unclear, and placed somewhere between public goods that are national or global in nature. This makes identification of RPG beneficiaries difficult, which often generates less incentive to invest in public goods that can solve regional market failures.

The types of desirable provision mechanisms also vary by the way individual nations contribute to aggregate RPG provision. For example, while benefits of tropical rain forests are global, a regional action to protect a rain forest that extends over more than one country has a clear comparative advantage. Identifying influential players in preserving the shared resource is the key, and financial and technical assistance for the countries’ lacking funds and knowledge capacity would motivate them to provide the RPG.

Accordingly, there are several reasons why the study to enhance conceptual clarity of RPGs is useful to understand RPGs. First, it is important to distinguish RPGs from other classes of public goods and to identify factors that either facilitate or inhibit their provision. Second, RPGs take various forms, each with a distinct set of properties that determine the incentives for provision. Some RPGs are provided effectively by the countries themselves, while others require assistance from regional institutions that have a wider operational experience as well as funding capacity and technical expertise. An understanding of the incentives to provide RPGs is necessary to establish whether scope exists for intervention from multilateral institutions. Third, the study on the concept and issues of RPGs can help analyze the effectiveness of different policies in fostering RPG provision.

Therefore, the next section revisits the concept of RPGs and analyzes issues that impede adequate provision of RPGs in Asia with a view to offering some guidance for a

policy framework on how the region can work together toward better RPG provision. In the third section of this chapter, the rising importance of RPG provision is examined as regional cooperation and integration is increasing and the need to take collective action to address complex and transnational development challenges is further required in Asia, and a snapshot of RPG provision is presented using a few measures. In the fourth section, practical approaches to identifying and measuring RPG benefits are also discussed, alongside case studies on provision mechanisms in various sectors and regions such as Europe, Latin America and the Caribbean, and Asia. The last section presents policy considerations by RPG functional areas and a mode of RPG provision to stress the roles of RPG suppliers, in particular the roles of MDBs based on their strengths.

Concepts, Typologies, and Issues in Efficient Provision

Concepts and Typologies of RPGs

RPGs in this chapter refer to “public goods whose benefits extend beyond a single nation’s territory to some well-defined region.”

The definition of RPGs, adopted from Sandler (2013, 2018a), stem from being “public” and being “regional.” The representation of public goods commonly used today stems from Musgrave (1969), who defined them in terms of two “classic” properties.⁵¹ First is nonexcludability, which implies that once a good is provided, everyone will enjoy the benefits of its consumption (that is, benefits cannot be withheld from nonpayers for the good). Second is nonrivalry, that is, one person’s consumption does not diminish the consumption opportunities of others (Cornes and Sandler 1996). When a public good satisfies both properties, this is considered as a “pure” public good. The examples of pure public goods include national defense, lighthouse, public health, and public knowledge

⁵¹ The concept of “public goods” came to maturity in the middle of the 20th century, owing largely to the contributions of Paul A. Samuelson and Richard A. Musgrave. In his 1954 seminal paper “The Pure Theory of Public Expenditure,” Samuelson laid the foundation for the contemporary theory of these goods by offering the first mathematical definition of public goods.

Table 7.1: A Classification of Goods

	Rival	Nonrival
Excludable	Pure private good	Club good (impure public good)
Nonexcludable	Common-pool resource (impure public good)	Pure public good

Source: Mankiw (2015).

such as official statistics published by government agencies, which are available to all including those who do not pay for their benefits, while their consumption does not diminish the benefits enjoyed by others.

However, most public goods are “impure,” meaning that they are partially rivalrous and/or partially excludable. Types of impure public goods include (i) “club goods” which involve some excludability but do not involve rivalry among the group of users, and (ii) “common-pool resources” which involve rivalry but not excludability (Table 7.1).

An example of a club good is a toll road where additional vehicles using the road do not reduce the benefits (up to a maximum road capacity) enjoyed by current users, but they can be excluded if they do not pay the toll. A common pool resource includes a shared fishing ground in a region where one country’s catch reduces the fish stock available.⁵² In general, partial nonexcludability could easily occur when costs for maintenance need to be charged at minimal levels while partial rivalry could arise when the quality and quantity of RPGs could be worsened when there are a large number of participating countries in a club (Sandler 2013, Cornes and Sandler 1996). Further examples of RPGs are illustrated in Table 7.2.

As much as being “public” may not be easily defined for a certain good, being “regional” is often elusive to appropriately capture the reach of the good’s benefits.

Goods can easily change from being public to private and vice versa, subject to policy decisions with legal

and institutional setups. For example, a book is a private good, but the words it contains are only private if protected by copyright laws. Knowledge is a public good, but inventions are private only when patented. Without copyright and patent laws, the writers and inventors may not have incentive to provide innovations that produce public benefits. On the other hand, many nonprofit organizations make research and information freely available, making the good public. As such, being public may not be defined by characteristics such as nonrivalry and nonexcludability, but by prevailing social values and the perception of what good should be provided by society through nonmarket mechanisms.

Like being public, being regional is also subject to a geographic definition that in many cases is set through national policy and/or intergovernmental decisions. Limitations are inherent in the definition of “a region” whose boundaries are seldom well-defined (De Lombaerde et al. 2010). A region can be defined variously in geological, geoclimatic, geographic, cultural, or political terms (Sandler 2004). The degree of interconnectedness with other countries can influence the definition of a region. Furthermore, a region’s boundaries may change over time (Estevadeordal and Goodman 2017). The size of a political union can grow as more countries join. The expansion of a region implies that the number of potential beneficiaries increases.

While the scope of benefits of RPGs is often used to distinguish the classes of public goods (being either national, regional, or global public goods), it is rather difficult to clearly delineate the boundaries of these benefits between nations or regions in practice.

National public goods (NPGs) such as national security, lighthouses, and national parks, produce public benefits that remain within a national border. GPGs such as the protection of the ozone layer and climate change mitigation can produce benefits worldwide. RPGs such as controlling regionally contained diseases, cross-border infrastructure connectivity, and a regional

⁵² Another class of public goods are “joint products,” which result in multiple outputs that vary in their degree of publicness (Sandler 2003). Joint products may yield both country-specific benefits and nonexcludable regional benefits. For instance, electricity generated from renewable sources can provide domestic consumers with electricity at a premium (a country-specific benefit) and can reduce pollution in the region by displacing fossil fuel-based electricity sources, which is a regional pure public benefit (Kotchen 2006).

Table 7.2: Examples of Regional Public Goods and Their Benefits/Externalities

Function	Regional Public Goods	Benefits/Externalities
Economic Cooperation and Integration	Bilateral and regional trade agreements	Reduces discriminatory trade restrictions and promotes peace and security
	Prevention of financial contagion	Prevents spread of negative shocks such as excessively volatile exchange rates and equity prices
	Regional liquidity support through regional financial agreements	Promotes regional macroeconomic and financial stability
Human and Social Development	Response to outbreaks of emerging and reemerging diseases	Reduces health-related loss of work hour and labor productivity
	Elimination of communicable diseases	Breaks chain of transmission within region. May serve as stepping stone to global elimination
	Preventing emergence of resistance	Prevents reduction in the region's working-age population who are affected by the virus' resistance to drugs
	Unrestricted knowledge generated from research and development particularly beneficial to the region	Improves the quality of life in the region through technological advances in fields such as medicine and education
	Advisory services and research on agriculture through regional agricultural organizations	Increases agricultural productivity in the countries applying such knowledge
Natural Resources and Environment	Reduction in greenhouse gas emissions and climate change adaptation	Lowers the risk of climate change (such as rising sea level, changing growing seasons, and increased droughts and heatwaves) while adaptation reduces the damages from climate change to particular countries
	Control of air pollution transboundary in nature	Reduces prevalence of diseases related to air pollution as well as occurrence of acid rain
	River basin management	Benefits all riparian states in terms of water sharing, flood control, water quality
	Control of marine pollution and protection of regional seas	Protects marine life and is especially beneficial to coastal states.
	Control of persistent pollutants	Protects human health and the environment
	Control of hazardous waste transport	Benefits countries with weak governance that import wastes
	Marine fisheries management	Increases sustainable yields and prevents collapse of stocks
	Food security and resource management through regional cooperation	Promotes consistent supply of food and other agricultural products, as well as conservation of their sources
Connectivity	Cross-border transport and ICT infrastructure and national infrastructure that involves cross-border dimensions	Expands trade opportunities and promotes freer movement of commodities and inputs
	Trade facilitation such as customs reform and national single window	Facilitates international trade, faster movement of perishable goods
Peace and Security	Nonproliferation of nuclear weapons	Provides a security to all countries in the region and beyond
	Prohibition on nuclear testing	Limits development of new weapons, and therefore a technological arms race
	Prevention of terrorism	Promotes influx of investments and tourists, as well as stable business environment
	Preventing state failure	Promotes market stability and investor confidence
Governance	Nonproprietary technical standards	Encourages adapting best practices for increased productivity and growth
	Harmonized standards and higher quality education through regional cooperation	Promotes regionwide labor productive gain due to wider access to quality education
	Harmonization of intellectual property rules	Increases knowledge production at the margin; it would also redistribute rents to past research and development

ICT = information and communication technology.
 Source: ADB based on Barrett (2018a, 2018b).

Figure 7.1: Classes of Public Goods, by Scope of Benefits

* It is possible for the public good to be partially rival and/or partially excludable, in which case it would be an impure public good.
Source: Fredriksson and Wolff (2018).

disaster warning system, lie in between national and global public goods in the scope of benefits (Figure 7.1). However, NPGs are becoming increasingly interlinked and challenging the domain of regional and global public goods. For example, national defense, commonly considered an NPG, may have cross-country spillovers if it affects the likelihood of conflict between countries within a region. Reducing air or water pollution can be considered an example of an NPG and RPG, since a country doing so provides benefits of cleaner air or water domestically and to its neighbors, but such benefits may not necessarily have global reach. Most GPGs are indeed more regional in nature than global, as many public goods are at least on some level excludable and only to some degree nonrival, confining the benefits to a certain geographic scope.

Overall, some concepts of being “public” and “regional” are used together to define RPGs by most RPG suppliers including MDBs.

For example, the Asian Development Bank (ADB) defines an RPG as “a benefit shared by two or more countries in a region” under its strategy for regional economic cooperation and integration (ADB 2006). The operational definition of RPGs used by the Inter-American Development Bank (IDB) is “goods, services, or resources that are produced and consumed

Table 7.3: Definition of Regional Public Goods—Multilateral Development Banks and the Literature

MDB / Literature	RPG Definition
Asian Development Bank	A benefit shared by two or more countries in a region
African Development Bank	Goods or services whose benefits are shared by a group of countries in the same region in a nonrival and nonexcludable way
Sandler (2013, 2018a)	RPGs are public goods whose benefits extend beyond a single nation's territory to some well-defined region.

MDB = multilateral development bank, RPG = regional public good.
Sources: ADB (2006), AfDB (2013).

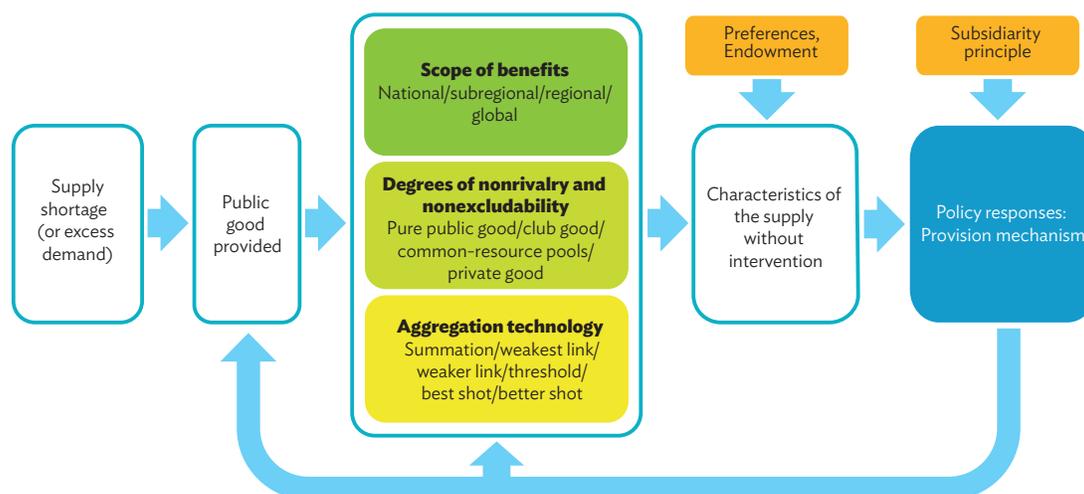
collectively by the public sector and, if appropriate, the private, nonprofit sector in a minimum of three borrowing member countries of the IDB” (Tres et al. 2014). The African Development Bank (AfDB) defined RPGs as goods or services whose benefits are shared by countries in the same region in a nonrival and nonexcludable way (AfDB 2015) (Table 7.3).

Issues in Efficient Provision of RPGs

This subsection touches upon four key properties of determining RPG provision. Those four key properties help determine countries’ incentives to contribute to RPG provision and the scope for collective action, including the degrees of (i) nonexcludability; (ii) nonrivalry; (iii) aggregation technology (that is, how individual contributions add up to make the socially available level of the public good); and (iv) the scope of benefits (Figure 7.2). The effectiveness of provision mechanisms mainly depends on these properties, and potential interventions should therefore be tailored accordingly.

For instance, in response to bottlenecks in road transport network where it is nonrival and excludable and the role of a country with the poorest transport network is the most influential, multilateral institutions can provide capacity building and funds if the country lacks knowledge and financial resources. Efficiency of the RPG provision mechanism may also depend on

Figure 7.2: An Overview of the Regional Public Good Provision Process



Source: ADB based on Sandler (2018a, 2018b).

country-specific endowment and preferences as well as whether the subsidiarity principle can hold; i.e., if the scope of benefits is matched to the jurisdiction of the RPG supplier.⁵³

MARKET FAILURES

The two properties of public goods, making it extremely difficult to exclude consumption by others once provided (termed “nonexcludability”) and making it extremely difficult for one party’s consumption of a good to diminish consumption by others (termed “nonrivalry”), give rise to market failures that may require policy interventions to facilitate provision.

Nonexcludability means that it is costly to prevent nonpaying parties from consumption of a good’s benefits. In this context, the incentive to contribute to the provision of nonexcludable RPGs would be weak due to the free-riding problem (see Box 7.1 for a game theoretic approach to the free-riding problem). Market failures are also caused by nonrivalry of benefits which implies the marginal cost of extending consumption to another user is zero (Hardin 1997). An efficient allocation of nonrival RPGs requires a price of the

public good equal to the marginal cost which is zero. However, charging a price above zero for nonrival RPGs is allocatively inefficient, since this implies charging additional users for enjoying the benefits from the good even if it costs nothing to include them. The inefficiency can be reduced if governments tax its consumption and redistribute the revenue. However, citizens’ valuations of the good are often unknown and difficult to estimate in practice. Further, imposing a tax at a transnational level may require a supranational authority, which may not exist (Arce M and Sandler 2002).

“Impure” public goods are less undersupplied or overused because of limited exclusion and partial rivalry compared to “pure” public goods.

The inefficiency associated with impure public goods is less extreme than that of pure public goods if some exclusion is practiced to account for consumption-related incremental costs such as user charges (Sandler 2013). Club goods such as highway networks are subject to congestion; in this case toll charges can enhance efficiency by internalizing negative spillovers of congestion via identifying a price mechanism such as charging toll fees. If there is no price mechanism to

⁵³ The subsidiarity principle indicates that allocative efficiency is achieved when an institution’s jurisdiction precisely matches the benefit range of the public good (Olson 1969; Sandler 2004, 2006).

Box 7.1: Game Theoretic Approach in Public Goods Provision: The Linear Public Goods Game

Suppose that there are N countries, and that each country must decide whether to contribute to the public good. Country i ($i=1, 2, \dots, N$) chooses to provide the good ($q_i=1$) or not to provide it ($q_i=0$) with the objective of maximizing its payoff unilaterally, denoted π_i , taking as given the provision choices of all other countries in the region. The provision of a regional (linear) public good can be viewed as a “game” in the sense that, the outcome any country i is able to realize depends not only on what country i does but also on what the other country does.

The simplest representation of payoffs is for a linear public good:

$$\pi_i = bQ - cq_i, \quad \text{where } Q = q_i + Q_{-i} = q_i + \sum_{j=1, j \neq i}^N q_j$$

where Q is the aggregate provision by all countries, q_i the amount provided by country i , Q_{-i} the amount supplied by all countries except country i , b is a benefit for one more unit of provision, and c is a cost for one more unit of provision.

It can be shown that every country will supply the good if $b > c$. However, every country will want not to supply the good if $c > b$, i.e., “not provide” becomes a dominant strategy, which leads to the Nash equilibrium where no country can gain by changing what it is doing, given what all the other countries are doing.

Alternatively, all countries in the region can act collectively to choose provision levels q_1, q_2, \dots, q_N so as to maximize the collective payoffs, denoted Π , assuming that an agreement to cooperate among players is binding:

$$\Pi = \sum_{j=1}^N \pi_j = (bN - c)Q$$

It can be shown that that every country contributes to the public good if $bN > c$ and not to supply it if $c > bN$. This solution describes the full cooperative outcome of the linear public goods game.

The first row in the table below shows the conditions under which countries have neither unilateral nor collective incentives to supply the public good. The next row shows the conditions that apply when countries have unilateral incentives to supply the public good, and this is also the best possible outcome for the entire region. Finally, the last row shows the conditions under which the region does best when every country supplies the public good, but no country within the region has an incentive to supply the public good unilaterally. It describes provision of the public good as the “Prisoners’ Dilemma” game.

Solutions in the Linear Public Goods Game

Condition	Nash Equilibrium	Full Cooperative Outcome	Interpretation
$c > bN$	$q_i^{NE} = 0$	$q_i^{FC} = 0$	The good is not provided and should not be provided.
$b > c$	$q_i^{NE} = 1$	$q_i^{FC} = 1$	The good is provided and should be provided.
$bN > c > b$	$q_i^{NE} = 0$	$q_i^{FC} = 1$	The good is not provided, but should be provided (Prisoners’ Dilemma).

Source: Barrett (2018a).

internalize negative spillovers, then impure public goods are overused.

AGGREGATION TECHNOLOGIES

Understanding how individual nation's contribution adds to the overall provision of RPGs (so called "aggregation technology") can help RPG suppliers, including nations and MDBs alike, take the most appropriate modes of provision to avoid collective action problem.⁵⁴

Aggregation technology may include, for example, "summation," "weighted sum," "weakest link and weaker link," "threshold," and "best and better shot" (Table 7.4).

Summation. A summation aggregator indicates that the level of the public good is determined by the sum of all contributors' provision. This type of public goods is exposed to the strongest free-riding incentive. In reducing greenhouse gas emissions, for example, the overall reduction would be equal to the sum of the decrease in each country's emission level. However, a noncontributing country can easily enjoy the benefits of climate change mitigation by relying on the efforts of other countries. Such free-riding problem can result in the aggregate reduction much less than needed. As such, regional and subregional institutions can fund RPGs with the summation technology through loans or grants. Efforts to fund RPGs can be bolstered by charitable foundations, partnerships, or nongovernment organizations.

Weighted sum. For a weighted-sum aggregator, each contributor's provision can be assigned an empirically determined weight when determining the overall level of the public good. Weighted-sum aggregators have less free-riding incentives as countries are informed about how they impact total provision. Examples include the reduction of acid rain or river pollution, for which

a country's relative location affects its ability to clean up the pollutant. In an acid-rain scenario, downwind countries are the main recipients of depositions and are, therefore, motivated to reach agreement with other countries to control sulfur and nitrogen emissions. When regional and subregional institutions take a lead to bolster countries' actions, scientific monitoring data allow these institutions to distribute their resources among countries, where these resources can have the greatest effect based on spatial and other factors.⁵⁵

Weakest link and weaker link. For a weakest-link aggregator, the smallest contribution determines the aggregate level of RPG provision. Weakest-link aggregation for instance is associated with actions that curb the spread of an infectious disease. Disease outbreaks are most likely to occur in those countries with the poorest disease-controlling capacity. Policy intervention would be efficient when it is directed to the most vulnerable economies in need for funding and capacity building. If all countries in a region have the same endowments and preferences, weakest-link public goods present less efficiency concerns; that is, resources are unlikely to be wasted as each country's provision is likely to match the smallest contribution. When endowments differ and poorer countries cannot afford to contribute, necessary assistance can be provided by regional and subregional institutions in the form of grants and capacity building.

