Part III
Best Practices and Recommendations in Each Sector to Make It Happen

Chapter 8
Low-Carbon Transport in India

Assessment of Best Practice Case Studies

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Abstract India is the world's fourth largest emitter of greenhouse gases. Transport contributes 13 % of India's GHG emissions (MoEF. India: green house gas emissions 2007, Indian Network for Climate Change Assessment (INCCA), Ministry of Environment and Forests (MoEF). Government of India, New Delhi. Accessed 13 Sept 2013, 2010). Driven by rising population, income, and urbanization, under a business-as-usual scenario, India's energy demand from transport is projected to increase sixfold in 2050 from current levels. This has vital impact on key national sustainable development indicators like energy security and air pollution. In response, several national and subnational policies and measures were initiated to ameliorate the adverse impacts of transport decisions on sustainability. These include national policies and programs for fuel efficiency, low-carbon technologies, investments in public transport infrastructure, and climate change mitigation. These aside, several bottom-up interventions that are initiated locally are showing promise.

This chapter offers an overview of transport sector in India and presents selected best practice case studies that identify good practices. Evidently, the challenge is to replicate and scale up these practices to gain sizable CO_2 mitigation together with co-benefits vis-à-vis various national sustainable development goals. The assessments show that successful implementation of national policies at the subnational level requires widely agreed goals and targets and support from the national government. The support can be in the form of capacity building, technology, or finance. In the overall, the chapter argues for (1) integrating transport policies with local, national, and global objectives, (2) a comprehensive assessment of the impacts (co-benefits and risks) of policies and project from the planning to the post-implementation stage, and (3) cooperation and knowledge sharing among cities and regions facilitated by the national government for cross-learning and transfer of best practices. The lessons from these studies provide important

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learnings for designing policies and projects elsewhere including other developing countries.

Keywords Low carbon • Best practice • Transport • Co-benefits • Replicability • Policy

Key Message to Policy Makers

- Transport "best practices" deliver sustained carbon mitigation and co-benefits.
- Best practice cases include policies and projects which are replicable and scalable.
- Case studies demonstrate contextual effectiveness of methods and practices.
- Best practices align sustainability and low-carbon goals spatially and temporally.
- Rational transport system needs integration of inter- and intracity transport choices.
- Technology cooperation and carbon finance are vital for replication and scalability.

8.1 Introduction

This chapter examines selected case studies which represent "best practice" vis-à-vis sustainable low-carbon transport policies, measures, technologies, and investments in India. The term "best practice" is used contextually. The central idea for this chapter is not to look for a perfect blueprint of a policy or plan but to critically evaluate what has been or is being implemented and is proven to work. The key "best practice" criteria considered in assessing the case studies are clear vision, assessment of delivered or demonstrated co-benefits of low-carbon choices, as well as their replicability and scalability. The case studies are selected, keeping in view the diversity of transport sector and the multiple interfaces of the sector with development and environment.

The overarching transport policies are framed, mandated, and facilitated by the national government. The implementation in most cases involves subnational governments or sector-specific departments or organizations. The projects are implemented by agencies, including those operated under public-private partnership (PPP). The case studies are therefore selected belonging to both policy and project domains. Successful low-carbon integration between national and subnational governments is essential for successful implementation of policies which requires integration between national policies and subnational initiatives

(Matsumoto et al. 2014). The cases selected here look at both national and subnational initiatives on low-carbon transport policies and infrastructure.

The three case studies on policies include major initiatives by the Government of India to improve local environment and/or energy security, but also have bearing on greenhouse gas emissions from transport. The three project case studies include new areas where either the first project is recently initiated (e.g., dedicated freight corridor), the first project is identified (e.g., high-speed rail), or an initial set of projects are already under implementation (e.g., bus rapid transit).

8.1.1 Current Transport Scenario in India

India's transport sector is a rapidly growing sector and contributes 6.4 % to the GDP of the country. The sector is largely oil dependent and accounts for 13 % of the country's energy-related CO_2 emissions (MoEF 2010). Crude oil imports have been increasing steadily and making India the third largest oil importer globally. Nearly 80 % of India's current crude oil consumption comes from imports raising challenges of national energy security.

Intercity transport is mainly met by road (88 %), rail (11 %), and a limited share of air transport. Indian railways are among the largest rail networks globally and transport 23 million passengers and 3 million tonnes of freight daily (GoI 2015). Despite its extensive network, railways are faced with issues of capacity constraints and poor infrastructure. The share of rail has dropped from over 40 % in 1970 to 11 % in 2010 due to high competition from road transport. Similarly, rail dominated freight transport in India; however, this share is on the decline in recent years.

In urban areas, road transport dominates. Present status of urban transport is characterized by increasing trip distances, increasing share of private motorized transport, and declining share of public and non-motorized transport. These trends are leading to increasing problems of poor air quality, road safety, noise, and congestion.