A less extreme form of weakest link is weaker link, where the smallest contribution has the greatest influence on the aggregate level of RPG provision, followed by the second smallest contribution, and so on (Cornes 1993, Cornes and Sandler 1996, Sandler 1992). For example, maintaining regional financial stability is the typical weakest- or weaker-link RPG, whose level is disproportionately determined by one or more countries with the most vulnerable financial institutions and the poorest financial practices. When endowments differ by country, shoring-up efforts are still needed by regional and subregional institutions.

⁵⁴ One of the earliest papers on the aggregation technology of public goods is Jack Hirshleifer's 1983 article "From Weakest-Link to Best-Shot: The Voluntary Provision of Public Goods," where it was called a "social composition function." Afterwards, this concept was discussed by Harrison and Hirshleifer (1989), Cornes (1993), and Cornes and Sandler (1996). Formally, the term aggregation technology then appeared in latter works such as Conybeare, Murdoch, and Sandler (1994); and Sandler (1998). See Cornes and Sandler (1996) for mathematical expressions of aggregation technology.

⁵⁵ The Convention on Long-Range Transboundary Air Pollution program and the Acid Deposition Monitoring Network are intended to ascertain the weights based on the monitored dispersion of pollutants from the source to the recipient countries (Chung 2017).

Table 7.4: Selected Aggregator Technologies—Characteristics and Recommendations

Technology	Illustration	Characteristics of the Technology and Recommendations
<p>Summation</p> $Q = \sum_{i=1}^n q_i$ <p>curbing greenhouse gas emissions</p>	<p>Individual contributors: C, B, A Total RPG provided: A + B + C</p>	<p><i>Characteristics:</i></p> <ul style="list-style-type: none"> Free-riding tendency due to the presence of countries relying on the efforts of others Prisoners' Dilemma tends to arise <p><i>Recommendations:</i></p> <ul style="list-style-type: none"> Regional institutions can provide funding (grants, loans) Other institutions can bolster the support
<p>Weighted sum</p> $Q = \sum_{i=1}^n \alpha_i q_i$ <p>reducing acid rain or river pollution</p>	<p>Individual contributors: C, B, A Total RPG provided given country weights 2, 1, 0.75: 2A + 1B + 0.75C</p>	<p><i>Characteristics:</i></p> <ul style="list-style-type: none"> Less of a free-riding tendency Countries with larger impacts are incentivized to act <p><i>Recommendations:</i></p> <ul style="list-style-type: none"> Regional institutions can provide information on countries' impacts Institute monitoring Distribute resources according to countries' impact
<p>Weakest link</p> $Q = \min \{q_1, \dots, q_n\}$ <p>reducing the spread of an infectious disease</p>	<p>Individual contributors: C, B, A Total RPG provided: A</p>	<p><i>Characteristics:</i></p> <ul style="list-style-type: none"> Efficient if all countries have the same endowments and preferences Problem arises when poorer countries cannot afford to contribute <p><i>Recommendations:</i></p> <ul style="list-style-type: none"> Capacity building is the key Regional institutions can shore up weakest-link countries through grants
<p>Threshold</p> $Q = \sum_{i=1}^n q_i \geq \bar{Q};$ <p>otherwise 0</p> <p>malaria elimination</p>	<p>Case 1: threshold > A + B + C Case 2: threshold < A + B + C</p> <p>Individual contributors: C, B, A Total RPG provided: A + B + C</p>	<p><i>Characteristics:</i></p> <ul style="list-style-type: none"> A higher threshold provides a greater incentive to act Coordination problem in reaching the threshold <p><i>Recommendations:</i></p> <ul style="list-style-type: none"> Regional institutions can design thresholds Motivate (reward) countries to be part of the threshold contributors Global institutions can assist
<p>Best shot</p> $Q = \max \{q_1, \dots, q_n\}$ <p>Development of vaccines/Best practices and measures to contain financial contagion</p>	<p>Individual contributors: C, B, A Total RPG provided: A</p>	<p><i>Characteristics:</i></p> <ul style="list-style-type: none"> Hegemony fosters provision Coordination may be difficult for multiple best shooters It becomes an issue when a region is devoid of a best shooter <p><i>Recommendations:</i></p> <ul style="list-style-type: none"> Loans are appropriate to assist best-shooter countries Regional institutions can pool actions for large-scale best-shot RPGs

RPG = regional public good.

Note: Q is overall amount of the public good available for consumption, q_i is a contribution of country i , α_i is a weight, and \bar{Q} is a threshold.

Source: ADB based on Sandler (2018a).

Threshold. The threshold aggregator requires provision of the public good to meet or exceed a certain level before benefits are generated. Threshold RPGs offer greater incentive than summation RPGs to act until the threshold is obtained. A higher threshold provides more incentives to provide toward efficient outcome. For example, in eliminating infectious diseases such as malaria in a region, countries may take possible measures independently and/or collectively to ensure that the required level of aggregate efforts is reached. Regional and subregional institutions can identify or design a threshold so that more efficient provision is achieved.⁵⁶ These institutions can also pool efforts by contributing funds of their own and reaching out to other institutions.

Best shot and better shot. For best-shot public goods, the largest contribution determines the available level of RPG. For example, the development of vaccines would have the best chance of success if the most technologically advanced country takes the lead. Loans are appropriate to assist best-shooter countries. At the regional level, the issue becomes a coordination issue when there are many potential best-shooter countries because only a single capable country needs to provide the best-shot RPGs. Regional institutions can serve to coordinate and prioritize actions among the leader countries. If the best-shooter country is not available, then regional institutions can pool actions or coordinate action among subregions. For large-scale best-shot RPGs, funds from global institutions or other multilateral institutions can be solicited.

Better-shot public goods are a softer version of best shot, for which the largest contribution has the biggest marginal influence on the overall provision, followed by the second-largest contribution, and so on. Governance and institutions often involve developing best practices, which are typical examples of better- or best-shot RPGs. More practical examples include regulatory practices, banking practices, and benchmarking data (Berg and Horrall 2008). Better-shot public goods require less need for hegemony, pooling of actions, and outside intervention than the best shot case of many potential best shooter economies. Since more than one country is willing to provide, there is less need to coordinate or concentrate provision activity.

THE SCOPE OF RPG BENEFITS AND THE SUBSIDIARITY PRINCIPLE

The subsidiarity principle indicates that allocative efficiency is achieved when an institution's jurisdiction precisely matches the benefit range of the public good.

If the public good's range of spillover benefits is greater than the institution's jurisdiction whose members supply the public good, provision decisions will fail to account for some benefit recipients, resulting in under-provision (Sandler 2004, 2006). On the other hand, if the range of spillover benefits is smaller than the institution's jurisdiction, over-provision is anticipated as non-recipients cover some of the good's provision cost. Therefore, the subsidiarity implies that global public goods should be provided or assisted by global institutions, while RPGs should be provided or assisted by regional institutions.

A blind application of the subsidiarity principle, however, may be undesirable due to economies of scale and spillovers associated with RPG provision.

Adherence to the appropriate jurisdictional arrangement can boost efficiency, reduce transaction costs, and promote institutional evolution and innovation (Table 7.5). On the other hand, economies of scale may justify an RPG-providing jurisdiction whose domain exceeds that of a good's spillover range if the reduced unit costs offset any inefficiency losses. For example, in peacekeeping missions, the United Nations can achieve scale economies which may not be achievable at the regional or subregional levels. Similarly, economies of scope refer to cost-savings when two or more RPGs are supplied by the same institution regardless of heterogeneous benefit recipients. Tailoring jurisdictions to these spillover ranges would result in a proliferation of jurisdictions, which is costly to support. In practice, when the requisite regional institution or jurisdiction is absent, the next nearest (smaller or larger) jurisdiction can assume the role.

⁵⁶ Other design principles that promote optimal supply for a threshold RPG is to allow for cost sharing or refundability if the threshold is not reached (Sandler 2004).

Table 7.5: Supporting and Detracting Factors for Regional Subsidiarity

Supporting Factors	Detracting Factors
<ul style="list-style-type: none"> • Bolsters efficiency by matching recipients' marginal gains with marginal provision costs • Curtails tax spillovers to non-beneficiaries, thereby fostering efficiency • Limits transaction costs by augmenting repeated interactions, reducing asymmetric information, and curtailing the number of participants • Promotes the evolution of regional institutions based on shared culture, experiences, challenges, norms, and values • Fosters intraregional institutional innovations • Focuses on participants with the most at stake 	<ul style="list-style-type: none"> • Economies of scale favor larger jurisdictions than RPG's spillover range • Economies of scope support providing two or more RPGs whose spillover ranges do not coincide • Economies of learning may require oversized jurisdictions to augment the cumulative RPG provision • Requisite subsidiarity-based institution (jurisdiction) may not exist • Too costly to tailor jurisdictions to each subregional public good owing to the proliferation of jurisdictions • Aggregator technologies (e.g., best shot, better shot, and threshold) may favor pooling efforts beyond requisite jurisdiction • Aggregator technologies (e.g., weakest link and weaker link) may require that participants bolster capacity beyond the spillover range of the public good • Requisite financing may require a jurisdiction beyond the good's range of benefit spillovers

RPG = regional public good.
Source: Sandler (2018a).

OTHER FACTORS TO CONSIDER IN RPG PROVISION

The provision of RPGs can be also affected by region-specific circumstances and conditions.

First, some regions may lack a dominant country and consequently leadership in providing RPGs. This issue may be less severe on a global level, as developed countries may either lead by example by providing the global public goods (GPGs) themselves or encourage other countries to also contribute to provision (Arce M and Sandler 2002). Second, regions may be prone to rivalries and local disagreements that reduce the scope for collaboration (Collier et al. 2003, Sandler 2013). Third, donors have traditionally relied on global and national institutions, as opposed to regional institutions, to provide public goods (Sandler 2013). Regional institutions that are often in the best position to promote the provision of RPGs may therefore be weaker in terms of reputation, experience, and capacity (Sandler 2006).

On the other hand, factors such as a smaller number of participants and proximities in geography and culture can facilitate RPG supply relative to GPGs.

Cooperation is more likely to succeed if the size of the group is small and thus, coercion between members is strong (Olson 1965). Countries within a region are

located close to each other and may be culturally similar (Estevadeordal and Goodman 2017). As such, they are more likely to regularly interact and may therefore have strong incentives to abide by agreements (Sandler 2006). These can give more scope for collective action than for GPGs by reducing the costs of cooperation or enforcing agreements to provide RPGs.

Regional Public Goods in Asia

Regional Cooperation and Integration and RPGs

Asia's demand for RPGs has been rising as the region is being more interconnected.

Asia has progressed rapidly on regional economic integration over the past few decades, driven by, in particular, trade and investment and the expansion of regional value chain. Asia's intraregional trade share has grown, from 53.2% in 2001 to about 57.8% in 2017, while 68%⁵⁷ of Asia's total exports participated in the global value chain in 2017. Foreign direct investment inflows within Asia have risen in the same steady manner, from about \$61.8 billion in 2001 to \$260.0 billion in 2017, with intraregional share increasing from 46.6% to 50.2%

⁵⁷ This is measured by the share of value-added contents of gross exports used for further processing through cross-border production networks.

during the same period. Intraregional share of portfolio equity (debt) rose from 11.7% (7.7%) in 2001 to 18.1% (16.4%) as of December 2017. Migration within the region similarly climbed, from about 23.6 million in 2000 to 30.2 million in 2017.

Increasing regional and global integration creates risks that can go beyond national borders and cross generations. The global financial crisis of a decade ago reversed years of development in many countries, while economies and financial systems continue to be vulnerable to the risk of financial contagion. Following the 1997/98 Asian financial crisis, Asian countries recognized the need for a regional mechanism to avert crises, mitigate financial contagion risks, and improve regional policy dialogue and cooperation to deal with potential policy spillovers (Huh and Park 2017). Other regional challenges have emerged in various sectors, including environment and climate change, health and disease, energy, trade, and transport facilitation.

Collective action is required to address increasingly complex and transnational development challenges. However, various obstacles to cooperation, such as diverging national interests, exist.

Climate change affects countries unevenly, and scientific uncertainty about its impacts contributes to divergent interests and incentives to act. Reforms in the global financial system are made difficult when countries do not agree to more stringent standards to protect their national banking systems. Information asymmetries such as insufficient information about corruption or local authorities' implementation also hamper donors' willingness to contribute, while limited resources and capacity make it difficult for low-income countries to reform different economic sectors. Centered on the common goal, knowledge sharing and dissemination as well as support for capacity building can help narrow information gaps and reduce the uncertainty of cooperation failure (Ötger-Robe 2014). When incentives are not aligned, an incremental approach may be useful because it helps communicate the benefits of collective action.

Regional cooperation can promote RPG provision that complements national efforts to advance national welfare.

With fewer nations involved than in global agreements, regional arrangements can complement global frameworks and help effectively provide global public goods such as malaria control and elimination. Regional arrangements can reduce uncertainty and take advantage of spatial and cultural proximity. Past and ongoing interactions among a small group of regional economies facilitates compliance of regional arrangements (Sandler 2006).

Greater provision of RPGs via regional arrangements can promote regional cooperation and integration (RCI). The experience of the European monetary union, for instance, shows the benefits of regional collective actions and how regional institutions can help move the process along, including through proper sequencing from a common currency to regional full regulatory and supervisory integration (Box 7.2). A regional labor mobility framework and a human capital development mechanism are increasingly promising forms of RPGs for aging Asia because they facilitate migration from labor-surplus to labor-deficit countries (Box 7.3).

MDBs can help promote RCI through the provision of RPGs as they have substantial regional expertise in knowledge, finance, and coordinating country efforts.

MDBs can help to reduce knowledge gaps to demonstrate the benefits of regional projects and boost cooperation among member countries in reaching regional agreements. National capacities can be harnessed into higher regional standards and benefit from economies of scale, while financial resources can be mobilized to help low-income countries develop capacity and implement RPG projects. MDBs also reduce the costs of coordination among governments, lifting efforts to tackle common development issues. MDBs play an important role in achieving the Sustainable Development Goals (SDGs) where a systematic link between RPGs and those goals can be established (Box 7.4).⁵⁸

⁵⁸ The Sustainable Development Goals (SDGs) represent a global agenda with 17 goals to end poverty, protect the planet, and ensure prosperity for all. The goals were adopted as part of the 2030 Agenda for Sustainable Development adopted by 191 member states of the United Nations in September 2016. (United Nations. About the Sustainable Development Goals. <https://www.un.org/sustainabledevelopment/sustainable-development-goals/> [accessed September 2018]).

Box 7.2: Financial Stability in Europe

Europe's historical quest for exchange rate stability lies at the root of the European monetary integration process. An urgent push toward integration came with the crisis of the Bretton Woods international monetary arrangements, which collapsed in 1971 with the suspension of dollar convertibility. Exchange rates were a particular concern to countries that were very open and traded a lot with each other. Moreover, exchange rate volatility would have increased the cost of administering the European Common Agricultural Policy (CAP) (McNamara 1998, Eichengreen 2007).

The Maastricht Treaty, ratified in 1992, laid out a set of convergence criteria for prospective members to meet to join the monetary union.^a In May 1998, 11 countries met these and formed the nucleus of the monetary union, which then expanded to today's 19 members. On 1 January 1999, the euro was introduced and the Eurosystem—the European Central Bank (ECB) and the central banks of European Economic and Monetary Union (EMU) countries—took responsibility for monetary policy in the euro area.

The monetary union, however, still suffered the typical weakness of fixed exchange rate systems—i.e., that no institution could force central banks to intervene to support the currencies of other countries. The single currency had a huge impact on financial flows within the euro area. The convergence of short- and long-term yields, coupled with persistent differences in inflation rates, led to marked divergence in real interest rates. In the so-called “South” (or “Periphery”) of the euro area, interest rates dropped to historic lows. With access to a euro area-wide (as opposed to country-wide) markets for funds, this led to a boom of private indebtedness and the development of large current account imbalances within the monetary union. The volatility underlying the capital flow movements became clear during the euro crisis in 2011, when capital flows suddenly stopped and reversed, revealing an underlying structural economic divergence that was hardly sustainable.

The crisis also revealed that the euro area lacked tools to prevent macroeconomic imbalances and financial imbalances—i.e., strict and uniform micro-prudential banking

supervision (Claeys 2017). Efforts at regulatory harmonization left supervision to an exclusively national level: even monetary unification in 1999 was not accompanied by the establishment of supranational institutions for financial supervision and resolution, even though there was a logic for it (Folkerts-Landau and Garber 1992; Schoenmaker 1997; Darvas, Schoenmaker, and Véron 2016).

In 2009, the report from the “de Larosière group” appointed by the European Commission concluded that the supervisory framework needed to be strengthened and recommended the creation of three European supervisory authorities: European Banking Authority, European Securities and Markets Authority, and European Insurance and Occupational Pensions Authority. This also recommended that a European Systemic Risk Board be established to monitor macroprudential risk (but without active macroprudential powers). These initiatives were meant to ensure closer cooperation and better exchange of information between national supervisors and to shape the further development of a “single rulebook” applicable to all the European Union countries.

The bolder institutional development was the establishment of the European banking union for euro area countries, triggered by the self-reinforcing negative feedback loops between banks and issuers of sovereign debt that characterized the euro crisis. The existence of national supervision and resolution for banks that, in the euro area, tended to be overexposed to government bonds created a correlation between banking and sovereign debt crises, which in the context of a monetary union triggered a balance of payment crisis (Merler and Pisani-Ferry 2012). The European Council of 28–29 June 2012 agreed to shift bank supervisory authority from the national to the European level, delegating it to the Single Supervisory Mechanism within the ECB. Overall, national supervisors would have little incentive to internalize the cross-border effects of their domestic decisions, and could be prone to capture by their local political systems. A supranational supervisor like the ECB is better placed to oversee the transnational dimension of domestic policy and identify potential risks for the euro area.

^a The inflation rate should be no more than 1.5% higher than the average of the inflation rates in the three European Union (EU) states with the lowest inflation. Government deficit should be no more than 3% of GDP. Public debt should be no more than 60% of GDP. Exchange rate should be within a $\pm 15\%$ range from an unchanged central rate stable interest rates. The 10-year government bonds shall be no more than 2% higher than the average of similar 10-year government bond yields in the three EU states with the lowest inflation.

Box 7.3: Cross-Border Labor Mobility and Human Capital Development in Aging Asia

In Asia, aging societies in some countries and a growing workforce in others provide an opportunity for labor mobility. Advanced economies in the region are facing aging populations as their working-age population (ages 15–64) declines. According to the United Nations, by 2030, the workforce is expected to contract by 10.4% in Hong Kong, China; 10.3% in the Republic of Korea; and 8.7% in Japan. In contrast, most countries in the region will expect significant increases in their working-age populations by 2030, ranging from 6.8% (Viet Nam) to 33.0% (Papua New Guinea). Kang and Magoncia (2016) project that labor migration from surplus countries is more than sufficient (i.e., a net surplus of around 443 million by 2050) to cover the needs of host (aged and aging) countries.

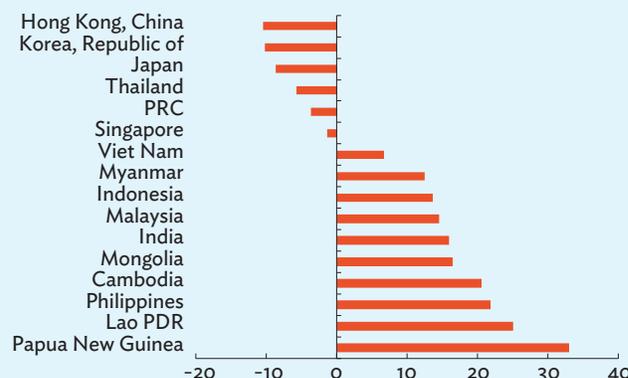
The benefits gained from both trade and labor mobility liberalization far exceed the anticipated gains from removing barriers to trade or capital flows (Clemens 2011). The estimated global gains are as large as \$3.4 trillion (Hamilton and Whalley 1984) and up to \$1.97 trillion a year even without full migration in 2004 (Moses and Letnes 2004). In terms of efficiency gains, Iregui (2003) notes that eliminating global restrictions could result in gains from 15% to 67% of the world’s gross domestic product (GDP). Moses and Letnes (2004) also show that a 10% increase in international migration corresponds to an efficiency gain of about \$774 billion.

However, Asia remains a region of large net emigration, where the number of Asians moving to destinations such as the Middle East, North America, and Europe far exceeds those moving within Asian countries. The share of intraregional movement of people in Asia has declined, from 47.5% in 1990 to 34.7% in 2017. Preference for non-Asian destinations is becoming more apparent as educational attainment rises at a fast pace. Tertiary educated migrants from Thailand to Organisation for Economic Co-operation and Development (OECD) countries more than doubled from 2000–2011 to 2010–2011, followed by Brunei Darussalam (a 74.3% increase), the Philippines (73.8%), and Myanmar (67.2%) (Batalova, Shymonyak, and Sugiyarto 2017).

Creating and implementing a labor mobility framework and a human capital development mechanism can help countries in the region to improve portability of skills, increase job opportunities, and reduce costs of migration.

Portability of occupational skills across national borders often remains limited, and recognition mostly relies on host country schemes. As such, the Mutual Recognition of Skills within the Association of Southeast Asian Nations (ASEAN) have

Projected Percentage Change in Population Ages 15–64 between 2017 and 2030



Lao PDR = Lao People’s Democratic Republic, PRC = People’s Republic of China. Source: ADB calculations using data from the United Nations, Department of Economic and Social Affairs, Population Division. International Migrant Stock: The 2017 Revision. <http://www.un.org/en/development/desa/population/migration/data/estimates2/estimates17.shtml> (accessed May 2018).

great potential to catalyze labor mobility across borders. Labor facilitation can move beyond mutual recognition agreements by introducing more active policies to facilitate movement across a wider array of skills. Where skills are portable, they are often not linked to job opportunities and are not widely known to professional organizations.

In addition, multilateral arrangements for cross-border labor mobility such as in harmonized skills and qualification recognition schemes reduce the costs of migration. Hredzak and Yuhua (2011), for instance, found that travel costs for Asia-Pacific Economic Cooperation (APEC) business cardholders were reduced by 38% (over a 12-month period from 2010 to 2011), while visa application time improved by 43.3% and immigration processing by 52.4%. The program also brought a 27.8% saving on visa application fees. Moreover, multilateral frameworks on skills recognition and enhanced mobility provide greater flexibility to workers and firms than bilateral processes.

Transparency should also be improved to mitigate exploitation. High migration costs arise from multiple layers of recruitments where workers compete to “buy” limited vacancies. Household workers and agricultural workers can find themselves in highly exploitive work environments. Recipient employers signing cooperation agreements with sourcing agencies abroad can help but monitoring costs can be high if done bilaterally. Implementing a regional framework to set a standard on labor mobility scheme will eliminate duplicate efforts.

Source: Kikkawa (2018).

Box 7.4: The Role of Regional Public Goods in Achieving Sustainable Development

Regional public goods (RPGs) can be found relevant for all 17 Sustainable Development Goals (SDGs). Under “zero poverty” or SDG 1 for instance, target 1.5 seeks to build the resilience of the poor and reduce vulnerability to climate-related extreme events and other economic, social, and environmental shocks and disasters. Climate risk insurance mechanisms will help mitigate these risks, while investment in dams or irrigation to reduce drought risk will generate greater productivity. RPGs are also relevant in the health sector. In the Association of Southeast Asian Nations (ASEAN), the

Rational Use of Medicines program was identified as a priority under the ASEAN work plan on pharmaceutical development for 2011–2015. It was a timely initiative to address aging populations, emerging communicable and noncommunicable diseases, increasing income and health literacy, and demands for new medicines and other health technologies (ASEAN 2017). RPGs in other sectors can also contribute to a wider range of SDGs.

Sustainable Development Goals and Regional Public Goods

Sustainable Development Goal		Examples of Related Regional Public Goods in Asia
 	No poverty, climate action (Goal #1, #13)	Climate risk financing strategies in the Greater Mekong Subregion
 	Food security and sustainable agriculture and land management (Goal #2, #15)	Regional research institutions on agriculture, ASEAN+3 Emergency Rice Reserve
	Health and well-being (Goal #3)	Regional cooperation in health, the Rational Use of Medicines program
	Equitable quality education (Goal #4)	Harmonizing standards in education in ASEAN Economic Community
 	Gender equality, reduced inequalities (Goal #5, #10)	Integrating small and medium-sized enterprises and women in employment, trade, and microfinance
	Sustainable management of water and sanitation (Goal #6)	Water management in the Ganges Brahmaputra Meghna and Indus basins

Continued on next page

Box 7.4 *continued*

Sustainable Development Goals and Regional Public Goods *continued*

Sustainable Development Goal		Examples of Related Regional Public Goods in Asia
	Access to sustainable energy (Goal #7)	Cross-border energy trading in South Asia
 	Decent work and economic growth; industry, infrastructure, and innovation (Goal #8, #9)	Investments in cross-border infrastructure (transport, ICT, trade facilitation)
	Sustainable and inclusive cities (Goal #11)	Clean Air Asia initiative
 	Sustainable production, management of marine resources (Goal #12, #14)	Regional cooperation in granting fishing licenses in the Pacific
 	Strong institutions, partnerships (Goal #16, #17)	Capacity-building programs in national and regional institutions

ASEAN = Association of Southeast Asian Nations, ICT = information and communication technology.

Sources: ADB. ADB's Focus on Regional Cooperation and Integration. <https://www.adb.org/themes/regional-cooperation/main> (accessed September 2018); and United Nations. Sustainable Development Knowledge Platform. <https://sustainabledevelopment.un.org/> (accessed September 2018).

Source: ADB.

Table 7.6: Regional Public Goods and Regional Cooperation and Integration Projects by Multilateral Development Banks

MDB	RPG and RCI
Asian Development Bank	<ul style="list-style-type: none"> • Promotion of RPGs is required to foster RCI. • ADB will expand and diversify support to (i) mitigate financial and disaster risks, (ii) improve cross-border health security, (iii) assist DMCs to manage shared natural resources, and (iv) assist countries to implement COP21 commitments and similar agreements with regional impact
African Development Bank	<ul style="list-style-type: none"> • RPGs are part of the regional integration pillar on regional infrastructure development • RPG operations should be in line with the strategic objectives: inclusive growth (including inclusive access to infrastructure) and the transition to green growth

COP21 = 21st Conference of the Parties, DMC = developing member country, MDB = multilateral development bank, RCI = regional cooperation and integration, RPG = regional public good.

Sources: ADB (2016b, 2018b); AfDB (2013, 2015).

To foster RCI, MDBs including ADB are paying more attention to environment, health, and infrastructure as priority areas for RPG provision.

ADB's Strategy 2030, for example, aims to increase support for RPGs and collective actions to mitigate cross-border risks from climate change, pollution, energy and water security, and communicable and infectious diseases (ADB 2018b). ADB supports subregional programs that offer platforms to address cross-border issues and to implement projects. MDBs, as facilitators of partnerships, promote dialogue and collaboration among diverse partners and stakeholders. It is clear that the agenda to promote RCI incorporates RPG considerations in other MDBs such as the African Development Bank where environment, health, and infrastructure are common areas in their assistance for RPG provisions (Table 7.6). The IDB's RPG Initiative is one of several key instruments that it uses for fostering RCI.⁵⁹

Trends of RPG Provision by Sector and RCI Projects

INTERNATIONAL COOPERATION IN RPGs

Two measures can be regarded as proxies for the RPG provision such as official development assistance and international treaties.

Liu and Kahn (2017) suggested the two following measures as proxies for the RPG provision. The official development assistance (ODA) measures the provision of bilateral or multilateral aid from the donor-recipient perspective, whereas international treaties represent the efforts of countries to provide RPGs through cooperative arrangements (see Box 7.5 for data and methodology). ODA beneficiaries are mainly developing countries, while the benefits of international treaties accrue to both developed and developing countries. It is more common for regional and global public goods to be supplied by agreements/treaties aimed at supplying a particular public good or to address a common problem.

⁵⁹ Additional information on the IDB's RPG Initiative can be found at IDB. Regional Public Goods. <https://www.iadb.org/en/sector/trade/regional-public-goods/home>

Box 7.5: Regional Public Good-Related Official Development Assistance and International Treaties—Data and Methodology

The data for the official development assistance (ODA) are taken from the Creditor Reporting System (CRS) of the Organisation for Economic Co-operation and Development (OECD). This database provides information on ODA from 1995 to 2016, including information on the amount, donor, recipient, sector, and the type of aid. The analysis here includes ODA grants and ODA loans as defined in the OECD–CRS database. ODA for debt relief is not included in the data. Following te Velde, Morrissey, and Hewitt (2002); Reisen, Soto, and Weithöner (2004); and Cepparulo and Giuriato (2009), selected ODA sectors are considered proxies for RPGs (box table).

Some of the limitations on the ODA data as proxies for RPG provision are as follows: (i) RPG-promoting national projects

self-funded by individual countries are not included, and (ii) the data do not include nonmeasurable efforts to promote RPGs, such as informal coordination efforts and knowledge dissemination by regional institutions.

For the data of international treaties, following Liu and Kahn (2017), the number of treaties is considered a proxy for inputs to promote RPGs. The treaty data are from the IDB RPG cooperation database based on United Nations, World Intellectual Property Organization, and World Trade Organization data for 1945–2017. Six major functional areas are examined: (i) natural resources and environment, (ii) economic cooperation and integration, (iii) human and social development, (iv) governance and institutions, (v) peace and security, and (vi) connectivity.

Classification of Regional Public Goods Sectors in the Official Development Assistance Statistics

Education		
11181: education research		
Health		
12110: health policy/management	12182: medical resources	12250: infectious diseases control
12181: medical education/training	12191: medical services	12281: health education
Population Policies/Programs and Reproductive Health		
13010: population policy	13040: STD control	13081: personnel development for population and reproductive health
13030: family planning		
Water Supply and Sanitation		
14010: water resources policy	14020: supply and sanitation	14050: waste management
14015: water resources protection	14040: river development	14081: education/training
Government and Civil Society		
15110: economic policy		
Other Social Infrastructure and Services		
16361: narcotics control		
Transport and Storage		
21010: policy/management	21040: water transport	21061: storage
21020: road transport	21050: air transport	21081: education/training
21030: rail transport		
Communications		
22010: communication policy	22020: telecommunications	22030: media
Energy		
23030: power generation	23067: solar energy	23070: biomass
23065: hydro plants	23068: wind power	23081: energy education
23066: geothermal energy	23069: ocean power	23082: energy resources

Continued on next page

Box 7.5 *continued***Classification of Regional Public Goods Sectors in the Official Development Assistance Statistics** *continued*

Banking and Financial Services		
24010: financial policy	24020: monetary institutions	
Agriculture, Forestry, Fishing		
31165: agri alternative	31192: protection and pest control	31282: forestry resources
31182: agri resources	31210: forestry policy	31310: fishing policy
31183: agri research	31220: forestry development	31320: fishery development
31184: livestock research	31261: fuel wood/charcoal	31382: fishery resources
Industry, Mining, Construction		
32181: technological research and development		
Trade Policies and Regulation		
33110: trade policy		
General Environmental Protection		
41010: environmental policy	41031: bio diversity	41081: environmental education
41020: bio sphere	41040: site preservation	41082: environmental research
41030: bio diversity	41050: flood prevention	
Other Multisector		
43040: rural development	43050: non-agri alternative	

RPG = regional public good, STD = sexually transmitted disease.

Sources: ADB based on Cepparulo and Giuriato (2009); Reisen, Soto, and Weithöner (2004); and te Velde, Morrissey, and Hewitt (2002).

Sources: ADB based on Cepparulo and Giuriato (2009); Inter-American Development Bank. Regional public good cooperation database based on United Nations, World Intellectual Property Organization, and World Trade Organization data (accessed August 2018); Liu and Kahn (2017); Reisen, Soto, and Weithöner (2004); and te Velde, Morrissey, and Hewitt (2002).

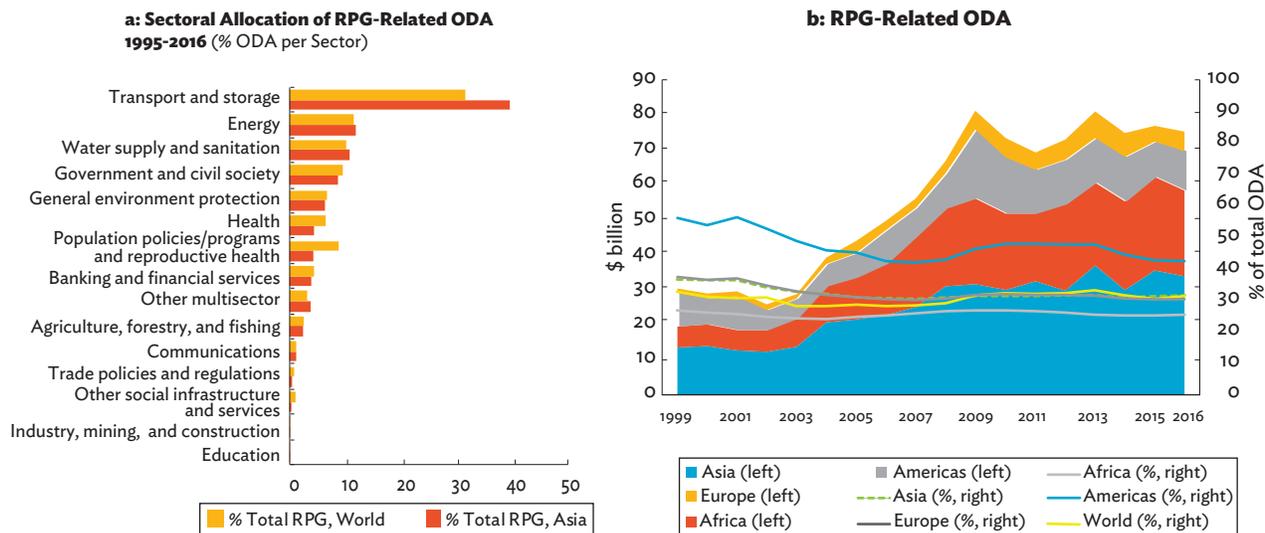
International ODA for developing Asian countries appear to be economically motivated and are largely focused on enhancing connectivity in the region.

Among the ODA sectors considered to have cross-border benefits (defined as RPG-related ODA), aid for infrastructure including transport and energy, accounts for more than half of total ODA for recipients in Asia. The total RPG-related ODA increased rapidly until 2009, then in recent years settled within a range of \$70 billion to \$80 billion, while its share against total ODA has remained steady over the past decade, at around 30% to 40% (Figure 7.3).

Connectivity is ranked second in cooperative arrangements for RPGs measured by the number of international treaties, following economic cooperation and integration.

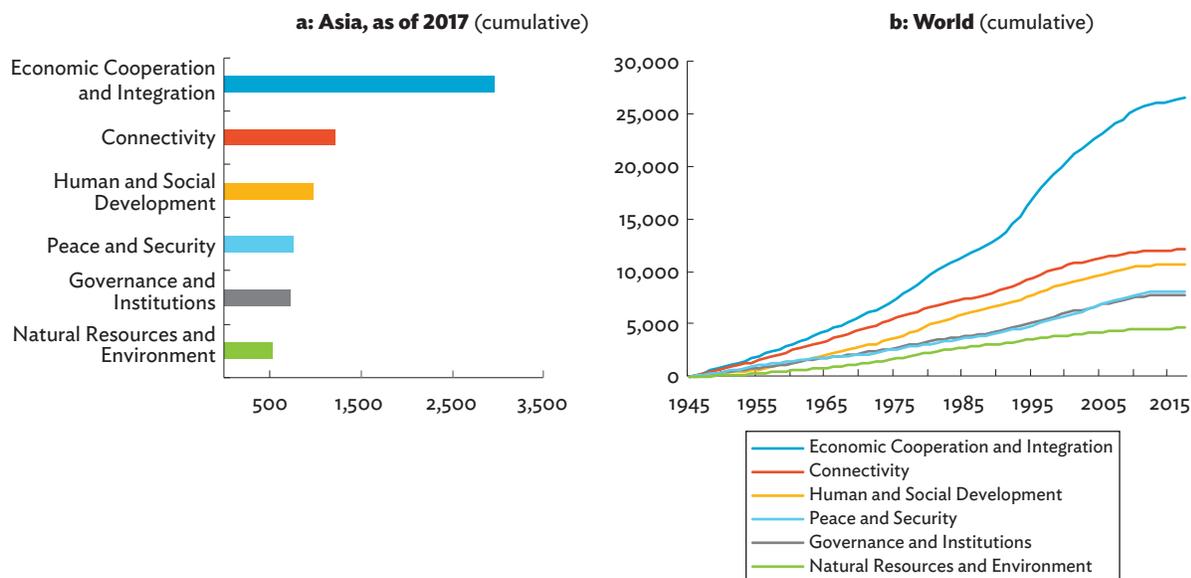
The data show that most international treaties in Asia fall under the area of economic cooperation and integration which includes bilateral/multilateral trade agreements and bilateral investment treaties (Figure 7.4). This trend has continued since 1945, with the focus on economic cooperation and integration much more reinforced than other functional areas of RPGs. Connectivity has been another prominent area.

Figure 7.3: Regional Public Good-Related Official Development Assistance



CRS = Creditor Reporting System, ODA = official development assistance, RPG = regional public good.
 Notes: See Box 7.5 for the list of CRS subsectors that were considered as RPGs. The figures include ODA grants and ODA loans; ODA for debt relief is not included. The lines on the right chart are 5-year moving averages.
 Sources: ADB calculations using data from the Organisation for Economic Co-operation and Development. CRS database. <https://stats.oecd.org/index.aspx?DataSetCode=CRS1> (accessed July 2018); Cepparulo and Giuriato (2009); Resien, Soto, and Weithöner (2004); and te Velde, Morrissey, and Hewitt (2002).

Figure 7.4: Number of Regional Public Good-Related International Treaties



Note: Includes both bilateral and multilateral treaties.
 Source: Inter-American Development Bank. Regional public good cooperation database based on United Nations, World Intellectual Property Organization, and World Trade Organization data (accessed August 2018).

MULTILATERAL DEVELOPMENT BANKS' ROLE IN REGIONAL PUBLIC GOOD PROVISION

ADB's RCI Projects and RPGs

Through RCI or regional projects, ADB has been facilitating the provision of RPGs in Asia.

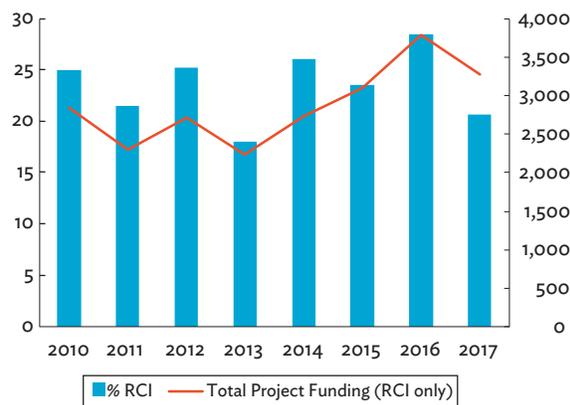
ADB's RCI or regional projects can be either (i) a single-country project such as a national sector project helping implement a multicountry sector agreement, or (ii) a multicountry regional project such as formal joint commitments, actions, and/or resource allocations between at least two countries.⁶⁰ Aiming to foster regional cooperation and integration in the region, investing in RPGs and collective action offer support to (i) mitigate financial and disaster risks, (ii) improve

cross-border health security, (iii) assist ADB developing member countries in managing shared natural resources, and (iv) help countries implement the 21st Conference of the Parties (COP21) commitments⁶¹ and similar agreements with regional impact (ADB 2016, 2018b). The RPG concept is also used to describe an economic rationale to address market or nonmarket failures when conducting economic analyses for projects (ADB 2017b).