8.1.2 Transport Scenarios for India

India is witnessing a unique period of population growth, economic growth, and urbanization. A third of India's population lives in urban areas. Urban population is expected to grow in the future, and by 2050, half of India's population is projected to reside in cities (UN 2014). India's GDP is also expected to grow at a healthy rate with per capita incomes reaching USD 15,842 (2010 prices) in 2050. Population, income, and urbanization are expected to drive vehicle ownership, travel demand, and freight transport demand.

Intercity travel demand will increase by 4.3 times between 2010 and 2050. In business-as-usual (BAU), this demand will be met by road-based transport and a

growing share of air transport resulting in a higher energy demand resulting in challenges of national energy security and greenhouse gas emissions. In cities, increasing travel demand, reliance on private motorized modes, and declining share of public transport and non-motorized modes will increase energy demand and GHG emissions from cities (Dhar et al. 2013).

Under a BAU scenario, oil will dominate as the energy source, despite a minor diversification into natural gas, electricity, and biofuels. Increasing electrification of intercity rail, urban rail, and freight transport will increase electricity demand from transport. Transport emissions in the BAU are expected to reach around 1 billion tCO2 in 2050—an increase of 5.5 times increase from 2010 levels (Dhar and Shukla 2014). It is increasingly becoming clear that the BAU will not deliver the desired level of GHG mitigation. For policy makers in the Indian transport sector, this growth poses multiple challenges. Besides the impact on climate change, this raises other issues on how to offer wider mobility access at affordable rates, limit the health impacts of air pollution, and reduce traffic congestion and dependence on fossil fuels.

8.1.3 Need for Assessment

Concerns in developing countries exist regarding the costs imposed by mitigation targets and their impact on economic growth (Olsen 2013). The "co-benefits approach" helps identify actions that balance the short-term development concerns with long-term goals of climate change mitigation (IGES 2011; Creutzig and He 2009). Opportunities exist to mitigate GHG emissions from India's transport sector and facilitate sustainable mobility by integrating transportation policies with environment, development, and climate change policies. Key interventions include reducing travel demand through planning and sustainability measures, a shift of passenger and freight transport from road-based modes to rail and from private transport to public transport and non-motorized transport in cities, and increase penetration of alternate fuels and vehicles including electric vehicles and hybrid vehicles. These measures will also diversify the fuel mix with a higher share of electricity, natural gas, and biofuel (Dhar et al. 2013).

The sustainability focus is evident in policies of the Government of India. For instance, India's National Action Plan on Climate Change (NAPCC) highlights a mix of measures, including higher share of public transport, penetration of biofuels, and significant improvements in vehicle efficiency (GoI 2008). Several cities are proactively initiating infrastructure investments in mass transit, urban planning for better land use transport integration, and upgrading existing public transport. These policies and interventions have reduced GHG emissions and at the same time have delivered social and environmental benefits. Since these are limited to few cities, they have not realized the desired mitigation potential. Evidently, there is scope for replication to deliver higher emission reduction and deliver wide-ranging economic, social, and environmental benefits.

At the same time, some of these initiatives are beset with challenges during planning and implementation. It is essential to carry out a comprehensive assessment of good practices for three reasons: (1) this assessment can help highlight the mitigation potential and other benefits to guide policy makers in replication or scaling up, (2) it can highlight unique approaches or co-benefits, and (3) it can help understand challenges during planning and implementation which can be integrated during the next stage to avoid adverse impacts post-implementation.

For instance, the successful implementation of the Auto Fuel Policy 2003 catalyzed the development of a roadmap for further improvement till 2025. The success of transport initiatives in cities can facilitate cross-learning among subnational governments and help to bring in measures early. As an example, successful implementation of a mass transit system in a city can deliver useful lessons to subnational governments on developing mobility plans and leveraging finance for implementation. It is essential therefore to take critical and comprehensive assessment of objectives and impacts to guide future policies to better align these with development goals.

The central idea of this chapter is to look at selected case studies and highlight the success factors and critically examine issues in order to make informed decisions for replication in future. The paper is divided into four sections. After the introduction section, the second section outlines the key transport policies and plans in India. These include existing and proposed policies, planned investments including major infrastructure projects, and urban initiatives. A detailed assessment of case studies is described in Sect. 8.3. The final section concludes with the key highlights from the case study assessment.

8.2 Transport Policies in India

The Government of India has initiated several policies and initiatives for the transportation sector with the objective of enhancing passenger mobility, improving logistics of freight transport, increasing rail use by improving efficiency, raising the average speed, promoting low-carbon transport, and at the same time improving energy security and local benefits of air quality and congestion (Table 8.1). Cities have initiated urban transport initiatives including infrastructure for public transport and non-motorized transport and urban planning and zoning interventions to facilitate transit-oriented development.

Transport sector takes up a share of 45 % in the total infrastructure investments in India. There are plans to increase investments from 2.6 % of GDP between 2006 and 2011 to 3.6 % of total GDP in the period between 2018 and 2022. The Government of India policies highlight rapid expansion and modernization of transport infrastructure. Some of these include expansion and upgradation of roads and highways, reducing congestion in railways, electrification of rail corridors, investments in dedicated freight corridors, and expansion of air infrastructure

Table 8.1 Overview of selected transport policies in India

Sector	Policy/plan	Highlights
Urban transport	National Urban Transport Policy	Enhancing mobility to support economic growth and development
		Reduce environmental impacts
		Enhancing regulatory and enforcement mechanisms
	National Mission on Sustainable Habitat	Submission under India's National Plan on Climate Change
		One of the key components is promotion of urban public transport
Alternate fuels and vehicles	National Policy on Biofuels	5 % blending of ethanol in petrol in 20 states and eight union territories
		Financial incentives
		Waiver on excise duty for bio-ethanol and excise duty concessions for biodiesel
	National Electric Mobility Mission Plan	Investments in R&D, power, and electric vehicle infrastructure
		Savings from the decrease in liquid fossil fuel consumption
		Substantial lowering of vehicular emissions and decrease in carbon dioxide emissions by 1.3–1.5 % in 2020
		Phase-wise strategy for research and development, demand and supply incentives, manufacturing and infrastructure upgrade
Intercity passenger transport	High Speed Rail Project	High Speed Rail Corporation of India Limited (HSRC) formed for development and implementation of high-speed rail projects
		2000 km high-speed railways network (HSR) by 2020
		14 corridors identified
Efficiency	Fuel Economy Standards for cars	Binding fuel economy standards starting 2017
		Fuel efficiency improvement in cars by 10 % in 2017
		20 % in 2022
	Auto Fuel Policy	30 new cities are planned to move to Euro IV by 2015
		Euro V in the entire country by 2020
Freight	Dedicated freight corridors	Double employment potential in 5 years (14.87 % CAGR)
		Triple industrial output in 5 years (24.57 % CAGR)
		Quadruple exports from the region in 5 years (31.95 % CAGR)

investments in high-speed rail and mass transit in cities. Improving water-based transport is now receiving some attention, and this has been mentioned as one of the focus areas in the National Urban Transport Policy.

Table 8.2 Chronology of transport initiatives implemented

Year—measure implemented
1991—First set of mass emission norms for all vehicles introduced
1995—Catalytic converters made compulsory
1995—Unleaded petrol introduced in Delhi
1996—Diesel with 0.5 % S introduced in four metros and Taj Trapezium
1997—Low-sulfur diesel (0.25 %) in Delhi and Taj Trapezium
1998—Low-sulfur diesel (0.25 %) in three metros
1999—Euro I equivalent norms for passenger cars in Delhi
2000—Auto Fuel Policy Committee formed; unleaded petrol in the country; low-sulfur diesel
(0.25 %) in the country; (0.05 %) in four metros
2000–2001—Euro II equivalent norms for passenger cars in four metros
2002—All public transport converted to CNG in Delhi
2003—Phase out of old taxis
Three-wheelers to CNG in Mumbai
2005—Low-sulfur diesel (0.05 %) in the entire country; (0.035 %) in metros
2005—Euro III equivalent norms for all cars in seven megacities
2008—BRTS becomes operational in Delhi
2009—BRTS becomes operational in two other cities
2010—Low-sulfur diesel (0.035 %) in the entire country; (0.0005 %) in ten metros
2010—Euro IV equivalent norms in major cities; Euro III equivalent for the rest of the country
2011—Delhi Metro Phase II completed
2012—National Electric Mobility Mission Plan announced
2013—Ahmedabad BRTS ridership reaches record high
2014—Dedicated bicycle track in Diu
2014—Low-carbon comprehensive mobility plan for three cities
2015—Electric rickshaws legalized in Delhi

Compiled from: GoI (2003), CPCB (2008)

Emerging policies highlight the focus on multiple benefits of meeting the transport demand and delivering environment and development benefits (Table 8.1). An example is the recent initiative to develop high-speed rail corridors in the country (GoI 2014a) which is expected to benefit cities along major corridors by improving their connectivity.

Historically, transport interventions in India have been driven by various push factors. For instance, in Delhi, a public interest litigation regarding air pollution prompted a Supreme Court directive authorizing the conversion of public transport to CNG. This was a landmark achievement as Delhi's success prompted several other cities to bring in CNG vehicles. Similarly, the success of electric auto-rickshaws in Delhi was driven by favorable economics and not necessarily government intervention (Shukla et al. 2014). Table 8.2 documents the range of policies and interventions on improving air quality that were been implemented successfully since the 1990s.

8.3 Transport Policy at the National and Subnational Levels

8.3.1 Selection and Assessment Criteria

Assessment of best practice is a popular approach, and literature has focused on different facets of best practice research. The terms "best practice" and "good practice" are also debated. The central idea for this chapter is not to look for a perfect blueprint of a policy or plan but to critically evaluate the policies implemented or under implementation that are showing initial benefits. Vesely (2011) classifies good practices into (1) those that depend on functionality that were successful and generated replicable outcomes, (2) practices that emphasized a unique methodology that helped to achieve the objectives, and (3) practices where new approaches were introduced.