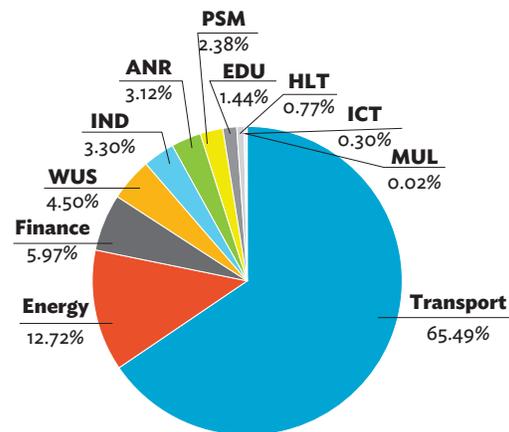
ADB's regional projects come in the form of loans, grants, and technical assistance. ADB aims for 30% of projects to be composed of RCI operations (ADB 2008). During 2010–2017, the share of RCI projects ranged from 18% to 28% of total operations. By sector, around 80% of RCI projects are focused on enhancing connectivity through transport and energy infrastructure (Figure 7.5).

Figure 7.5: ADB Regional Projects

a: Trend of Regional Projects



b: Breakdown of RCI Projects, by Sector, 2010–2017



ANR = agriculture, natural resources, and rural development; EDU = education; HLT = health; ICT = information and communication technology; IND = industry and trade; MUL = multisector; PSM = public sector management; RCI = regional cooperation and integration, WUS = water and other urban infrastructure and services.

Source: ADB Internal Projects Database (accessed May 2018).

⁶⁰ See ADB (2016) for a comprehensive list of requirements to be classified as RCI projects.

⁶¹ The Conference of the Parties (COP) is the supreme decision-making body of the United Nations Framework Convention on Climate Change (UNFCCC). The 21st session of the Conference of the Parties (COP21), also known as the 2015 Paris Climate Conference, aim to achieve a legally binding and universal agreement on climate to keep global warming below 2°C. Find out more about COP21. <http://www.cop21paris.org/about/cop21> [accessed September 2018].

IDB's Regional Public Goods Initiative

Latin American and Caribbean countries face common development challenges and opportunities that can be addressed more effectively and efficiently at a regional level through collective action.

Among several regional instruments of the IDB to promote regional integration and cooperation is its grant ordinary capital program Regional Public Goods Initiative, created in 2004.⁶² Examples of collective action to address development challenges include regional regulation to reduce water pollution in a multinational sea, lake, or watershed, and a common risk management and preparedness strategy in a seismic region. On the other hand, examples of development opportunities include a joint export promotion scheme by small economies to target overseas markets, and a regional arrangement of small countries to purchase medicines at lower prices and at higher quality or creating a single public procurement procedure in the Caribbean.

The objective of the RPG Initiative is to support the generation of RPGs that have a high potential development impact in the IDB's borrowing member countries.

The RPG Initiative provides nonreimbursable grant resources for proposals that have been selected through a competitive process following an annual call for proposals. The proposal must be demand-driven and endorsed by a minimum of three and exceptionally two of the IDB's borrowing member countries, with the proposed good to be produced through collective action. Partner countries and institutions decide together their goal, how to achieve it, including their work plan, the agenda and the mechanisms of their governance and regional cooperation. The IDB plays several roles such as

honest-broker, convener, and financier; offers technical support; and identifies global good practices that may benefit the RPG project. Another key feature of the initiative is its thematic focus.⁶³

The IDB's RPG Initiative has financed so far more than 160 projects totaling more than \$110 million since its launch.

On average, 13–15 projects are selected for financing each year. The initiative focuses on RPGs that have the potential to generate significant shared benefits and positive spillover effects in terms of scope (benefits extend beyond the originally targeted sector in each country) and/or scale (benefits extend beyond the original group of countries).

Measurement Issues and Case Studies on Provision Mechanisms

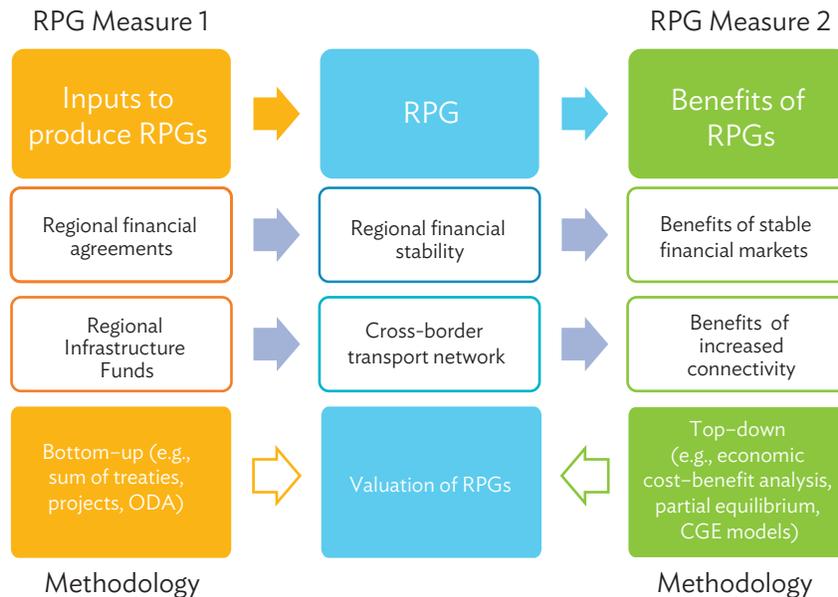
Measurement of RPGs

RPGs can be measured as either inputs to promote the RPGs or their benefits (outputs).

Given the broad scope of RPGs and its ambiguity in concept, there are no universally accepted data sources and methodologies for their measurement. However, two general approaches to quantitative measuring of RPGs (e.g., regional financial stability) can be considered, depending on the view of input (e.g., regional financial agreements) versus output (e.g., benefits of stable financial markets) (Figure 7.6).

⁶² In 2003, the joint volume *Regional Public Goods: From Theory to Practice* was published in the context of early research collaboration between the ADB and IDB on the subject (Frantz, Nguyen, and Estevadeordal 2003).

⁶³ The initiative is open to the promotion of RPGs in any area, in which the IDB is active. However, alignment with the IDB's goals, objectives, and priorities is a selection criterion. Proposals that address cross-cutting issues of the Update to the Institutional Strategy 2016–2019 will be evaluated positively (gender equality and diversity; climate change and environmental sustainability; and institutional capacity and the rule of law).

Figure 7.6: Two Ways of Measuring Regional Public Goods

CGE = computable general equilibrium, ODA = official development assistance, RPG = regional public good.
Source: ADB based on Liu and Kahn (2017).

The first is the bottom-up approach, where the inputs used to produce/promote/preserve RPGs are taken as proxy for their value. For example, the amount of ODA to developing countries that is expected to have cross-border benefits can be considered as the RPG supply by aid donors (Raffer 1999; te Velde, Morrissey, and Hewitt 2002; Reisen, Soto, and Weithöner 2004; Birdsall 2005; Cepparulo and Giuriato 2009). Another example includes the number of international treaties that countries signed for creating RPGs such as regional trade and investment agreements (Liu and Kahn 2017).⁶⁴

The second is the top-down approach, where the benefits of RPGs including cross-border spillovers are measured. This methodology can involve analysis of partial equilibrium and computable general equilibrium models using country- and industry-level data. At the project level, economic cost-benefit analyses based on net present value and internal rate of return (Adhikari and Weiss 2004) can also fall under this category. More discussion of the cost-benefit analyses for regional projects by sector follows in the next section.

Valuation of RPG Projects: Cost-Benefit Analysis

For regional projects involving more than one country, the presence of positive spillover implies that the sum of individual contributions is smaller than the overall regional benefits.

In the cost-benefit analysis, the total regional benefits for the group of participating countries is represented by the regional economic net present value (ENPV). The net present value approach suggests that if there is no budget constraint, investment in regional projects should be made up to the point at which an additional investment yields an ENPV of zero at a discount rate, which reflects the collective social time preference in the region.⁶⁵ Where a budget is fixed, investment should be made up to the point that the budget is exhausted with projects with a positive ENPV.

⁶⁴ The “International Cooperation in RPGs” subsection of this chapter illustrates the application of the bottom-up approach.

⁶⁵ Refer to Appendix 18 of ADB (2017c) for more discussion of the social discount rate.

Table 7.7: Channels of Regional Spillover Benefits

Channel	Description
Additional funding and technology transfer through foreign direct investment	New project financed within a regional framework may bring in foreign funding from official or private capital flows that individual economies would otherwise receive.
Additional trade through improved transport and communications	Net benefit of these trade flows not picked up in the national analysis of the project will constitute a regional spillover created by the project.
Economies of scale and efficiency gains from regional specialization	Reduction in unit costs of production through specialization as a result of production for a larger regional market; regional efficiency is improved through a higher consumer surplus.
Agglomeration and network effects through the development of cross-border economic corridors	Increased proximity of producers to urban centers in a neighboring country through economic corridors can enhance productivity by the exchange of ideas, inputs, technology, and skilled workers.
Mitigation of cross-border environmental and public health risks	More efficient to control these risks acting collectively as inaction on one side of a border can undermine efforts taken on the other side.

Source: ADB (2017c).

The proper valuation of regional benefits commonly requires identification of spillover channels, induced benefits through the channels, and beneficiaries while there are also sector-specific considerations.

Regional projects (e.g., cross-border road network) need to identify induced benefits (e.g., increased cross-border trade and movement of people) as well as direct benefits (e.g., increased traffic). These benefits can also be measured savings from averting free-riding by comparing the sum of savings from unilateral projects with the cost savings from a regional project with cross-border spillovers. For regional benefits valuation, it is essential to identify regional spillover channels such as agglomeration and network effects of cross-border economic corridors (Table 7.7).

Some sector-specific considerations including issues and challenges in calculating spillover benefits of regional projects are discussed below.

Energy. For cross-border energy trade, it is necessary to establish whether a power project creates either exports to a regional partner or enables power imports from the region. If it is an export project, the willingness to pay for power in the importing country should be estimated. For energy transmission projects, the existence of surplus capacity in the exporting country should be assessed. If there is surplus capacity, the operating and distribution cost of moving the power to the point of export should be estimated. Any regional benefits in the form of consumer and producer surpluses in the neighboring country must be added to national benefits in the full analysis of the project.

Transport. A key issue for regional transport projects is how accurately generated traffic and the induced trade and production created by the cross-border dimension can be estimated. All road transport projects must tackle the difficulty of separating traffic from diverted traffic and generated traffic that results directly from the new project. A regional dimension arises because traffic can be generated not just because of a reduction in fares and vehicle and time costs, but also because obstacles to cross-border trade, in the form of lengthy customs procedures, have been removed. It is also possible that the reduction in economic distance between production centers in different countries creates cross-border agglomeration effects leading to benefits in terms of higher productivity growth in the linked locations.

Trade Facilitation. Regional benefits of trade facilitation can be expected through the impact of lower transit time on international cross-border trade flows. However, prediction of the extent to which export or import volumes will increase is extremely difficult. The main regional effect will be in creating an operating environment, where it is perceived that transit procedures are no longer an obstacle to trade with neighboring countries. This can encourage investment in export activities on both sides of a border. This type of induced trade effect will also be difficult to capture at the project level and will not be picked up in trade elasticity estimates. Alternatively, economy-wide impacts of trade facilitation are often measured using econometric and general equilibrium models (see Box 7.6 for economy-wide impacts of trade facilitation through infrastructure).

Box 7.6: Empirical Assessment of Spillover Benefits of Trade Facilitation through Infrastructure

Approach 1: A Reduced-Form Model Using Spatial Econometric Methods

Both direct and indirect (or cross-border spillover) impacts of infrastructure can be estimated using spatial econometric methods (See Annex 7a for the data, methodology, and model). In the model, a production function based on Calderón, Moral-Benito, and Servén (2015) is extended to include the infrastructure stock of neighboring countries to explain an own-country's output. While most studies have employed this method to the analysis of subnational economy spillovers, the approach used here explicitly applies to cross-country infrastructure panel data separately (i) for transport (i.e., road and rail) and energy, and (ii) for information and communication technology (ICT) infrastructure (i.e., telephone, mobile, and broadband).

The results show that all transport and energy infrastructure are found to have significant economic impacts on own economies, while rail infrastructure have impacts on neighboring countries as well (box table 1). The finding on spillover effects of rail infrastructure supports the key role of other countries' transport infrastructure on a country's own economy. The quality of trading partners' infrastructure is often highlighted as one of the major determinants that facilitate bilateral trade (see Grigoriou [2007], for example). Human capital also shows positive cross-border spillover

effects on growth under the ICT model, while its direct impact on growth is robust across the board.

Among the three types in the ICT infrastructure, broadband shows not only positive direct impact on output, but also indirect impact. This implies that increased internet access can lift not only the investing country's economic growth, but also other neighboring economies.

Approach 2: A Structural Model Using a Computable General Equilibrium Model

Using a static computable general equilibrium (CGE) model, three types of channels are defined to evaluate the impact of infrastructure shocks by assuming that the infrastructure gap in the region estimated in ADB (2017a) is to be met (See Annex 7a for data, methodology, and model). The long-term output impacts of infrastructure investments in Asia are examined through three channels: (i) domestic industries where these investments are made, (ii) domestic spillovers on other industries, and (iii) cross-border spillovers on countries outside Asia (box figure).

The first channel represents the long-run impact of a production increase driven by productivity growth in the affected domestic infrastructure-related industries. Next,

1: Impact of Infrastructure: Spatial Econometric Model Results

1% increase in: (+1yr for human capital)	%ΔOutput		1% increase in: (+1yr for human capital)	%ΔOutput	
	Own country	Neighbors		Own country	Neighbors
Non-TRE infra	(0.03)	-	Non-ICT infra	(0.03)	-
Human capital	(0.09-0.14)	(0.13-0.26)	Human capital	(0.10-0.13)	-
TRE: Roads	(0.10-0.11)	-	ICT: Telephone	-	-
TRE: Rails	(0.15-0.17)	(0.46) ^a	ICT: Mobile	-	-
TRE: Energy	(0.20-0.22)	-	ICT: Broadband	(0.02-0.03) ^b	(0.03-0.11)

%Δ = percent change, - = no significant effect, ICT = information and communication technology, TRE = transport and energy, yr = year.

^a For inverse distance weight matrix only.

^b For exponential decay weight matrix and square of inverse distance matrix with a cutoff only.

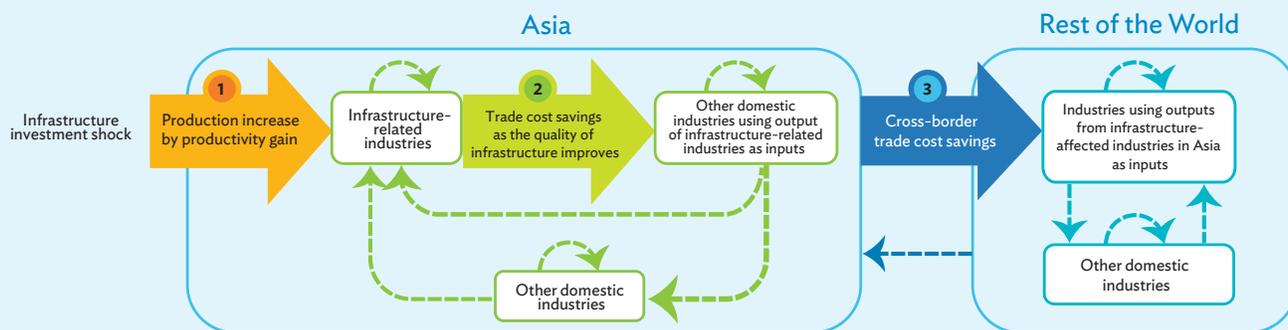
Notes: Based on the spatial panel models including the non-infrastructure variable. See Annex 7a for the details on the spatial econometric models.

Source: Kim et al. (2018).

Continued on next page

Box 7.6 continued

Three Channels of Infrastructure Investment Shocks



Note: The dotted lines represent indirect impacts due to inter-industry linkages by way of domestic and international input-output relationship. Source: ADB based on Lee (2018).

the infrastructure investments would also reduce the trade costs (e.g., cost savings from the bottlenecks overcome as infrastructure improves) in other domestic industries using the goods and services produced in the infrastructure industries as intermediate inputs. These benefits are transmitted to other industries sequentially and repeatedly through domestic forward and backward linkages. Finally, the last channel accounts for cross-border spillover effects; i.e., the trade cost savings by foreign industries connected through the global supply chain.

Infrastructure shocks in Asia are expected to stimulate economic growth in the region itself as well as other regions. Simulation results suggest that the output impact of infrastructure investments significantly intensifies in non-Asian regions as well as in the own region when domestic and cross-border spillovers are accounted, besides productivity shock (box table 2). The results imply that Cambodia, the Lao People’s Democratic Republic, Myanmar, and Viet Nam (the CLMV countries referred to in box table 2) benefit the most from meeting the infrastructure gaps, followed by other developing Asia and ASEAN4 countries, while these investments benefit other regions too. The results suggest that strengthening the forward linkages of infrastructure with foreign industries would enhance the potential cross-border spillover benefits among trading partners.

2: Impact of Infrastructure on Output: Computable General Equilibrium Model Results

Country/region	Infrastructure shocks (gap as %GDP) used in the model (2016-2020)	% change in GDP at 2014 prices due to Spillovers from infrastructure shocks
PRC*	0.5	4.92
ASEAN4*	3.8	5.33
CLMV*	3.3	11.98
Other developing Asia*	4.6	7.39
Japan	-	0.25
Korea, Rep. of	-	0.30
Other developed Asia	-	0.38
United States	-	0.10
European Union	-	0.07
Rest of the World	-	0.07

* = countries with infrastructure investment shocks (25 countries); ASEAN4 = Indonesia, Malaysia, the Philippines, and Thailand; CLMV = Cambodia, the Lao People’s Democratic Republic, Myanmar, and Viet Nam; GDP = gross domestic product; PRC = People’s Republic of China. Notes: Spillovers include (i) the impact of productivity shocks in affected infrastructure industries in Asia, (ii) domestic spillovers on other non-infrastructure industries in Asia, and (iii) cross-border spillovers. See Annex 7a for the details on the CGE model and country breakdown. Sources: Lee (2018) and ADB (2017a).

Health. Analysis of regional health projects requires either a demonstration that a regional approach offers a cost-effective alternative to separate national projects or that a regional approach offers higher benefits, if these can be quantified satisfactorily in economic terms. Health impacts on morbidity and mortality are typically quantified as disability-adjusted life years (DALYs) which can be interpreted as the number of years lost due to disability and premature death (see Box 7.7 for a regional health project using the DALY). An economic rate of return analysis requires that the DALYs saved be given a monetary value per unit to create a benefit value. Cost-effectiveness analysis compares the cost per DALY saved with project costs.

Environment. Environmental valuation may involve transferring values for environmental effects from one site to another and applying these transferred values in a particular appraisal. For example, regional watershed management projects may create various environmental

benefits such as soil conservation and improved forest cover through both on-site and off-site effects. On-site benefits from soil conservation include incremental agricultural production and the net income from this is the normal measure of economic value. Such production and income effects on farmers in particular countries can also be allocated in a similar fashion. However, other off-site impacts such as water quality, flood levels, or siltation affected by eroded soil from one site will be more difficult to assess if they are distributed among several countries sharing a river basin.

Education. Regional education projects involve cooperation from higher education and research institutes to spread the fixed costs of university teaching and research across several countries. The “human capital” approach values education on the basis of the higher productivity that additional years of education or research expenditure create. Higher productivity in turn is approximated by the incremental life-time earnings

Box 7.7: Case Study—Calculating Regional Spillovers of the Greater Mekong Subregion Health Security Project

The Greater Mekong Subregion (GMS) Health Security Project is a \$132 million project launched in 2016 to assist Cambodia, the Lao People’s Democratic Republic (Lao PDR), Myanmar, and Viet Nam to strengthen their health systems for the control of communicable diseases. The project is implemented in the border areas of each country, where the risk of transmission between countries is highest. The original economic analysis in the GMS Security Project shows the returns from the project to each of the four countries but does not separate a distinct regional effect (ADB 2016a). A separate recalculation based on different assumptions shows how a distinct regional effect can be identified.