For the selection of case studies, we followed a stepwise method. The first step included listing potential case studies covering major transportation subsectors. These included policies, programs, and projects at the national, regional, and city levels. We used a broad-brush method to evaluate these on the three criteria based on the information available: (1) clear vision, (2) evidence or potential of reducing GHG emissions, and (3) delivered or demonstrated the potential of economic development and/or environmental advantages. The idea was to consider diverse case studies from national and subnational levels and from different subsectors of the transport sector—passenger, freight, technology, infrastructures, as well as policies.

Few peer-reviewed studies that comprehensively examine these policies are available. The assessment in case studies therefore relies on peer-reviewed studies (where available), research, gray literature including project reports, reports from think tanks, or other organizations that analyze experiences, published case studies, as well as official documents. Six case studies were studied for impacts at various dimensions and ongoing or post-implementation issues. For developing criteria, we referred to other similar assessments available (Vesely 2011; GGBP 2014). The cases were then assessed for (1) vision and impact (whether the policy/project had clear objectives and was implemented successfully), (2) replicability (whether the practices were scaled up or replicated in other contexts or have the potential for replication), and (3) co-benefits (the intervention has delivered or has the potential to deliver co-benefits). The range of benefits includes GHG mitigation, local air quality benefits, and social and development impacts. The first three case studies are implemented, and we have attempted to draw insights on impacts and challenges. The next three case studies are emerging practices and have the potential to deliver low-carbon sustainability benefits. We believe the insights coming out of each case will enhance understanding of these interventions to enable replication and deliver the ultimate goal of a low-carbon transport transition for India.

8.3.2 Case 1: Delhi Metro

The Delhi Metro Rail Corporation Limited (DMRC) was established to implement the construction of a mass rapid transit system in Delhi. The objective was to develop a mass transit system to enhance mobility and simultaneously to ease congestion and reduce air pollution in Delhi.

The first phase of the metro corridor with a length of 65 km was completed in less than 3 years. An additional 125 km in Phase 2 became fully operational in 2011, taking the present network to 193 km covering 140 stations. The infrastructure covering four phases totaling 245 km is expected to complete by 2021. The project was funded with a joint contribution of Japan International Cooperation Agency (JICA), joint equity contribution by the national and state governments, and a small proportion coming from property development (DMRC 2015). The Delhi Metro has not only improved connectivity within the city but has also improved transport integration through its airport-city link and regional connectivity through its planned connections to towns in the neighboring state of Haryana.

8.3.2.1 Impacts

Delhi Metro has a daily ridership of 2.6 million passengers (DMRC 2014b). A recent study has reported that about 0.3 million vehicles have been taken off the road due to the introduction of the Delhi Metro (CRRI 2011). Expansion of the metro network delivered air quality benefits of reduced NO_2, CO, and $PM_{2.5}$ (Goel and Gupta 2014). In 2011, shifting of commuters from road-based transportation to metro rail in Delhi saved 1320 tons of NOx, 107 tons of particulate matter, and over 3880 tons of CO_2 (Sharma et al. 2014).

This is the first urban rail CDM project globally and has achieved significant reductions in GHG emissions. This is also a landmark project for the country as it has already registered three successful projects under the Clean Development Mechanism (CDM) (DMRC 2014a). These include the carbon credits from regenerative braking, the Modal Shift Project, and the Energy Efficiency Project under CDM and Gold Standard which are expected to reduce approximately 570,000 tCO_2 annually. The project saved 90,000 tons of CO_2 from regenerative braking between 2004 and 2007 and continues to claim credit. Increasing ridership, modal shift, and energy conservation practices will deliver further mitigation benefits in the future (Sharma et al. 2014).

In response to the success of DMRC, the Government of India has submitted the MRTS Program of Activities (PoA) to The United Nations Framework Convention on Climate Change (UNFCCC). The PoA will cover a series of rail-based MRTS projects (like metro rail, LRT, monorail) implemented across India. The objective of MRTS PoA by DMRC is to promote implementation of mass transit systems to reduce GHG emissions and support with implementation for the construction of an MRTS projects by providing fast-track carbon funding and risk-free registration of future projects (UNFCCC 2014).

Khanna et al. (2011) carried out scenario analysis to demonstrate that a rail-dominated mass transit system in Delhi can deliver 61 % reduction in energy use compared to 31 % reduction for a bus-dominated system. A cost-benefit analysis of the Delhi Metro calculated a 22 % social rate of return, a financial rate of return of 17 %, and an economic rate of return of 23.9 % including gains from air pollution reduction (Murty et al. 2006). The study reported that Delhi Metro generated benefits to the stakeholders including citizens and government; however, other transport providers suffered from income losses (ibid).

The implementation of the Delhi Metro has resulted in social impacts including relocation of people and reduced accessibility of the relocated low-income households (Tiwari 2011). The DMRC faces challenges due to land acquisition issues. Metro infrastructure projects are being planned or are under construction in nearly 20 cities—several of which will follow the Delhi model. It is crucial to address issues of equity and development to minimize adverse social impacts during project implementation. An additional concern is the vulnerability of cities and infrastructures to the risks from climate variability, especially extreme weather events (Garg et al. 2013; Pathak et al. 2014). These considerations should be factored in as far as possible into planning of long-term transport infrastructure.