The project defines three project outputs: (i) improved regional cooperation and disease control in the border areas, (ii) strengthened national disease surveillance and outbreak response systems, and (iii) improvement of laboratory services and hospital infection prevention and control.

Regional benefits from improved regional cooperation and disease control in the border areas

The health effects of the project on a set of infectious diseases (HIV, tuberculosis, dengue, and helminth) are expressed in terms of disability-adjusted life years (DALYs). The improvement in disease incidence due to the project is estimated by assuming that the gap between health status in the border areas and the national average will be reduced due to the project by 10% annually over the project’s 10-year life. Total DALYs from each of the four diseases without the project are taken from the World Health Organization’s Burden of Disease data. An estimate is made of the difference in health status between border areas and the national average.^a

Continued on next page

^a This is done by comparing urban and rural areas in each country using an estimate of health conditions in rural areas as a proxy for the health status in border areas.

Box 7.7 *continued*

Total benefits in the border area for country k (B_{djk}) should be calculated as:^b

$$B_{djk} = (DALY_{jkbwo} - DALY_{jkw}) * POP_{bk}$$

where $DALY_{jkbwo}$ is DALY per 1,000 from disease j in country k in border areas without the project, $DALY_{jkw}$ is the national incidence of disease from j in k with the project and POP_{bk} is the population in border areas in country k (in 1,000s). As the data are not available to make this estimate, the original values for benefits are retained on the assumption that had this alternative approach been applied it would have created the same estimate in DALYs saved. Using these estimates for DALYs saved from output 1 and the estimated border average income figures gives the benefit figures by country.

As an infectious disease can travel readily across borders, particularly as in this case across land borders, it is a reasonable assumption that most if not all the disease incidence reduction in the border area assumed in the calculations would not occur without complementary prevention and control measures in neighboring countries. Thus, the benefits from output 1 of the project are considered regional benefits arising from cooperation and coordination of health systems.

National benefits from strengthened national disease surveillance and outbreak response systems

The benefits of output 2 are less directly regional in that they arise from improved community and hospital level practices. Benefits are estimated as a reduction in the incidence of epidemics assumed to be attributable to improved surveillance combined with the estimated cost of epidemics. The calculation is at an aggregate level not distinguishing between types of disease outbreak.^c Further, it does not appear to take account

of the activities of the project under output 1 in reducing the probability of a disease outbreak. These are treated as national benefits because the impact of complementary measures in neighboring countries was already allowed for in the calculation of benefits from output 1.

National benefits from improvement of laboratory services and hospital infection prevention and control

Benefits from improved laboratory testing and hospital practices are estimated on the basis of costs saved. They include the reduced cost of dengue infections due to improved laboratory testing, and the reduction in inpatient costs due to shorter hospital stays. The benefits to the border areas are estimated as a proportion of the savings for overall national benefits, with the proportion determined by their population share. Saving in hospital costs due to shortening patient stays are calculated from the starting point of the total national inpatient hospital cost (millions of bed days × the cost per bed day). A saving of 5% is then attributed to the project and this national saving is allocated to border areas on the basis of the population share. As allowance has been made for the feedback effect from output 1, these are treated as national benefits independent from the actions of neighboring countries.

The strong regional effect—with over half of benefits dependent on complementary actions in neighboring countries—is to be expected for this type of regional public good project. For each country, in the recalculation, regional benefits or spillovers are 61% of gross benefits for Cambodia, 80% for the Lao PDR, 30% for Myanmar, 46% for Viet Nam, and 54% for the total project (box table). The results show low project returns in Myanmar and very high returns in the Lao PDR.^d This would support the case for special financial support to the government of Myanmar to ensure that the project, which creates cross-border benefits for others, is continued despite its low return to the country itself.

Continued on next page

^b In the original economic analysis, benefits are taken to be a saving in DALYs from each disease set at 10% of the disease incidence created by a difference in health status between the national average and the border areas. These benefits (B_{djk}) are estimated for disease j in country k as

$$B_{djk} = (DALY_{jkw} * H_k * 0.10) * POP_{bk} / POP_{totk}$$

where $DALY_{jkw}$ is the total disease burden in DALYs (per 1,000) in country k created by disease j without the project (which rises annually with population growth), H_k is the composite health status index used to adjust the national average data to reflect conditions in the border areas, POP_{bk} is the population in border areas (districts) in country k (in 1,000s) and POP_{totk} is total population in k (in 1,000s). This calculation assumes that benefits in border districts can be calculated from a notional national benefit measured by the term in brackets, which is then allocated to the border areas in proportion to their share of population.

^c Other parameters in the original analysis are retained. These are the cost of epidemics as a proportion of GDP (3%), the impact of surveillance and response activities in reducing the risk of an epidemic (10%), and the effectiveness of the project output 2 in improving surveillance and responses (5%).

^d If 9% represents the cost of capital in Myanmar and benefits are captured accurately then with an economic internal rate of return of 5% this project would not be accepted.

Box 7.7 *continued***Benefit of the Greater Mekong Subregion Health Security Project** (present value, \$ million)

Country	Total Benefits (A)	Regional Benefits	Costs (B)	ENPV (A-B)	EIRR (%)
Myanmar	10.78	3.27 (30%)	12.10	-1.32	5
Viet Nam	78.87	35.98 (46%)	76.41	2.46	10
Lao PDR	27.07	21.67 (80%)	11.75	15.32	58
Cambodia	29.35	17.94 (61%)	21.01	8.34	22
Total	146.07	78.82 (54%)	121.27	24.80	15

EIRR = economic internal rate of return, ENPV = economic net present value, Lao PDR = Lao People's Democratic Republic.

Note: Discount rate is 9%.

Source: Weiss (2017).

that can accrue from the education project. These external benefits can also be the changes in innovation, health, and social attitudes that arise in a better-educated society. Such effects are, however, rarely incorporated into national analyses of economic benefits of education and thus, it is unrealistic to expect that they can be estimated in a meaningful way on a regional basis. As such, for education projects, a simple modification of existing practice can be used to approximate regional as opposed to national benefits.

Case Studies: Provision Mechanisms

EUROPEAN CASES

Integrated energy market

The integration of national energy markets has been led by regional institutions through strengthening cooperation among national regulators and harmonizing national market rules.

For over 60 years, the European Union (EU) countries have coordinated their national energy policies to guarantee their citizens access to energy at reasonable and stable prices, to maintain industrial competitiveness,

to promote sustainable development, and to ensure security of energy supply.⁶⁶ Although significant progress has been made to harmonize rules, more cross-border interconnection capacity is required to achieve a fully integrated energy market. In 2015, the European Commission presented its strategy for establishing an “Energy Union,” with the goal of improving Europe’s energy security, sustainability and competitiveness. Attaining a fully integrated energy market was highlighted as among the prerequisites to realizing the union.

A fully integrated energy market requires a common legislative framework (the “software”) and cross-border infrastructure investments such as gas pipelines and electricity cables (the “hardware”).

On the software side, the EU has made significant progress. Between 1996 and 2009, it adopted three major legislative packages to harmonize regulation across energy markets in Europe and liberalize the internal energy market. The most recent one, the Third Internal Energy Market Package, is seen as a key step toward laying a legislative foundation for a joint energy market.

However, progress has been slower on the hardware side. Electricity markets have generally developed either on a national level or through regional pools within the EU. Similarly, gas flows have typically developed on a

⁶⁶ The integration of the energy markets (i.e., electricity and gas) can be considered a regional club good. The benefits are excludable to nonmembers. They are partially rival for members as the addition of another country to a network may increase administrative and transaction costs.

bilateral basis, through agreements between supplier and consumer countries. These agreements have been motivated by a supply-demand rationale rather than efforts to create an integrated gas market in Europe. Overall, therefore, the European electricity and gas markets remain largely fragmented.

In addition to ongoing support for cross-border infrastructure projects, the Connecting Europe Facility was established in 2013 to further bridge the infrastructure gap.

The European Investment Bank (EIB) has provided financial support for the EU energy projects, including for cross-border infrastructure. The bank is tasked with borrowing on capital markets and lending at favorable terms to projects that support the EU objectives. Among the sectors the EIB has financed since 1959, energy is the third largest, amounting to €195 billion, following credit lines and transport.⁶⁷ The Connecting Europe Facility (CEF) was created in 2013 as an EU funding instrument to direct investment in key cross-border infrastructure projects related to energy, transport, and information and communication technology.⁶⁸ The CEF budget amounts to €30.4 billion for 2014–2020, of which €5.4 billion is allocated to energy projects.⁶⁹ Of that, €4.7 billion is available in grants that support the development of so-called EU Projects of Common Interests.

Substantial efficiency gains from the interconnected energy market are expected due to increased competition and cross-border energy trade.

First, the integration can increase competition among energy suppliers, and thus lead to better usage of inputs and reductions in firm costs. Second, the cross-border trade of electricity can lead to efficiency gains from, among other things, the benefits of exchanging

differences in resource endowments across countries (e.g., trading intermittent wind power for dispatchable hydropower) and the ability to maintain a more diversified generation mix. The efficiency gains are found to increase more rapidly as countries expand their capacity of renewables (Zachmann 2013).

Energy market integration in Europe illustrates regional policy implementation based on the weakest-link and best-shot technologies.

Providing financial assistance for energy infrastructure through the EIB and CEF can be considered a weakest-link RPG as the assistance focuses on strengthening the energy infrastructure of the member countries with the lowest level of energy market integration. Harmonization of market rules in the EU has best-shot aggregation technology characteristics as the United Kingdom started energy market reform which then became the main driver for further development in Europe (Karan and Kazdağlı 2011).

Mitigating Overpricing in International Mobile Roaming

There have been concerns that the prices of international mobile roaming in Europe are unreasonably higher than the price of domestic telecommunications services.

Before 2007, the wholesale charges for roaming voice calls placed in Europe averaged approximately €1 per minute, even though the cost to provide the service was just a few cents.⁷⁰ To the home network, the tariff payment made to an unaffiliated visited network in a different country is a real cost—the underlying cost to the visited network of providing the service is irrelevant to the home network. The wholesale payment of

⁶⁷ See European Investment Bank. Breakdown by Sector. <http://www.eib.org/en/projects/loan/sectors/index.htm?from=1959&to=2018> (accessed September 2018).

⁶⁸ Specifically, the funding is directed toward investment in the Trans-European Transport Networks (TENT), Trans-European Energy Networks (TEN-E), and Broadband and ICT (European Commission. Connecting Europe Facility. https://ec.europa.eu/transport/themes/infrastructure/ten-t-guidelines/project-funding/cef_en [accessed September 2018]).

⁶⁹ As of September 2018, the remaining €24.1 billion was allocated to projects in transport, and €1.04 billion to telecommunications.

⁷⁰ Wholesale charges for roaming (the inter-operator tariff) are the fees that the home network pays the visited (or foreign) network for their roaming subscribers using the visited network (GSMA 2012).

€1 consequently resulted in average retail prices for roaming voice calls placed in Europe of about €1.30, corresponding to a retail margin of about 25%–30% (Stumpf 2001).

The EU initially tried to address the high price of international mobile roaming with ex ante regulation based on competition law principles in each member state, but this approach had limitations due to the transnational nature of the markets for roaming services.

Addressing the excessively high prices of international roaming proved to be difficult as they resulted from rational profit-taking by different networks in two different countries. The incentives of the home network and the visited network are often not aligned. Furthermore, they are regulated by different national authorities whose interests may also not be in step.

The adoption of an EU-wide approach in 2007 reduced the wholesale and retail prices, and thus led to an increase in the consumption of roaming services.

In 2007, an EU-wide regulation was introduced, and was subsequently amended in 2009, 2012, and 2015.⁷¹ In each case, both wholesale inter-operator charges and retail prices were progressively reduced. The measures effectively led to increased consumption of roaming services—far more for data than for voice calls. An analysis conducted in preparation for the 2012 revisions to the EU Roaming Regulation suggests that the societal costs over 2012–2014 in the absence of the roaming regulation would have been substantial, leading to a net loss of €13.6 billion in social welfare (European Commission 2011).

CASES IN LATIN AMERICA AND THE CARIBBEAN⁷²

IDB RPG Projects in Latin America and the Caribbean

The Interoperability of Foreign Trade Single Windows project aimed to address the lack of harmonization among national Foreign Trade Single Window platforms in the Pacific Alliance.⁷³

This trade facilitation project launched in 2014 called to implement a digital platform to enable the members of the alliance to interoperate and exchange real-time information such as phytosanitary, zoosanitary, and origin certificates. About 7,000 certificates have been exchanged since 2016, and the interoperability platform has contributed to reduce both the time required to process phytosanitary certificates by importers and the time spent at the border by perishable goods subject to phytosanitary clearance.

The Learning in 21st Century Schools project aims to generate data, guidelines, and standards at the regional level that countries can use to upgrade and modernize their educational infrastructure.

This ongoing project has so far yielded a regional comparative inventory of school construction standards and regional norms for maintenance, as well as best practices for school design and construction that withstand disasters.⁷⁴ The project also included the implementation of a school census tool in order to collect data for education investment policy making. Recommendations for community involvement and school designs that foster security and an environment conducive to higher learning have also been included.

⁷¹ This covered the 28 EU member states and three European Economic Area countries: Norway, Iceland, and Liechtenstein.

⁷² This section was drawn from the presentation by IDB at the ADB–ADB Institute conference on Toward Optimal Provision of Regional Public Goods in Asia and the Pacific held in Tokyo on 10–11 May 2018 (Estevadeordal 2018).

⁷³ The Pacific Alliance is a Latin American trading bloc consisting of South American neighbors Chile, Colombia, and Peru; and non-neighbor Mexico.

⁷⁴ Thirteen countries are participating in the Learning in 21st Century Schools: Argentina, Barbados, Chile, Colombia, Costa Rica, Dominican Republic, Guatemala, Honduras, Mexico, Peru, Paraguay, Trinidad and Tobago, and Uruguay.

The Central American Protocol for Procurement and Quality Control of Medicines sought to improve access to quality pharmaceuticals for public hospitals at better prices by supporting the creation of a regional pharmaceutical market in Central America.

The project aimed to set up a coordinated regulatory framework for medicine procurement through a joint price negotiation process in order to provide the subregion with common regulation, procedures, and

quality control standards for the medications used in public hospitals. The IDB ended its financial support for this RPG in 2012, and the Central American countries and their regional institutions, led by the Council of Ministers of Health of Central America, have continued to benefit from lower prices and higher-quality medicines through annual tendering processes. This RPG resulted in the successful implementation of a regional arrangement of small countries to collectively procure medicines at lower prices and at higher quality (Box 7.8 lists IDB's lessons for successful RPG projects).

Box 7.8: Inter-American Development Bank—Lessons for Successful Regional Public Good Projects

The regional public good (RPG) operations of the Inter-American Development Bank (IDB) aim to perform development interventions within the framework of the Management for Development Results as well as to extract lessons learned on why projects work and what institutional arrangements make projects successful.^a Part of the challenge of implementation is that while RPG projects are regional in nature, they are implemented at the national level. Moreover, the time needed to see the impact of an RPG project is greater than national projects. RPG projects, especially those on less tangible outcomes, such as multinational dialogues, may find it harder to identify a causal link between outputs and expected outcomes while facing omitted variable bias problems during evaluation (Nores and Kennedy 2017).

The experience of the Latin America and the Caribbean highlights new patterns of cooperation and illustrates the importance of innovative approaches to evaluation. Trade cooperation has been shown to be an effective first step for developing regional cooperation in other sectors such as transport, connectivity, finance, climate, and health. Moreover, new patterns of cooperation such as the Pacific Alliance are based on mutual interests rather than geographic proximity and allow a broader form of cooperation for the provision of RPGs. Finally, the issue of evaluation of the outcome of cooperation has been raised as the impact of regional bodies such as the South–South Cooperation is more knowledge-based and institutional-intensive and therefore more challenging to gauge.

IDB's experience also gives rise to key factors for successful RPG projects: (i) aligned and sustained political will is key for executing RPGs; (ii) technical focal points in RPG with closer ties to policy makers may be more effective in promoting reform toward national implementation; and (iii) RPGs should support different moments of the policy cycle from identification, design, and regulatory convergence to national implementation.^b

The Regional Public Goods Initiative is promoting an evaluation effort in order to find and estimate the impact of RPG project, and extract lessons for other regional cooperation projects. The importance of an RPG evaluation agenda lies in the fact that rigorous evaluation (and its results) would allow to take evidence-based decisions and refocus the RPG Initiative as a relevant instrument for regional development.

RPG projects can have different approaches during the monitoring and evaluation process. A first approach can be placed on interactions, products, and networks that an RPG project creates during its implementation. Second, the spotlight can be placed on whether countries adopt the project on a national level or find some internal barriers to do so. Then, the target is to measure the results of the implementation of the project, in a tangible and rigorous way. Furthermore, an impact evaluation and a cost–benefit analysis can be conducted to estimate the effect and extract lessons about the success or failure of RPG projects.

^a Management for Development Results (MfDR) is a style of Public Administration which emphasizes the maximization of public value via management tools that complement each other in a collective and coordinated manner to generate the social changes sought in the objectives of government policies. (IDB. What is Management for Development Results (MfDR)? <https://www.iadb.org/en/mfdr> [accessed September 2018]).

^b These factors have implications for the IDB's operations. Projects, for instance, average 36 months to reduce the likelihood of changes in national administrations that may jeopardize timely execution; commitment letters and counterpart resources are required while relevant actors are included into the governance structure; and some flexibility is included to finance second phases or existing national projects that want to converge.

ASIAN CASES

Early warnings of disasters

The Boxing Day tsunami of 2004 clearly shows the need for a region-wide disaster warning system which is generally underprovided.

More than 230,000 people were killed in the Boxing Day tsunami of 2004, which originated with the earthquake off of the west coast of Sumatra, Indonesia, where the number of deaths is around 130,000. Had an early warning system been in place at that time, many thousands of lives would have been saved. For example, the tsunami hit Sri Lanka about 2 hours after the initial earthquake, with the epicenter about 1,600 kilometers away. In Sri Lanka alone, more than 30,000 people died.⁷⁵

The “early warning” includes detection of an impending disaster and the reporting of this knowledge. Detection is an RPG if the information is disseminated throughout the region without restriction. Investment in a system for detection and reporting, and its ongoing maintenance, is critical to whether knowledge of an impending disaster is reported.

A collective approach to establishing and maintaining integrated early warning systems for disasters would be more beneficial.

First, the cost of an integrated system would be lower than the aggregate cost of separate systems of equal coverage, not least because an integrated system can avoid duplicative components. Second, an integrated early warning system will generally be more effective than a collection of separate systems, as it will enable full coordination of the deployment of detection

equipment and provide every member in the system with a complete reading of the signals, especially as some detection facilities will be under the jurisdiction of other member countries.⁷⁶ Detection of the earthquake coupled with detection of the tsunami’s path is critical information since waves can be very high in the countries distant from the epicenter of the earthquake.

Once the integrated system is in place, the member countries may have less incentive to maintain the system as the tsunamis of the scale of the Boxing Day 2004 are extremely rare. However, neglect of maintenance could lead to a system failure. One way to help operate the system all the time is to integrate it with a larger system more regularly used for similar hazards such as storm surges (Alverson 2005).⁷⁷ Just as tsunamis can be triggered by underwater earthquakes, so storm surges can be caused by tropical cyclones located far from shore. Many of the same investments, like tide gauges, that detect a tsunami can also detect storm surges associated with tropical cyclones.

Regional public good of detection and reporting and the national public good of communication and trained response are strong complements.

The Indian Ocean Tsunami Warning and Mitigation System (IOTWMS) was launched in 2011. Under this arrangement, three tsunami service providers (TSPs) of Australia, India, and Indonesia are responsible for issuing warnings to member states (Intergovernmental Coordination Group/IOTWMS 2017). Figure 7.7 shows the increase in investment for detection that has been made since the Boxing Day tsunami, and their locations. Seismometers detect seismic waves that point to the creation of a tsunami. Sea-level gauges and tsunameters confirm the existence of a tsunami. Multiple sites of detection make prediction of a tsunami’s path more precise.

⁷⁵ Compared with the Pacific Tsunami Warning System founded in 1949, a system was not in place in Asia maybe because tsunamis are more common in the Pacific, and a higher frequency of occurrence clearly increases the benefits of having an early warning system. Another reason may be that countries in the Pacific are more accustomed to cooperating and/or that one or two countries, such as the United States and Japan, are willing and able to take the lead in establishing such a system.

⁷⁶ Seismometers are generally located on land whereas sea-level gauges are within the exclusive economic zones of coastal states.

⁷⁷ Tropical cyclones can be as destructive as tsunamis. For example, cyclone Nargis killed over 130,000 people in Myanmar in 2008. Tropical cyclones occur much more frequently than tsunamis. One regional system for tropical cyclones is the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP)/World Meteorological Organization (WMO) Typhoon Committee, which covers storms in the Western Pacific. Another is the ESCAP/WMO Panel on Tropical Cyclones, responsible for the Bay of Bengal and the Arabian Sea.

Figure 7.7: Placement of Indian Ocean Tsunami Detection Equipment, 2004 and 2014

a: Broadband Seismometer

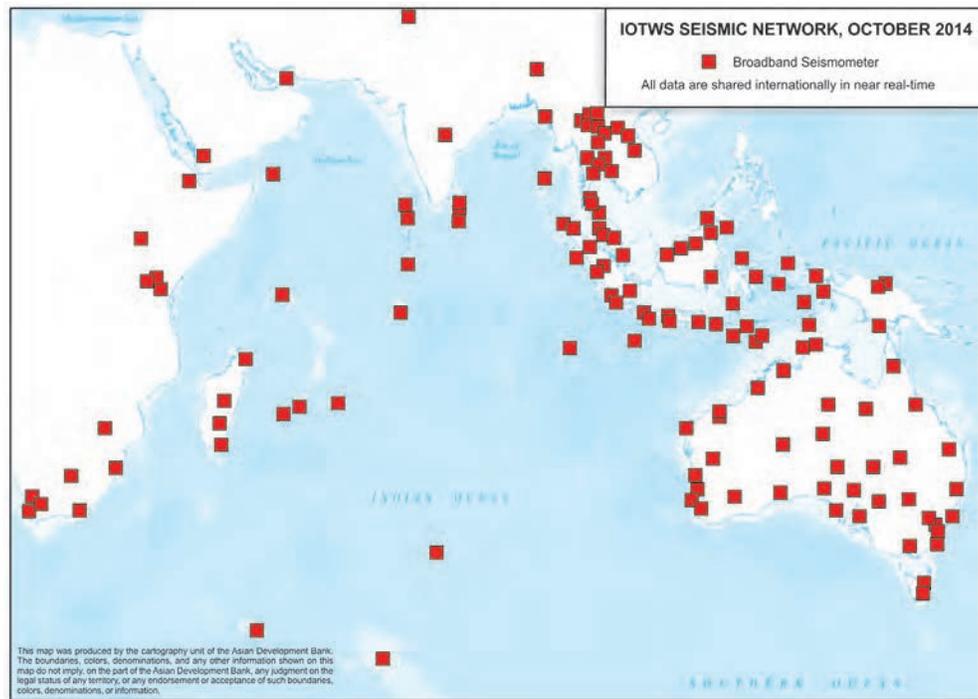
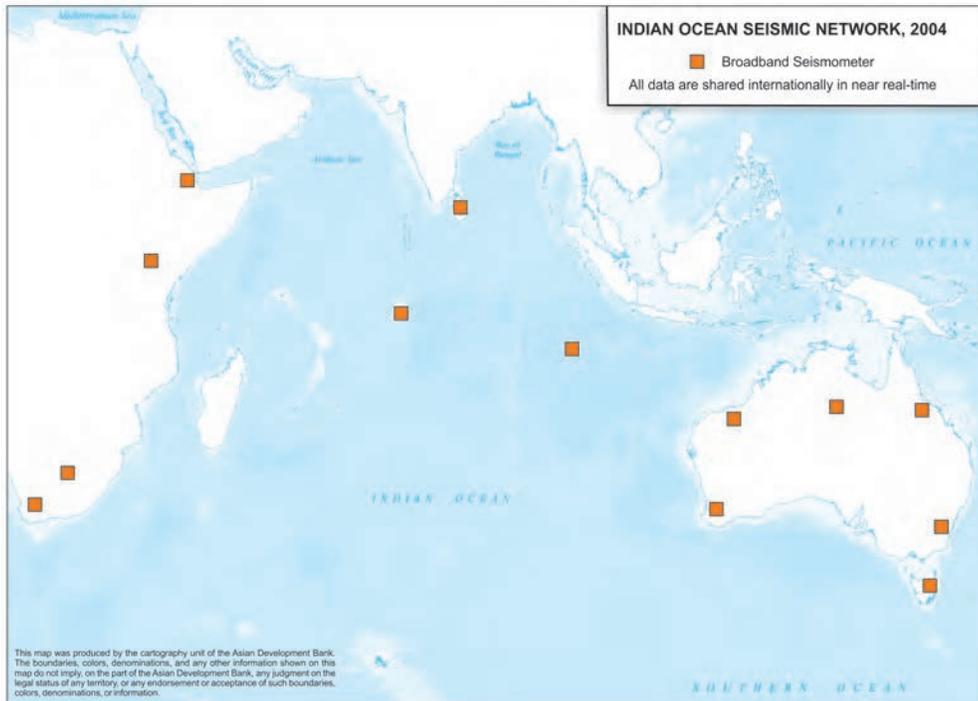
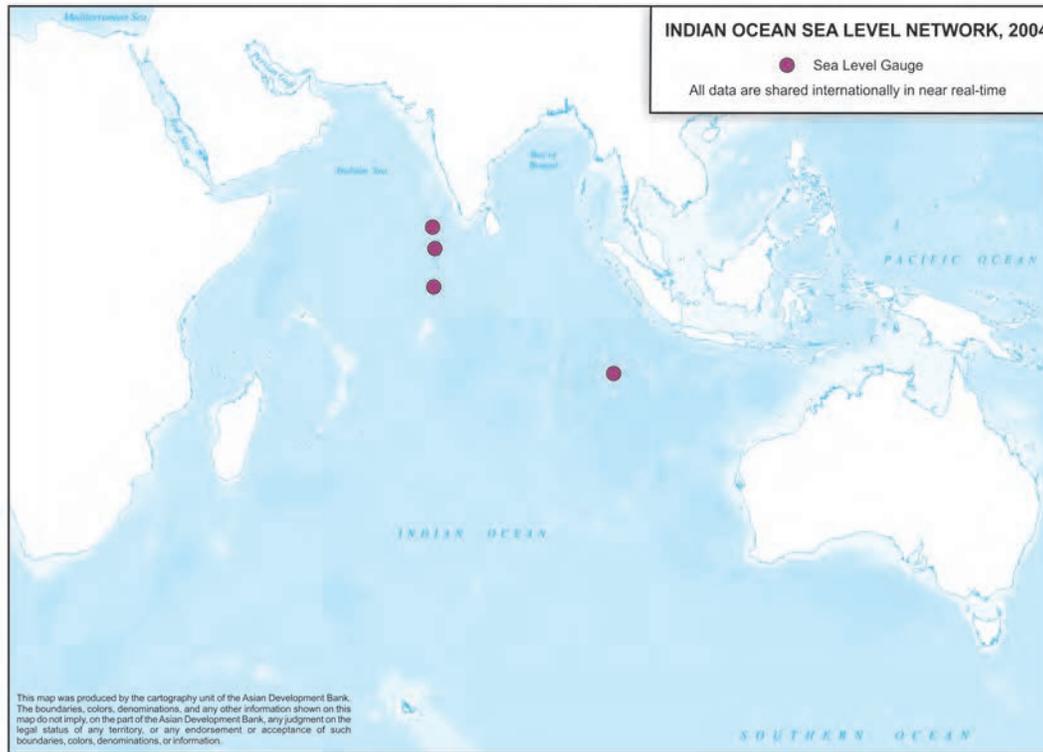
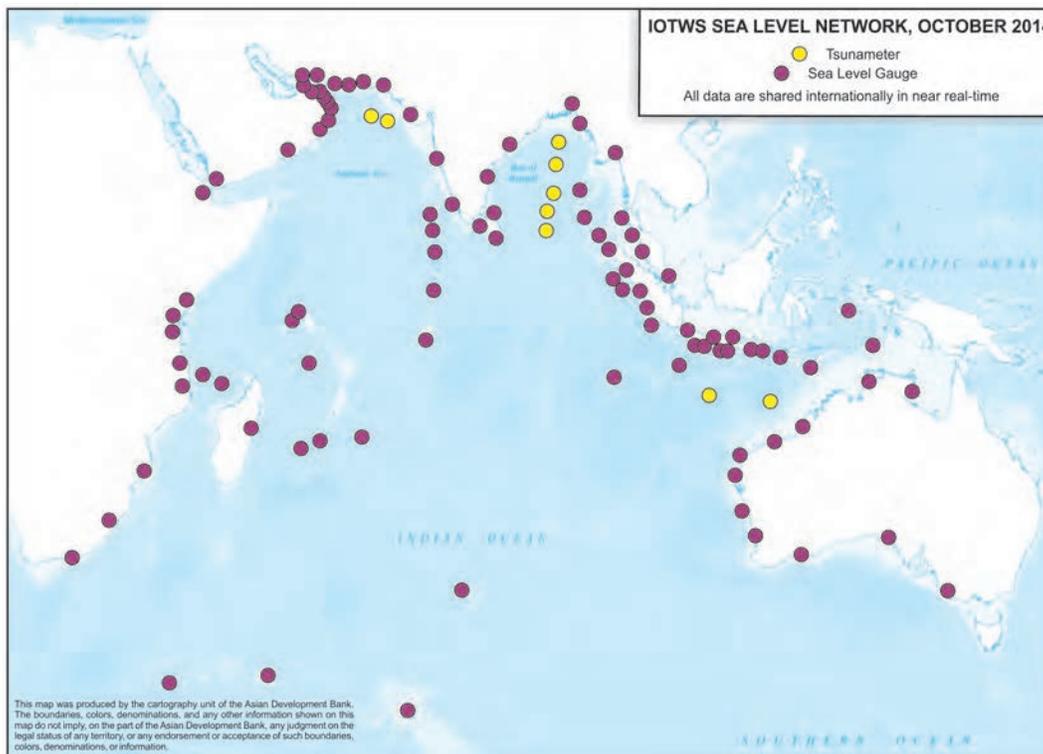


Figure 7.7 continued

b: Coastal Sea Level Gauges



18-2526B ABV



18-2526C ABV

IOTWMS = Indian Ocean Tsunami Warning and Mitigation System.

Source: ADB approximation based on the Intergovernmental Oceanographic Commission of United Nations Educational, Scientific and Cultural Organization (2015).

It is essential to have an international reporting system through official channels, involving one state reporting to others or a multilateral organization reporting to its member states. Another part of the system involves states communicating early warnings to communities at risk. It also involves states ensuring that such communities, having been given this information, know how to respond. Communication and trained response are national public goods (NPGs). The benefits from communicating warnings increase both with the timeliness and accuracy of the warnings and the ability and inclinations of communities to respond.

The provision of early warning systems for disasters highlights the role of better-shot and weakest-link technologies as well as the interplay of national and regional provision of a public good.

While detection and reporting at a regional level are led by a few countries with commitment and advanced technologies, communication and trained responses are more national in scope. A regional early warning system is of little value if countries lack the ability to communicate such warnings and respond to the threats to coastal communities. Therefore, regional institutions can shore up the weakest-link economies with financing and capacity building to enhance their communication and trained responses.

Regional fisheries management

Current property rights arrangements for the oceans give every state a right to fish on the high seas.

Coastal states have exclusive jurisdiction over fisheries out to a distance of up to 370 kilometers from shore. Fisheries located entirely within the exclusive economic zone (EEZ) may be managed efficiently, by the coastal state regulating access as a “sole owner.” Overfishing is a problem only where the coastal state lacks either the ability or an interest in regulating access. However, an

open access fishery on the high seas gives rise to the “tragedy of the commons” (Hardin 1968). Overfishing is likely to occur as every country exploiting the resource will have an incentive to increase its harvest and similarly, countries that had not exploited the resource previously will have an incentive to enter the fishery.⁷⁸

A shared fishery requires aggregate efforts to balance exploitation and preservation to prevent the tragedy of the commons.

The rents earned from open access fisheries are substantially reduced as more rent-seeking countries enter to fish. As long as the number of countries fishing in an open-access fishery is regulated at a certain level, every country exploiting the resource can continue to earn positive rents. However, in the case of highly migratory tuna fishery, under the current property rights arrangements on the high seas, it is not possible to limit fishing to just a few countries. This is the principal challenge to an international regime for managing a fishery: deterring states that are in the fishery from fishing excessively, while at the same time deterring states that are not in the fishery from entering it.

The Western and Central Pacific Ocean which hosts the world’s largest tuna fishery is managed by two regional institutions: the Western and Central Pacific Fisheries Commission and the Pacific Islands Forum Fisheries Agency.

The main agreement that applies to this fishery is the Convention for the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific Ocean, which came into force in 2004. This agreement established the Western and Central Pacific Fisheries Commission, the organization responsible for managing this regional fishery. Another major organization to serve a similar purpose is the Pacific Islands Forum Fisheries Agency, which came into force in 1979 and was established by the South Pacific Fisheries Agency Convention. As a subgroup to the agency, the

⁷⁸ The cost of overfishing is indeed enormous. According to a recent World Bank (2017) study, overfishing reduced the aggregate net benefit of exploitation of the world’s fisheries by \$83 billion in 2012. Two-thirds of this loss is borne by Asia.

Parties to the Nauru Agreement (PNA) controls the world's largest sustainable purse seine tuna fishery.⁷⁹

Two measures were adopted to prevent overfishing in the Western and Central Pacific Ocean: closure of high-seas areas that border the EEZs, and a vessel day scheme that involves limiting the total number of days to fish.

The ban, adopted by the PNA in 2008, applies to high-sea “pockets” (areas A and B in Figure 7.8). Compliance with the ban is monitored by the requirement that all

licensed vessels fishing in the EEZs of PNA member states carry radio transponders which reveal their coordinates at all times. In this ocean, it is not profitable to fish only within these high-seas pockets, and so the states with expansive EEZs can allow fishing within their waters but conditional on vessels not fishing within these high-seas pockets. In other oceans, a ban on high-seas fishing could not be orchestrated as easily.

A first best solution would be putting a fishery under the exclusive control of a sole owner, involving a multiple of parties implementing the full cooperative outcome. Closing these high-sea pockets could easily be a good

Figure 7.8: High-Seas Areas Closed to Fishing by the Parties to Nauru Agreement



Note: Areas A and B are the sea pockets with the ban on fishing for the members of the Parties of Nauru Agreement as of August 2018.

Source: ADB approximation based on Western and Central Pacific Fisheries Commission (2016).

⁷⁹ The Pacific Islands Forum Fisheries Agency (FFA) has 17 Pacific Island members: Australia, the Cook Islands, the Federated States of Micronesia, Fiji, Kiribati, the Marshall Islands, Nauru, New Zealand, Niue, Palau, Papua New Guinea, Samoa, Solomon Islands, Tokelau, Tonga, Tuvalu, and Vanuatu. FFA is an advisory body providing expertise, technical assistance and other support to its members who make sovereign decisions about their tuna resources and participate in regional decision making on tuna management through agencies such as the Western and Central Pacific Fisheries Commission (Pacific Islands Forum Fisheries Agency. Welcome to the Pacific Islands Forum Fisheries Agency. <https://www.ffa.int/about> [accessed September 2018]).

move for PNA members, as it increases their control over the fishery. However, the restrictions may also increase the cost of fishing. Comprehensive management of the entire territory would likely improve matters.

The vessel day scheme, adopted by the PNA in 2012, sets a total number of days in which vessels may fish within PNA waters, a value chosen to satisfy the overall conservation and management objectives determined by the Western and Central Pacific Fisheries Commission. The current approach contrasts with the previous system, under which vessel numbers were fixed, with the allocations going directly to the vessels rather than the PNA members (Yeeting et al. 2016).

However, under the vessel day scheme, the problem of overfishing still remained due to adoption of new technologies like fish-aggregating devices and the use of larger vessels.

Purse seiners increased their catch of bigeye tuna, causing this species to be overfished. A limit on harvests would be more effective, but also harder to implement due to greater difficulties in monitoring catches as opposed to vessel days. Moreover, it does not tackle the incentives for other fisheries commission members to free ride by setting higher limits in their waters. At the same time, the new scheme increased access fees as a share of the total value of landed fish, rising from 3% to 6% under the old system to 14% under the new scheme (Yeeting et al. 2016).

Malaria control and elimination

Malaria “elimination” is an extreme version of “control.” This is a pure public good with a threshold aggregation technology.

“Control” is a public health intervention that reduces the number of cases of malaria in a well-defined area for

a certain period. However, it does not necessarily bring the incidence down to zero at any point. “Elimination,” on the other hand, is an extreme form of control that reduces the number of cases of malaria to zero. Control is normally assumed to be undertaken at the national level. Elimination is a national or regional public good.⁸⁰

In particular, malaria elimination is a threshold public good. To eliminate malaria, the life cycle of the parasite must be broken, which means that infections in mosquitoes and humans must be reduced to zero. This can be done by various means, including the application of larvicides in mosquito breeding sites, indoor spraying of walls with insecticide, the use of insecticide-treated bed nets, and the use of antimalarial drugs. To eliminate malaria, these means must be used in tandem and in sufficient volume to drive transmission to zero. Any less than the sufficient amount will lead to persistence of the disease, while any more would result to wasted resources.

Malaria elimination in Sri Lanka has been a success.

In 1935, there were over 1.5 million cases of malaria in the country, resulting in 80,000 deaths. As part of the global effort to eradicate malaria in the 1950s, Sri Lanka reduced the case count to just 17 in 1963. However, after that, malaria rebounded. By 1970, 1 million cases were recorded, with the epidemic remaining at a high level in the following decades (1980s–1990s).⁸¹ The number of malaria cases began to decline from 1999 onwards (Abeyasinghe et al. 2012). In 2016, Sri Lanka was certified by the World Health Organization (WHO) to have eliminated malaria, following 3 years in which no cases were observed. Although Sri Lanka has one advantage over some other countries, its relative isolation, Sri Lanka will need to institute effective surveillance and treatment of discovered cases to guard against the risks of reintroduction (Galappaththy, Fernando, and Abeyasinghe 2013).

⁸⁰ Once the parasite is removed from a locale, residents need not fear becoming infected, nor do they have to guard against infection. No one in living where malaria was eliminated can be excluded from enjoying this benefit, and nor does any such person’s enjoyment of this good affect anyone else’s enjoyment.

⁸¹ See World Health Organization. Sri Lanka Defeats Malaria and Reaches Zero Cases. <http://www.searo.who.int/srilanka/areas/malaria/sri-lanka-defeats-malaria/en/> (accessed September 2018).

Malaria elimination also requires regional arrangements, and providing poor countries with financing and capacity building can facilitate the elimination process.

Control and elimination in more continental areas is a different matter. The flow of malaria (carried both by infected mosquitoes and infected humans) can be so great that it may never pay or even be feasible for a country to eliminate malaria unilaterally. In these situations, a regional approach is needed.

At the 2014 East Asia Summit, 18 leaders declared the goal of eliminating malaria from the region by 2030.⁸² Elimination of this scale would be a true RPG. In a continental context, it may not pay any country in a region to eliminate malaria within its borders unilaterally, and yet it may pay all countries in the region to work together to eliminate malaria. In this case, provision of the public good is likely to succeed as it mainly requires coordination: once each country is assured that others in the region will eliminate malaria, each has an incentive to eliminate malaria.

When the poorest countries in a region lack the incentive or the capability or resources to eliminate malaria within their borders, external support through capacity building and funding will be effective.⁸³ Such an example is the Regional Malaria and Other Communicable Disease Threats Trust Fund, set up by ADB in 2013 “to support developing member countries to develop multi-country, cross-border, and multisector responses to urgent malaria and other communicable disease issues” (ADB 2015) (see Box 7.9 for the social dimensions of malaria control and the role of MDBs).