8.3.2.2 Replication and Scalability

The key lessons emerging from the Delhi Metro case study are as follows: (1) - low-carbon mobility projects can leverage financing through the international carbon market, (2) large infrastructure projects provide a good opportunity for technology cooperation between a developed and a developing country, (3) public transport projects, if implemented effectively, can deliver mitigation benefits and lead to environmental co-benefits from reduced congestion and improved air quality, and (4) large infrastructure projects should make all efforts to minimize adverse social impacts during planning and implementation.

8.3.3 Case 2: Auto Fuel Policy (AFP)

The Government of India set up the Auto Fuel Policy Committee in 2000 to prepare a policy for setting up of emission norms and fuel quality standards in the country and to provide a roadmap for its implementation (GoI 2003). In addition, the policy recommended improvement of fuel economy, reducing pollution from in-use vehicles, submitting vehicle for inspection and maintenance, and augmenting public transport.

The Committee recommended a progressive implementation of fuel quality norms and Euro equivalent exhaust emission norms for vehicles. Taking into account technical, financial, and institutional considerations, the roadmap suggested the implementation in a phased manner in the country starting from the

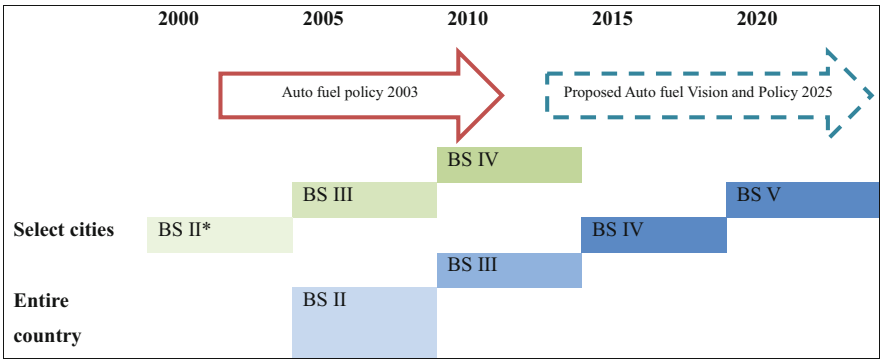

Fig. 8.1 Vehicular Emission norms in India: Implementation and future roadmap of India's Auto Fuel Policy (Sources: Authors. Adapted from: GoI 2003; 2014c; ICCT 2013a, b. Note: BS refers to Bharat Stage emission norms. These norms are broadly equivalent to Euro norms. This roadmap is for four wheelers including passenger cars, light commercial vehicles and heavy duty diesel vehicles)

implementation of Bharat Stage II fuel/emission norms in 2005 and progressively going to Euro IV in 2010. The implementation was to be initiated in 11 major cities followed by the rest of the country. Subsequently, in 2014, the Government of India outlined the Auto Fuel Vision and Policy that laid down future vehicle and fuel improvement roadmap for the country till 2025 (GoI 2014b). According to the roadmap, Bharat Stage (BS) IV will be adopted by 63 cities by the end of 2015 and adopted countrywide by April 2017. The implementation roadmap is shown in Fig. 8.1.

8.3.3.1 Impacts

Following the recommendation of the Auto Fuel Policy (GoI, 2003), implementation emission and fuel quality standards have been progressively modified in India. Euro I equivalent norms were introduced in the year 2000 starting with 11 identified cities including metros and subsequently implemented across the country. Subsequently, Euro II and Euro III equivalent norms were also introduced across the country in the year 2003 and 2005. India's Auto Fuel Policy report brought about significant air quality benefits compared to the "no-policy" scenario.

A detailed assessment showed that actions outlined in the policy were largely implemented in accordance with the policy roadmap (ICCT 2013a). There has been a reduction in sulfur content in gasoline (from 2000 ppm to 150 ppm) and diesel (from 10,000 ppm to 350 ppm). In selected 20 cities, sulfur content has been brought down to 50 ppm. As a result, SO_2 levels have come down significantly in Indian cities and remain well within WHO standards (CPCB 2012). Other improvements include a reduction in benzene levels in gasoline and increase in the use of zero-sulfur CNG and LPG in buses and auto-rickshaws. A recent study reported a

significant decrease in PM_{10} vehicular emissions throughout the previous decade and a slowing of growth of NOx emissions. This resulted in 21,500 deaths avoided from reduced $PM_{2.5}$ emissions (ICCT 2013a). The clear vision, process of implementation, and success of the AFP 2003 helped replicate and upscale Auto Fuel Policy Vision 2025.

8.3.3.2 Replication and Scalability

Despite the progressive vision and roadmap and successful implementation of the policy, India's fuel quality and emission norms still lag behind international standards, and air quality remains a serious problem in all parts of the country. Efforts are required to advance the implementation of BS IV and V than scheduled in the Policy Vision of 2025. A study has shown that accelerating implementation of stringent fuel quality and vehicle emission standards in India will avoid approximately 48,500 premature deaths. This would impose an additional cost of USD 45 billion; however, the economic benefits of these avoided deaths would amount to USD 90 billion, making a strong case for advancing the roadmap (ICCT 2013b).

When the Auto Fuel Policy Committee was formed in 2000, the focus was to address air quality issues in the country. However, a decade later, energy security and climate change are simultaneous national priority issues. Recently, the government has proposed fuel economy standards for cars starting 2017 (BEE 2014). According to this draft proposal, fuel economy of cars will improve by 10 % in 2017 and 15 % by 2020. The Auto Fuel Policy Roadmap 2025 can consider conjoint mitigation of local pollutants and GHG emissions. The key lessons from the case study are as follows: (1) clear vision and targets at the national level were important factors in successful implementation; (2) a phase-wise implementation roadmap taking into account existing technical, institutional, and financial considerations; (3) consideration of stakeholders' concerns; and (4) future policies can aim for conjoint mitigation of local air pollutants and greenhouse gas emissions.

8.3.4 Bus Rapid Transit System

The National Urban Transport Policy was announced by the Ministry of Urban Development (MoUD) in 2006. Key focus areas of the policy included encouraging use of public transport and facilitating the introduction of high-quality multimodal public transport systems (MoUD 2006). Simultaneously, the National Urban Renewal Mission (NURM) committed substantial funds for bringing about improvements in urban infrastructure which included funds for BRTS projects in the country. Presently, over a dozen Indian cities have BRTS systems which are operational, and few other cities are planning to construct BRTS. The BRTS in Ahmedabad is among the most successful systems in the country. The BRTS in Ahmedabad was introduced in 2009 in order to promote public transport, to reduce

the rapid growth of private vehicles, and to ease congestion. Based on a PPP model, the BRTS was implemented in a phased manner.

8.3.4.1 Impacts

The Ahmedabad Bus Rapid Transit System (BRTS) network has grown rapidly over the years and now operates a 52.5 km network with another 36 km under planning. The ridership started from 18,000 trips per day and has currently reached 0.1 million trips per day. In addition to increased ridership and revenue, the BRTS has resulted in other co-benefits including reduced travel time and other environmental benefits (NIUA 2014). Ahmedabad BRTS has improved mobility choices and reduced travel time (Rogat et al. 2015). The system has led to a reduction in CO_2 emissions and at the same time delivering social and economic benefits through enhanced mobility (UNFCCC 2015). The success of Ahmedabad BRTS encouraged several cities to implement BRTS based on the Ahmedabad model.

8.3.4.2 Replication and Scalability

A modal shift from private to public transport at lower cost can be facilitated by making public transport more attractive with a comprehensive plan that facilitates intermodal integration (Bubeck et al. 2014). The construction of two metro corridors in the city is commenced, the first phase of which is expected to initiate operations in 2018. Efforts are under way to integrate the networks of BRTS, metro rail, and local busway system in the city (Fig. 8.2). Ahmedabad Metro, though planned later, will be integrated with BRTS, and both BRTS and metro form an integral part of the Ahmedabad Urban Development Plan of 2021. The corridors are planned to ensure connectivity and coverage across the city. The routes for the local bus systems are now being planned for these to complement the BRTS network. BRTS is now integrated in the local and regional development plans looking at transit corridors to ensure wider coverage (AUDA 2015). The project is among the most successful public transport projects implemented on a public-private partnership model.

Despite several successful initiatives, BRTS implementation in India has experienced challenges and replication. Key challenges include lack of ownership of the system by the planning and implementing agencies, reluctance from private vehicle owners to share road space, and inadequate clarity in implementation (Mahadevia et al. 2013a). It was observed that BRTS systems fail to benefit the urban poor due to flaws in design and fare structure. While emission reductions achieved are modest, the system has potential to bring about sizable mitigation benefits. Evaluation of BRTS projects should be done in a slightly longer time frame as impacts may not be evident during initial years. Challenges of attracting private transport users, if overcome, can make the BRTS an attractive option. This will require supporting measures including pricing policies for private motorized vehicle users

Fig. 8.2 Existing and proposed BRTS and Metrorail corridors in Ahmedabad (Sources: AMC 2012; AUDA 2015 and GoG 2014)

and supporting infrastructure including feeder systems and parking facilities at stations. For BRTS to become a best practice, efforts will have to bring in social equity by enhancing infrastructure for non-motorized transport along BRTS

corridors, introduce measures to facilitate modal shift from private modes, and integrate the BRTS with other public transport systems in the city (Mahadevia et al. 2013b). Inclusiveness will depend on understanding the mobility needs and capacities of the users and integrating these into the plan. Planning of BRTS projects should be based on a comprehensive assessment to include all sections of the population, their travel patterns, and mode choices based on age, gender, and economic status.