Malaria elimination in Asia will have consequences for countries outside the region.

While fewer than 5,000 people—most of them adult males—die of malaria every year in this region, over

400,000 children die of malaria in Africa (WHO 2015). The Greater Mekong Subregion (GMS) has long been a crucible for antimalarial drug resistance (Roberts 2016).⁸⁴ If resistance were eliminated there, malaria would be much less likely to develop globally, providing a benefit to the whole world, sub-Saharan Africa especially. In this regard, the Strategy for Malaria Elimination in the GMS (2015–2030), which was endorsed by the World Health Assembly in May 2015, aims to supply this global public good by eliminating malaria throughout the GMS by 2030, at an estimated cost of about \$3 billion (WHO 2015).

Cooperative Management of the Mekong River Basin

River basin management is often referred to as an RPG because efficient management of a river basin would benefit all the counties sharing the river.

The Mekong River is shared by six countries and crosses some of the poorest parts of Asia. It starts in the Tibetan highlands of the People’s Republic of China (PRC), flows through Yunnan Province, and then into Myanmar, the Lao People’s Democratic Republic (Lao PDR), Thailand, Cambodia, and Viet Nam. The Mekong River serves different purposes for different countries. The PRC and the Lao PDR primarily regard the river as a resource for hydropower development and navigation. Thailand values it for irrigation, Cambodia for fisheries, and Viet Nam for agriculture (Pham Do and Dinar 2014). Collective action needs to reconcile not only the river’s many alternative uses, but also the interests of the different states as regards these uses.

⁸² ADB members include Brunei Darussalam, Cambodia, India, Indonesia, the Lao PDR, Malaysia, Myanmar, the People’s Republic of China, the Philippines, Singapore, the Republic of Korea, Thailand, and Viet Nam (APLMA 2014).

⁸³ A key component of success in eradicating smallpox was also financing and the provision of technical assistance in poor countries. The same is true of the ongoing efforts to eradicate polio and Guinea worm.

⁸⁴ Resistance to chloroquine emerged here in the 1950s. Resistance to sulfadoxine-pyrimethamine surfaced here in the 1960s. Mefloquine-resistant strains emerged in the 1970s. In 2008 and 2009, resistance to artemisinin was detected in the same area. Later still, resistance to piperazine, a drug often used in combination with artemisinin, acquired resistance here.

Box 7.9: The Social Dimensions of Malaria Control and the Role of Multilateral Development Banks

Lack of coordination and cooperation can cause a social dilemma in controlling or eliminating malaria, which suggests the importance of facilitating roles of multilateral development banks (MDBs) in regional public good (RPG) provision in the health sector. Lack of cooperation among neighboring communities in cleaning shared mosquito larval breeding areas such as swamps can be viewed as an outcome of the “Prisoners’ Dilemma” in malaria control. Although cleaning the areas would offer both communities the highest aggregate payoffs, a community may expect the other to act first, and both may end up not cleaning the site.^a In Mauritius, for example, cooperation between villages in the projects to clean *Anopheles* mosquito breeding sites was lacking even as health workers had given out public service reminders (World Health Organization 2012). The Prisoners’ Dilemma in malaria control may be attributed to (i) a lack of cross-community and cross-border arrangements, (ii) the absence of a mechanism for cross-border information sharing on health-related benefits and costs, and (iii) an insufficient political commitment.

Further, Shiroishi (2018) has observed that coordination failure in malaria control in the Greater Mekong Subregion tends to be compounded by (i) a large number of seasonal migrant workers, such as those engaged on private rubber plantations,^b whom public health agencies struggle to reach; (ii) ethnic minorities in remote areas having different sociocultural backgrounds and languages from most of the population; (iii) the low incomes and education attainment of migrants and rural people in border areas; and (vi) substandard health care and difficult access to people in remote border areas.

Addressing threats to regional health issues needs to first understand the multisectoral nature of the issue and requires integrated approaches and a common set of technical expertise and skills. The control of communicable diseases like malaria is not confined to the human health sector. It requires multisectoral and integrated approaches with significant support from all relevant areas, such as agriculture (particularly animal health and food safety), finance, environment, trade, transport, tourism, urbanization, and climate change. As such, the “One Health” approach,^c which calls for multisectoral and transdisciplinary cooperation is seen as important in addressing key health security issues such as zoonosis control and antimicrobial resistance, which are increasingly significant threats to human health and economic development in Asia.

MDBs are in a unique and competitive position to contribute to controlling cross-border communicable diseases, including malaria. With substantive operation experiences across multiple sectors, MDBs have a huge potential to establish and implement an integrated health approach in collaboration with governments and relevant agencies. Building on their coordination and cooperation capacity, MDBs can effectively support various regional forums and subregional strategies with effective use of policy dialogues and advocacy with developing member countries and relevant stake holders, including the private sector.

^a Under the following payoffs, not cleaning the larval breeding sites are the dominant strategies for both village 1 and 2. This results in the Nash equilibrium, where both villages do not clear (Malhotra 2012).

		Community 2	
		Clean (C)	Not Clean (NC)
Community 1	C	1, 1	0, 2
	NC	2, 0	0, 0

^b The Greater Mekong Subregion accounted for almost a half of global rubber production in 2014 (Golbon, Cotter, and Sauerborn 2018).

^c One Health is defined as “a collaborative, multisectoral, and transdisciplinary approach—working at the local, regional, national, and global levels—with the goal of achieving optimal health outcomes recognizing the interconnection between people, animals, plants, and their shared environment” (United States Centers for Disease Control and Prevention. History. <https://www.cdc.gov/onehealth/basics/history/index.html> [accessed September 2018]). Its development was formally recommended in 2007 at the International Ministerial Conference on Avian and Pandemic Influenza.

Source: ADB based on Shiroishi (2018).

A fruitful approach is for the parties to agree on the best use of the river basin taken as a whole, and for claims to individual rights to be addressed using the side-payments and cost-sharing arrangements.

A review of experience in transboundary river basin management worldwide shows that the bargains reached depend on the circumstances (Dinar 2006). When a river forms a border between two states, the costs of joint development are typically shared equally, with no need for side payments. When one state is upstream and another downstream, side payments are typical, but which state pays depends on relative income levels. When an upstream state wishes to develop its portion of a river to the detriment of its downstream neighbor, the upstream state tends to make a payment to the downstream state when the upstream state is richer than the downstream state. When the upstream state is poorer than the downstream state, the downstream state may pay the upstream state to modify its plans.

One of the difficulties for collective action is that the allocation of property rights is often disputed.

Upstream states have an obvious geographic advantage and may claim a right to develop “their” resources as they please. However, international law also recognizes that downstream states have a right not to be harmed by upstream development. Generally speaking, international law favors “equitable utilization” of transboundary rivers, but how this outcome is determined is for the parties themselves to negotiate (Barrett 2003). Side payments are a fairly simple matter when property rights are not in dispute. However, when property rights are disputed, side-payments may not suffice to secure an efficient outcome.

Management of the Mekong River basin has more room for improvement by strengthening cooperation and partnerships between related organizations.

In the Mekong River basin, the lower basin countries, the Lao PDR, Thailand, Cambodia, and Viet Nam, cooperate through the Mekong River Commission, while the upstream countries, the PRC and Myanmar, do not participate but are “dialogue partners.” Even among

lower basin countries, the commission has struggled to address a dispute over use (Pham Do and Dinar 2014). As such, the GMS Economic Cooperation Program, established with ADB assistance in 1992, might be a more appropriate institution for managing the river basin in partnership with the Mekong River Commission. It can serve as a forum for linking a broader set of issues relevant to regional sustainable development since its membership includes all the states in the GMS.

Conclusions and Policy Considerations

Globalization, economic integration, resource mobility, and technology spillovers have created greater interdependence of economies in the region, and demand for RPGs that can address transnational challenges and benefit a region as a whole. When provided adequately, RPGs can effectively bridge the gap between national and global public goods and hence contribute to achieving the Sustainable Development Goals. Infrastructure connectivity can facilitate international trade, increase employment and incomes both domestically and across borders. Transnational impacts on agriculture and food supplies due to climate change and environmental pressures require collective responses. More open trade regimes and increased labor mobility have potential to spread contagious diseases that can be tackled through regional cooperation in multiple areas such as health, trade, transport, and tourism.

RPGs produce spillover benefits that extend beyond borders. However, along with the often-unclear scope of benefits, their nature of being “public” gives a rise to market failures. Collective action for RPG provision can be difficult to achieve without a regional institution or framework that can coordinate provision across countries. Supply may also hinge on the willingness of countries to cooperate. Individual members in the group acting in their private interests may fail to achieve an optimal outcome for the group. Therefore, policy interventions are required to ensure the provision of adequate level of RPGs.

Policy considerations to encourage RPG provision and address collective action problems are suggested as follows. Proposals include the need to improve

understanding of RPGs and better assess the spillover effects of RPGs so that RPGs can receive the policy attention and support for adequate provision. Since different types of RPGs require different responses to address collective action problems, some policy suggestions by RPG type are also discussed. Finally, roles for national governments, MDBs, and other institutions are proposed.

Enhance Understanding of RPGs and Measuring the Benefits of RPGs

Challenges in dealing with coordination problems prevent RPGs from receiving enough policy attention and support.

Even with shared interests and benefits, parties may fail to cooperate over concerns about free-riding or the expected benefits of free-riding themselves. The parties may therefore withdraw efforts in producing a collective good, or they fail to exercise restraint in utilizing a common resource (Olivier 2018). Political economy considerations also matter, where entrenched interests compete with the national objectives. Various coordination challenges are expressed at regional,

national, and local levels. Greater recognition is needed that development is also a multilayered collective action problem, with various coordination challenges that prevent governments from acting consistently as “principals” in dynamic development processes (Booth 2012, Olivier 2018). Recognizing such challenges can guide institutional reform for greater effectiveness, however difficult that may be.

It is important to develop better measures to estimate the spillover benefits of RPGs while making more efforts to identify potential beneficiary countries who are yet to be included in the group of RPG suppliers.

Increased understanding of the shared benefits can help close knowledge gaps and create an incentive for cooperation (Figure 7.9). The perception of free-riding and lack of understanding of specific benefits enjoyed by each individual country deter developing countries from making their contributions toward RPGs. Greater effort should be made to identify and value shared regional benefits in addition to more information about clear benefits for each individual country.⁸⁵

In this regard, a guideline for valuation of regional projects should be based on the principle that benefit valuations for a regional project are not the same as

Figure 7.9: Improving Understanding of the Nature and Benefits of Regional Public Goods



RPG = regional public good.
Source: ADB.

⁸⁶ For example, to evaluate economic rationale, viability, and efficiency, ADB’s Operations Manual (B.2.; ADB 2017b) require a project to conduct an economic analysis. Specifically, the Guidelines for the Economic Analysis (para 172; ADB 2017c) state that “Economic analysis of regional cooperation projects requires the calculation of the returns for both the regional and individual countries. The regional economic net present value (ENPV) gives the total change in welfare for the group of participating countries, which must be equal to the sum of the national ENPVs.” It also says that “The principles of benefit valuation from the national case apply to regional cooperation projects.” However, the guidelines do not specify how regional benefits should be calculated.

those for a national case. Compared with a national project, a regional project has more layers of benefits shared across countries, such as induced foreign direct investment, trade, cross-border financial flows, and integrated markets. If possible, their spillover benefits need to be both identified and evaluated at the concept stage. A cost-benefit analysis may be complemented by alternative approaches such as partial/general equilibrium models accounting for spillover effects. Since there is no consensus on the best methods of measuring RPG benefits, a guideline that sets out the criteria for regional projects and potential methodologies for measurement along with the development of an RPG database would help providers and beneficiaries alike. Continued efforts to test the guideline against projects will help further refine the guideline.

Policy Lessons from Case Studies

Regional experiences highlight the important roles of regional institutions in facilitating regional cooperation and coordination, and promoting collective action in providing adequate level of RPGs.

European experiences show the provision of RPGs can be led and coordinated by regional institutions, including common legislation and regulations. For example, the EU tries to achieve a fully integrated energy system for the region to ensure energy security such as stable energy supply and affordable prices. The experience illustrates that the EU-wide legislation together with cooperation of national energy regulators made significant contributions to the progress toward an integrated energy system.

The experience of Latin America and the Caribbean illustrates the importance of sequencing and innovations for collective action to promote regional cooperation and facilitate RPG provision.

For many countries in Latin America and the Caribbean, trade integration has been a common policy priority. Therefore, pursuing trade integration provides an effective first step to foster provision in other related RPG sectors such as cross-border infrastructure. Also helpful in promoting collective action was the adoption of an innovative approach to form a new group for economic

cooperation such as the Pacific Alliance based on mutual interests rather than geographic proximity.

Experiences in Asia stress the need for a regional approach to tackling common issues that can complement national and global efforts.

For example, the development of the early warning system for tsunamis across the Indian Ocean has improved detection and reporting of disasters significantly, which was complemented by national efforts such as communication and trained responses. Like malaria control in the Greater Mekong Subregion, a stronger regional response could also improve the effectiveness in the prevention of communicable disease outbreaks both regionally and globally.

Policy Considerations by RPG Type Based on Aggregation Technology

There is no one-size-fits-all mechanism for RPG provision, but different aggregation technologies suggest a useful framework to guide how to promote RPG provision depending on their types.

Grants are usually recommended for shoring up the weakest-link nations, which are in many cases less developed low-income countries, such as in providing quarantine and surveillance to contain contagious diseases or boosting liquidity in troubled financial systems. Best-shot arrangements are desirable when advanced economies supply RPGs that require large capital outlays or specialized technical skills. Designing and implementing best practices, such as in building bond markets and sound financial systems, or finding a cure for communicable diseases, may be led by one country or a small number of countries with sufficient capacity and successful experiences.

Policy considerations specific to the type of RPGs are suggested for (i) natural resources and environment, (ii) economic cooperation and integration, (iii) human and social development, (iv) governance and institutions, (v) peace and security, and (vi) connectivity (see Table 7.8 for summary).

Table 7.8: Policy Considerations by Functional Area of Regional Public Goods

Functional Areas	Aggregator	Regional Institutions	Policy Considerations
<p><i>Natural Resources and Environment</i></p> <p>Addressing water pollution, curbing acid rain, commons management, reducing greenhouse gases</p>	Summation, weighted sum	Acid Deposition Monitoring Network in East Asia; Long-Range Transboundary Air Pollution in Northeast Asia; Pacific Island Renewable Energy Investment Program	<ul style="list-style-type: none"> • Setting up pollution monitors and identification of emitter and recipients requires funding at the regional and subregional levels • Grants can be used to fund poor countries' contribution to the natural disaster monitoring system • For assistance after a natural disaster (a summation technology), rich countries, charitable foundation, and nongovernment organizations have roles to play • Multilateral institutions and networks should bolster regional actions to address GPGs
<p><i>Economic Cooperation and Integration</i></p> <p>Free trade agreements, fostering foreign direct investment, maintaining financial stability, promoting macroeconomic stability, fostering regional growth</p>	Summation, weakest link, best shot	Greater Mekong Subregion (GMS) Program; South Asian Association of Regional Cooperation; Association of Southeast Asian Nations (ASEAN); Central Asia Regional Economic Cooperation; Free Trade Area of the Asia-Pacific; South Asia Free Trade Area; Chiang Mai Initiative Multilateralization	<ul style="list-style-type: none"> • In terms of maintaining regional financial stability, sound financial practices (best-shot RPGs) including well-established bond markets, emergency liquidity pools, or agreements with multilateral institutions can enhance resiliency to the regional financial system • In the case of poor countries, grants would be appropriate for constant surveillance to spot liquidity and other difficulties that could infect neighboring countries' banking systems (weakest-link RPGs)
<p><i>Human and Social Development</i></p> <p>Education, health, knowledge creation, culture, furthering science</p>	Weakest link, weaker link, best shot, better shot	GMS Health Security Project; International Rice Research Institute; ASEAN Quality Assurance Framework	<ul style="list-style-type: none"> • Regional and subregional institutions have a greater role to play for weakest-link health RPGs, such as quarantine and surveillance efforts to contain potential global impact of contagious diseases • Grants are needed to bolster the actions of poor weakest-link countries • Regional and global health efforts should be complementary and reinforcing
<p><i>Governance and Institutions</i></p> <p>Regulatory practices, regional collectives, rule of law, banking practices, benchmarking data, capacity building, policy harmonization, surveillance</p>	Best shot, better shot, threshold, weakest link	Economic Review and Policy Dialogue; South Asian Telecommunication Regulators Council; ASEAN+3 Macroeconomic Research Office	<ul style="list-style-type: none"> • To promote the best practices, regional institutions' capacity-building efforts would be recommended particularly for those weakest-link countries • To apply the very best practices, the region should look to the entire world, especially the most successful industrial countries, and borrow practices that have worked
<p><i>Peace and Security</i></p> <p>Peacekeeping, crisis management, limiting weapon proliferation, managing refugee flows, territorial dispute resolution, alliance, curbing drug trafficking, controlling terrorism, limiting corruption</p>	Best shot, better shot, threshold, weakest link	No regionwide Asia-Pacific alliance. Some non-aggression pacts (e.g., India and Pakistan and the People's Republic of China and Pakistan); Alliances with the United States and ASEAN.	<ul style="list-style-type: none"> • An alliance structure that links the region would allow for more rapid responses to conflict exigencies • Actions to shore up unstable regimes must be undertaken, ideally at the subregional level that richer subregions (e.g., East Asia) are able to address
<p><i>Connectivity</i></p> <p>Transportation network, infrastructure, customs control, communication network, energy network, air-traffic control</p>	Weakest link, weaker link, threshold	Border economic zone development; East Asia and Pacific Infrastructure Regulatory Forum; South Asia Forum for Infrastructure Regulation; Turkmenistan-Uzbekistan-Tajikistan-Afghanistan-Pakistan Power Interconnection Framework; GMS Cross-Border Transport Facilitation Agreement	<ul style="list-style-type: none"> • Connectivity action should first be at the subregional level, followed by regional efforts to link the subregions • When congestion tolls are used to internalize the associated crowding costs, the toll proceeds can be used to finance the club and achieve an efficient solution • Equity concerns can be addressed by regional or subregional institutions through funding the user charges or tolls of poor countries

GPGs = global public goods, RPG = regional public good.
 Source: ADB's policy considerations based on Sandler (2018a, 2018b).

Natural resources and environment. This area is generally associated with summation and weighted-sum aggregators. Weighted sum is most applicable to acid rain, water pollution, and other transboundary air and water emissions that affect an entire region and beyond. Thus, it is necessary to know the origin and the recipient countries of the pollutants so that appropriate treaties can be enacted and enforced. Gathering this information requires pollution monitors across a network of locations, with funding at both the regional and subregional levels. A regional institution can then come up with an overall grid for the entire spillover area so that all relevant emitters and recipients are included.⁸⁷

Economic cooperation and integration. Summation and weakest-link aggregators are commonly found in this area. All regional countries must put their financial system on a sound basis, which includes constant surveillance to identify liquidity shortages and other problems that could become systemic and infect neighboring countries' banking systems. This requires assistance via grants to advance financial development in weakest-link (poor) countries. Best-shot aggregators also play a role in economic cooperation. Coming up with sound financial practices that not only limit financial instability but also put into motion ways of ameliorating emerging crises is a best-shot RPG that has spillovers worldwide.

Human and social development. The best shot and weakest link are the most relevant aggregation technologies. Health is a best-shot public good that is created typically by best-endowed and best-staffed research teams—those generally found in the richest countries. Preference for strong public health motivates rich countries to provide the best-shot RPG through their own funds or from loans or aid to groups such as WHO, the Centers for Disease Control, or the Pasteur Institute. For weakest-link health RPGs such as quarantine and surveillance efforts, regional and subregional institutions (e.g., GMS, SASEC, and CAREC) can play a much greater role. Grants are needed to bolster the actions of weakest-link countries.

Governance and institutions. This is an area primarily categorized by best-shot, better-shot, and threshold

aggregators. Instituting appropriate regulatory practices, regional collectives, rule of law, benchmarking data, and banking practices are best- or better-shot RPGs. A region would want to apply best practices that make governance effective and further commerce, the functioning of markets, and civil and political freedoms. A weakest-link component is also present because a country that fails to follow best practices can produce negative externalities or consequences on countries that do adhere to them. To promote best practices, regional institutions' capacity-building efforts are recommended, particularly for the weakest-link countries.