8.3.5 Low-Carbon Comprehensive Mobility Plan Toolkit

In 2008, the Ministry of Urban Development (MoUD) released a toolkit for the preparation of a Comprehensive Mobility Plan (CMP) for cities. This was to encourage cities to prepare CMPs to fund urban transport projects under the Jawaharlal Nehru National Urban Renewal Mission (JnNURM). An assessment of submitted plans showed that these were not comprehensive in looking at social, economic, and environmental sustainability issues (GoI 2014c). Driven by concerns of climate change and sustainable development, the Ministry of Urban Development released a revised CMP toolkit in 2014. As part of a UNEP-supported project, a low-carbon comprehensive mobility plan was prepared for three cities in India—Udaipur, Rajkot, and Visakhapatnam.

The toolkit provides clear guidance on integrating land use and transport planning in order to align the transport plan with the development plans/master plans of the city. The revised toolkit incorporated learnings from implementation of earlier CMPs and from the three city case studies. The revised document was therefore more comprehensive—it incorporated elements of environmental sustainability and inclusiveness including poverty and gender issues. The revised document moves away from a deterministic approach to a more flexible scenario-based approach. This allows cities to look at the impacts of the conventional scenario where land use will follow the development plan or master plan and explore specific interventions in the alternate scenario including land use, infrastructure, public/non-motorized modes, and regulations (GoI 2014c). For instance, the Low Carbon Mobility Plan for Rajkot focuses on alternate transport scenarios based on land use, public transport and non-motorized transport, and technology-based scenarios.

8.3.5.1 Replication and Scalability

The toolkit is a comprehensive document as it integrates multiple objectives of environmental quality, inclusiveness, gender balance, and emission mitigation. This is also a unique initiative at the national level aimed to enable subnational transport plans. The process involved active stakeholder engagement by involving experts, city officials, and other stakeholders and incorporating these suggestions into the final document. The process also included a review of all existing

documents and policies including government reports, reports of the expert committees and groups on urban transport of the 11th and 12th five-year plans, national missions, guidelines and codes, and global case studies on transport plans.

The methodology can highlight strategies and projects for implementation in the short term, medium term, and long term allowing cities to integrate these within the overall plans (UNEP 2015). This will generate a common and comparable database of cities on transport indicators that will further facilitate adoption by a number of cities especially smaller cities. In addition, a robust methodology will enable cities to develop proposals for funding including international climate finance.

8.3.6 Dedicated Freight Corridor (DFC)

The Dedicated Freight Corridor Project is initiated by the Government of India to develop transport corridors dedicated for freight transport (DFCCIL 2014). This key objective is to facilitate faster freight transport and meet market needs more effectively. In addition, the creation of the extensive infrastructure will facilitate the growth of industrial corridors and logistic parks leading to regional and national economic benefits. The primary reasons for undertaking the project of this scale were the rapidly rising demand for freight transport and the inadequacy of the existing rail infrastructure. Presently, there are plans for developing two corridors—the western DFC and eastern DFC.

The western corridor covers 1483 km between Delhi and Mumbai. The introduction of the corridor is expected to result in a major shift from road- to rail-based transport. In terms of energy implications, this will increase efficiency and reduce the demand for oil while increasing the share of electricity. By 2046, the western DFC project is expected to bring down a substantial 81 % reduction in annual CO_2 emissions compared to the "no-project scenario." With increasing decarbonization of electricity in the future, this will generate significant low-carbon benefits. This will result in a cumulative emission reduction by nearly 170 million tons of CO_2 over 30 years (Pangotra and Shukla 2012). The corridor will enhance regional connectivity, a critical input to deliver regional economic benefits.

8.3.6.1 Highlights

Historically, Indian railways had dominated the inland movement of goods. Over time, economic growth led to a significant demand for freight transport; however, rail transport infrastructure did not meet the growing demand resulting in a growing share of road transport in overall freight transport (RITES 2009). A common corridor for passenger and freight resulted in high transaction time and costs due from inefficient operations. The modal shift from rail to road is not favorable given the efficiency of rail in terms of energy and CO_2 emissions. The dedicated corridor for freight transport will deliver emission reductions from modal shift and

additionally from increased efficiency of movement. In addition, India will be able to leverage global economic opportunities through better internal connectivity between centers and ports. This will facilitate industrial development along the corridor generating significant jobs in small towns and villages along the route. The case study highlights that large transport infrastructure projects have major impact on CO_2 emissions. A strong case for replication of freight corridors is the additional dimension of sustainability from simultaneous environmental and development benefits for the country.

8.3.7 National Electric Mobility Mission Plan

Recently, the Prime Minister of India launched the National Electric Mobility Mission Plan (NEMMP 2020) (GoI 2012) with a view to enhance national energy security, mitigate adverse environmental impacts of vehicle, and develop domestic manufacturing capabilities. The Plan envisions the sale of around seven million electric vehicles resulting in fuel savings of nearly 2.5 million tonnes. The NEMMP focuses on demand creation, manufacturing, R and D, and development of charging infrastructure (GoI 2012). Within these, the plan proposes phase-wise targets and strategies for implementation.