Peace and security. This area is primarily driven by best-shot, better-shot, and weakest-link aggregators. Peacekeeping efforts and managing refugee flows, for example, are best-shot or better-shot RPGs led by one or more nations. An alliance structure that links the region would allow for more rapid responses to conflict exigencies. Unstable regimes in a weakest-link country can spread conflicts that can hurt growth in neighboring states. Actions to shore up unstable regimes must therefore be addressed.

Connectivity. Enhancing connectivity is mainly driven by weakest- or weaker-link aggregators, since one substandard piece in an infrastructure grid can limit its entire functionality. To forestall such a consequence and to eliminate choke points or linkage failures, oversight and support must be provided at the regional level. Accordingly, grants to shore up these weakest-link challenged countries are needed.

Roles of RPG Suppliers—Nations, MDBs, and Others

Nations need to build the basic capacity—through the provision of national public goods—to be able to contribute RPGs.

A country that is unable to supply national public goods (NPGs) is unlikely to be able to contribute to the supply of RPGs, at least without external assistance. NPGs are important complements to RPGs. Education

⁸⁷ For example, the United Nations Environmental Program (UNEP) can assist as it has done throughout Europe in terms of monitoring sulfur, nitrogen, volatile organic compounds, and other pollutants. Such efforts by the UNEP resulted in effective transboundary air pollution treaties (e.g., Helsinki Protocol, Sofia Protocol, Oslo Protocol, and Geneva Protocol) concerning these substances.

at the country level for instance is essential to take advantage of knowledge shared across a region. The detection and reporting components of a tsunami warning system are best provided as an RPG only when supported by the NPGs of communication and trained responses. Elimination of malaria at the national level is a cornerstone of regional and global elimination of the disease.

Developing economies are generally well aware of the substantial benefits of RPGs, but view it difficult to contribute RPG provision.⁸⁸ Collective action can be promoted if national development priorities align with the need for RPGs.

Difficulties in balancing national and regional interests may lead to the view of RPGs as less important in development priorities. The perception of unequal RPG benefits may also discourage countries to contribute. Shortages of financial resources and capacity are another challenge for developing economies in providing RPGs. If national development priorities align with RPGs, developing economies would be much more willing to contribute. For example, when a group of countries share better infrastructure connectivity as their respective national development policies, coordinating more cross-border infrastructure investment can be easily facilitated. As such, the region can benefit from having a mechanism in place to share information on national development priorities and the benefits of RPGs among regional stakeholders. MDBs can also support regional governments in developing their national development strategies to better accommodate regional and subregional policies and priorities.

MDBs can help increase RPG provision via reducing knowledge and financing gaps as well as playing the role of an honest broker to enhance mutual trust and facilitate regional cooperation for the provision of RPGs.

MDBs, including ADB, have been active in RPG provision either directly funding or providing financial support. In addition, they can help facilitate RPG

provision of their member economies by strengthening knowledge and information sharing on the benefits and the costs of provision. The strengths of MDBs also build on effective coordination and their role as an honest broker with their accumulated social capital from member countries and their communities in the long run (Box 7.10). Their in-depth knowledge and experiences in multiple countries and sectors allow a more holistic and integrated approach to address regional and subregional development challenges and hence promote regional cooperation for RPG provision that can complement national efforts.

Maintaining an adequate level of RPG and strengthening the maintenance capacities of the participating countries are as crucial as RPG provision itself. An MDB can help in this area too. In the 1960s, for instance, in response to two major tsunamis in the Pacific, the Intergovernmental Oceanographic Commission of the United Nations Educational, Scientific and Cultural Organization (UNESCO) and its member states set up a warning system. By 2004, three of its six seafloor pressure sensors were out of commission, and there was very little funding for maintenance (Alverson 2005). Preventive maintenance for infrastructure can save costs of building new infrastructure (Pacific Infrastructure Advisory Centre 2013).

Collaboration and coordination among regional and subregional institutions can also help boost RPG provision further by complementing each other's different institutional roles and scopes of RPG provision.

Regional institutions including MDBs can coordinate actions among subregional institutions while making sure that the goals and practices of subregional public goods provision are aligned with those of RPG provision (Figure 7.10). Similarly, global institutions can coordinate and support actions among regional institutions. A host of other institutions such networks, partnerships, charitable foundations, and nongovernment organizations can provide additional RPG support to countries lacking knowledge and financial capabilities.

⁸⁸ The views from the developing countries' perspectives draw from the discussion at the conference on *Toward Optimal Provision of Regional Public Goods in Asia and the Pacific* which was held on 10–11 May 2018 in Tokyo, Japan. The conference highlights are available in ADB (2018a).

Box 7.10: The Theory of Repeated Games and Roles of Multilateral Development Banks in Regional Public Good Provision

Socially optimal resource allocation may not be guaranteed by the free market. There are situations where individually rational decisions based on conflicting self-interests may lead to persistently inefficient social outcomes, also seen in the Prisoners' Dilemma. Public goods, regardless of global or regional, have been modelled as the Prisoners' Dilemma game. One way to avoid such socially undesirable outcomes is through repeated interactions. The theory of infinitely repeated games shows that cooperation can be a dominant strategy of all players (i.e., a Nash equilibrium) for sufficiently patient players.^a A major contribution of game theory is the recognition that repeated interactions allow credible punishments or rewards that can lead to self-enforcing cooperation, that is, cooperation without external means to enforce cooperative behaviors among players (Dal Bó and Fréchette 2017). As such, repeated (ongoing) interaction explains cooperative behavior even as the decision to cooperate is against self-interest in the short run.

The classic example is the repeated Prisoners' Dilemma. Following Levin (2006) and Gibbons (1992), given two players $i = 1, 2$ and options "Contribute" and "Not Contribute" for each player, a payoff matrix can be set as follows:

		Player 2	
		Contribute (C)	Not Contribute (NC)
Player 1	C	1, 1	-1, 2
	NC	2, -1	0, 0

If the game is played once, the unique pure-strategy Nash equilibrium is (NC, NC), where each player acting rationally contributes nothing. However, if players 1 and 2 play the game repeatedly at time $t = 0, 1, 2, \dots, \infty$, player i 's average payoff for the entire repeated game would be:

$$(1 - \delta) \sum_{t=0}^{\infty} \delta^t \pi_t$$

where π_t is the payoff at time t and δ is a subjective discount factor ($0 \leq \delta < 1$), with $\delta < 1$ means that the players value today's consumption more than tomorrow's. Suppose

that the players begin the infinitely repeated game by using such strategies that one continues to contribute as long as the other contributes as well. Otherwise, neither player will contribute. Under such strategies, when player i chooses to contribute in every period, the average payoff for player i is $(1-\delta)(1+\delta+\delta^2+\dots)=1$. If player i chooses not to contribute today, the average payoff for player i would be $(1-\delta)(2+\delta \cdot 0+\delta^2 \cdot 0+\dots)=(1-\delta)2$. Therefore, he (or she) will contribute as long as $1 \geq (1-\delta)2$, or $\delta \geq \frac{1}{2}$. That is, as long as each player is sufficiently patient (hence putting sufficient weight on the future), cooperation would be a preferred strategy for both players in every round (a sub-game perfect equilibrium) and both players contribute for the entire repeated games.

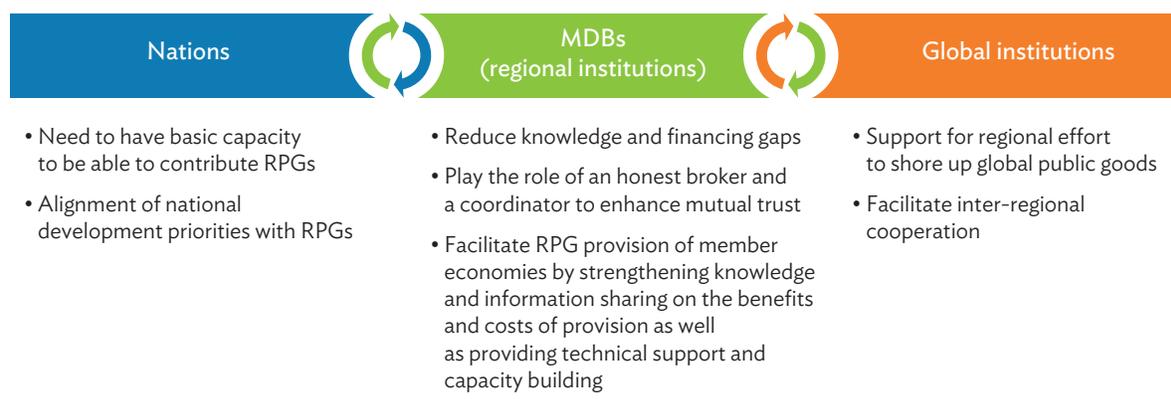
The theory implies that repeated interactions can reduce the players' opportunistic behaviors, leading them to enter into cooperative agreements and sustain them over time. Behavioral changes instigated by recognizing continuous interactions in the future with the same players, so-called "the shadow of the future" could lead to voluntarily self-enforcing commitments.^b For example, continued summit meetings (Putnam 1984) and regional forums can be seen as venues for repeated interactions, building relationship, and cooperation without the need for third party enforcement. Similarly, multilateral development banks (MDBs) can create such venues for their member economies and provide the platform for repeated long-term relationships. In addition, MDBs can facilitate each country's voluntary contributions toward regional public goods by building up mutual, informal trust relationship or "social capital" among member economies to recognize shared benefits and mitigate free riding incentives.^c

Nevertheless, actual applications of infinitely repeated games may be challenging in real international and regional cooperation scenes due to potential changes in nations' political situations and actors. Changes in domestic conditions such as leadership turnovers and the resulting changes in preference and ideology may pose a risk to continued cooperation (Mattes, Leeds, and Carrol 2015). Therefore, MDBs can play a critical role in providing platform for long-term cooperation among countries.

^a The Folk Theorem says that any individually rational outcome can arise as a Nash equilibrium in infinitely repeated games with sufficiently little discounting (Fudenberg and Maskin 1986). That is, players in repeated games must consider the reactions of the others, where the fear of retaliation may lead to outcomes that otherwise would not occur. Repeated games (or interactions) thus can potentially build trust and promote contribution. This may contrast with one-shot games where noncontribution results as an equilibrium. The latter however is also a feasible set under the Folk Theorem.

^b Axelord (1984) used the term "the shadow of the future" for the first time to argue that "mutual cooperation can be stable if the future is sufficiently important relative to the present. This is because the players can use an implicit threat of retaliation against the other's defection—if the interaction will last long enough to make the threat effective."

^c Social capital is defined as informal institutions based on social relationships, networks, and associations that create shared knowledge, mutual trust, social norms, and unwritten rules (Durlauf and Fafchamps 2004). Social capital plays an important role in pushing up growth (Barro 1991). In particular, the relationship of trust to growth is largely observed in poorer countries that may be due to their underdeveloped financial sectors, weak property rights, and inefficient contract enforcement (Knack and Keefer 1997). When social capital is low, it can be built up by "artifacts" such as infrastructure and institutions (Aoyagi, Sawada, and Shoji 2014; and Tabellini 2005).

Figure 7.10: Roles of Institutions in the Provision of the Regional Public Goods

MDB = multilateral development bank, RPG = regional public good.
Source: ADB.

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Annex 7a: Measuring Regional Benefits of Infrastructure: Data, Methodology, and Model

A reduced-form model using spatial econometric methods (Kim et al. 2018)

The variables were primarily taken from the data set in Calderón, Moral-Benito, and Servén (2015), spanning from 1960 to 2000, and extended up to 2014. Two new information and communication technology (ICT) infrastructure variables—mobile and fixed broadband subscriptions—were added. The final data set has a panel data for 78 countries covering 1960 to 2014 except for mobile and broadband subscriptions, which are available from 1995 to 2014.¹

Six types of infrastructure variables were used separately under two broader categories for analysis:

¹ The final data set includes 15 countries in Asia: East Asia—the People's Republic of China, Japan, the Republic of Korea; South Asia—Bangladesh, India, Nepal, Sri Lanka; Southeast Asia—Indonesia, Malaysia, the Philippines, Singapore, Thailand; Central and West Asia—Pakistan; Oceania—Australia, New Zealand.

- Transport and energy (TRE) infrastructure variables: length of total roads (in kilometers) from the World Road Statistics, length of rails (in route-kilometers) from the International Road Federation, and electricity generating capacity (in millions of kilowatts) from the United States Energy Information Administration; and
- ICT infrastructure variables: fixed-telephone subscriptions from the International Telecommunication Union (ITU), mobile-cellular telephone subscriptions from the ITU, and fixed broadband subscriptions from the World Bank's World Development Indicators (WDI).

The dependent variable, per capita income, was computed by dividing the output-side real GDP at chained purchasing power parity (in millions of 2011 \$) by the population. Both variables are from the Penn World Table 9.0 (PWT). The data for capital stock at constant 2011 national prices are also from the PWT. For the variable for human capital, average years of secondary schooling by country obtained from Barro and Lee (2013) was used.

The total capital stock variable includes all asset classes of gross fixed capital formation in the public and private industrial sectors of the national accounts: residential and nonresidential buildings, machinery and equipment, and civil engineering work. This raises an issue of double counting if infrastructure stock variables are included together with the total capital stock as explanatory variables. Therefore, an effort was made to extract non-infrastructure capital stock from the total capital stock using a statistical method; i.e., regressing total capital stock on infrastructure variables, and using the residuals as a proxy for non-infrastructure variable. The original data sources include many missing values for less developed countries. These omissions prevented the running of the spatial panel model due to missing information on neighbors. Thus, the data were collapsed from an annual frequency to a 5-year frequency by averaging non-missing values only.

Based on the Cobb–Douglas production function following Calderón, Moral-Benito, and Servén (2015), the spatial Durbin model (SDM) was implemented to account for the spatial spillover effect in the production function of country given by the equation:

$$y_{it} = \beta_0 + \beta_1 k_{it} + \beta_2 h_{it} + z_{it}\eta + \sum_{j=1}^n w_{ij}x'_j\theta + \rho \sum_{j=1}^n w_{ij}y_{jt} + \mu_i + \gamma_t + \epsilon_{it}$$

where y_{it} is the log of per capita real output for country $i=\{1,\dots,n\}$ at time t , k_{it} is the log of per capita non-infrastructure capital stock, h_{it} is human capital, z_{it} is a vector of log of infrastructure variables, μ_i is the unobserved country effect, γ_t is the time fixed effect, ϵ_{it} is a random fluctuation, and $\beta_0, \beta_1, \beta_2,$ and η are elasticities. x is a vector of other countries' infrastructure variables with its corresponding coefficient vector θ . w_{ij} is an entry of a spatial weight matrix, $W_{n \times n}$.

The definition of a neighborhood depends on the spatial weight matrix W . Four weight matrices with rows standardized were used: (i) exponential decay $W_1 = \{\exp(-0.01 \cdot 1/d_{ij})\}$ where d_{ij} is the geographic distance between country i and j , (ii) inverse of distance $W_2 = \{1/d_{ij}\}$, and (iii) inverse of square of distance $W_3 = \{1/d_{ij}^2\}$, all with a 25th percentile cutoff; i.e., the neighbors of a particular country are only the closest 25% of all countries in terms of distance. Countries with distance beyond the cutoff have a weight of zero. And lastly to account for economic distances among countries, a trade flow matrix was also used. That is, $W_4 = \{\text{total goods trade between countries } i \text{ and } j\}$ with the rows standardized.

A structural model using a computable general equilibrium model (Lee 2018)

The computable general equilibrium (CGE) analysis is conducted using the Global Trade Analysis Project (GTAP) model. The GTAP model can be described as a global, comparative static, general equilibrium model which hinges on an input–output accounting framework. First, it is global in a sense that all countries are represented in the model. Second, being a comparative static model, analysis using the GTAP model indicates being able to compare “base” and “policy cases” of the global economy—either at a fixed point or with respect to two periods (one serving as the base, and the other as the policy case). Finally, the GTAP model as a general equilibrium model means, as opposed to a partial equilibrium model, that all sectors in the model economy interact to endogenously determine supply, demand,

Global Trade Analysis Project Model: Sectoral and Regional Breakdown

a: Sectoral Breakdown

GTAP Industry	Infrastructure Sectors in ADB (2017a)
1	Agriculture
2	Mining
3	Textile and clothing
4	Chemical
5	Metal
6	Vehicles
7	Electronic products Mobile
8	Other manufacturing
9	Electricity and gas Electricity
10	Water and sewage Water
11	Construction
12	Trade
13	Transport-land Rail, Road
14	Transport-sea Seaport
15	Transport-air Airport
16	Communications Broadband, Telephone
17	Financial services
18	Other business services
19	Public services Sanitation
20	Other services

b: Regional Breakdown

1	People's Republic of China*		
2	Japan		
3	Republic of Korea		
4	ASEAN4 Indonesia*, Malaysia*, Philippines*, Thailand*		
5	CLMV Cambodia*, Lao PDR, Myanmar*, Viet Nam*		
6	Other developed Asia	ASEAN developed	Brunei Darussalam, Singapore
		East Asia	Hong Kong, China; Taipei, China
		Others	Australia, New Zealand
7	Other developing Asia	Central and West Asia	Armenia*, Azerbaijan, Georgia, Kazakhstan*, Kyrgyz Republic*, Tajikistan, Turkmenistan, Uzbekistan
		South Asia	Afghanistan*, Bangladesh*, Bhutan*, India*, Maldives*, Nepal*, Pakistan*, Sri Lanka*
		Pacific	Cook Islands, Federated States of Micronesia*, Fiji*, Kiribati*, Marshall Islands*, Nauru, Papua New Guinea*, Samoa, Solomon Islands, Timor-Leste, Tonga, Tuvalu, Vanuatu
		East Asia	Mongolia*
8	United States		
9	European Union (27 countries) excluding the United Kingdom		
10	Rest of the world		

* = economies with infrastructure investment shocks (25 economies), Lao PDR = Lao People's Democratic Republic.
Source: Lee (2018).

and prices at equilibrium. An input–output accounting framework ensures that “all sources and uses of each economic good are accounted for, as are all inputs into production” (see Corong et al. [2017] for more details on the GTAP model).

For analysis, the GTAP 10 Database with the 2014 base year was aggregated into 20 industries for 10 regions. The baseline infrastructure gap data (projected infrastructure needs less investments) for 25 countries in Asia during 2016–2020 (Table 5.1 in ADB 2017a) were used as investment shocks for policy simulations. Infrastructure industries include road, rail, seaport, airport, electricity, mobile, telephone, broadband, water

supply and sanitation, which were matched with the GTAP industry classification.²

Three shock transmission channels for infrastructure investments are defined: (i) direct impacts on infrastructure industries in Asian countries, (ii) domestic spillover impacts on other industries in the same countries using stimulated infrastructure outputs as intermediate inputs, (iii) cross-border spillover impacts on industries in other regions using the infrastructure outputs imported from the Asian countries as intermediate input. To measure the infrastructure impacts in each channel, the following technical change parameters were assumed to change: (i) output-

² In ADB (2017a), the infrastructure gap projections are only available for country aggregates, whereas the projected infrastructure needs are available by sector by country. As simulations in the GTAP model requires sector-specific shocks, it is assumed that sectoral distribution of infrastructure gap in a country is the same as that of infrastructure needs.

augmenting technical change in infrastructure sector i of region r [the variable name in the GTAP model: $ao(i,r)$]; (ii) infrastructure-input- i -augmenting technical change in industry j of region r [$af(i,j,r)$]; and (iii) import- i -from-region- r -augmenting technical change in region s [$ams(i,r,s)$].³ Therefore, the difference between Channel 2 and 1 (Channel 3 and 2) provides insights on the significance of and structural understanding about the domestic (cross-border) spillover effects.

³ Given that there are few studies on the level of technical changes due to large-scale multi-country infrastructure investments and this study is mainly to examine impacts by shock transmission channels, it is assumed that $ao(i,r)$ increases by the amount equivalent to 30% of infrastructure shock, $af(i,j,r)$ by 15%, and $ams(i,r,s)$ by 10% during 2016–2020.