EVs could have vital implications for energy security, local air quality, GHG mitigation, and increasing renewable share in the electricity sector. It is obvious that electric vehicles will play a significant role in India's sustainable transport transition. Around the year 2000, only a couple of electric two-wheelers were available in the Indian market. However, the market has expanded, and over two dozen different two-wheelers are available in the market at present. Efforts are under way by electric vehicle manufacturers to provide options that can reduce charging time and increase awareness among consumers regarding lower fuel and maintenance costs of E4Ws compared to conventional cars.

8.3.7.1 Highlights

The NEMMP is a good starting point to give an impetus to the country's manufacturing sector, enhance research in electric vehicles, and upgrade infrastructure, all of which will be instrumental in the penetration of electric vehicles in the country. The policy sets the direction and signals to manufacturers including private players.

The NEMMP is a comprehensive policy that will facilitate green growth by enabling environmental innovation and facilitating the development of a competitive domestic market for electric vehicles, green jobs, and local air quality benefits. By laying down actions in a phase-wise manner, it sets down initial direction and sets long-term targets for scaling up.

EVs are at a relatively initial stage in India. Scaling up EV penetration in India and making these competitive vis-à-vis conventional vehicles will require financial incentives for electric vehicles, improved infrastructures for charging and other local incentives (Shukla et al. 2014). Supportive and enabling policies have the potential to increase the share of electric two-wheelers from 40 to 100 % and electric cars to 40 % and reduce oil demand by 39 Mtoe. EVs will require upfront investments; however, savings from the reduced oil demand as a result of shift to electric mobility will far exceed the support provided, thereby making this economically viable.

8.4 Conclusion

Transportation has multifarious interfaces with economic development and environment. Transport networks create access to markets and render economic efficiency. In an emerging nation like India, the demand for transport will grow through this century driven by urbanization, industrialization, and rising income. The experience of developed countries shows that the business-as-usual transport policies lead to energy-intensive and oil-dependent transport leading to high GHG emissions.

India is a geographically diverse and vast country. National transport policies are crafted keeping in view the diversity of transport demand, appropriate mix of modes, technologies, fuels, and corresponding infrastructures. The transport system architecture varies at national and subnational levels and so do policy interventions. Transport decisions interface with numerous other development policy domains, e.g., land use, energy, environment, technologies, and finance. The transport decisions have inherent long-term lock-ins lasting several decades. The transport policy making needs long-term perspective and concurrent attention to interface with multifarious development goals. Climate change is now an added interface to which transport policy makers have to pay their attention. The assessment of development policies and plans of several countries in Asia shows that their development policies were not aligned with climate change goals, though their focus on other development and environment objectives like energy security and local air pollution has led to reduced GHG emissions (ADB 2012). For India, the studies have shown opportunities to align policies to simultaneously ensue multiple development and climate objectives (Menon-Choudhury et al. 2007). This chapter presents selected best practices that have shown the promise of gaining multiple co-benefits which are scalable and replicable (Table 8.3). The case studies also show that governance system, including monitoring, reporting, evaluation, and correction, is vital for ensuring replication and scalability.

The case studies represent best practices related to policies and projects. Evidently, the challenge is to replicate and scale up these practices to gain sizable CO_2 mitigation together with co-benefits vis-à-vis various national sustainable development goals. The global mitigation agreements now provide the opportunity to

Table 8.3 Summary assessment of best practice case studies

Sector/ scale	Measures for direct CO_2 benefits	Sustainability Co-benefits	Elements of replicability and scalability to gain sustainability and low-carbon benefits
Policy-related case studies			
CMP Toolkit *Focus*: urban mobility *Scale*: national, city	Integrates transport modes with land use Fuel/technology mandate Measures to reduce transport demand	Lower cost to consumer Lower congestion Improved air quality Safety and security Inclusive and affordable transport	Proactive and continuous stakeholder engagement Integration of climate, inclusiveness, environment, and quality of life Methodology for comparable and consistent databases across cities Cities have flexibility to tailor context-specific interventions Enables capacity building and early interventions in smaller cities
NEMM Plan *Focus*: EVs *Scale*: national, city	Electric vehicles using low-carbon electricity can reduce CO_2 sizably	Local air quality benefits Energy security co-benefits Reduced noise Batteries help electric load management and backup power	Charging infrastructure is easy to replicate and upscale Two-wheeler manufacturing is easy and is readily replicated Subnational policy makers have incentive to attract EV manufacturers, and this can help replication and scalability
Auto Fuel Policy *Focus*: clean air/fuel *Scale*: national, city	Direct GHG benefits can accrue from fuel economy standards GHG co-benefits from local emissions targets	Local air quality co-benefits National energy security co-benefits	AFP 2003 helped replicate and upscale Auto Fuel Policy Vision 2025 AFP process was stakeholder intensive which helped in acceptance and replication AFP process is amenable for conjoint mitigation of local pollutants and GHG emissions
Project-related case studies			
Delhi Metro *Focus*: mass transit in cities *Scale*: city	CO_2 emission reduction due to modal shift from motorized transport Low-carbon electricity in the future can deliver sizable CO_2 mitigation	Air quality co-benefits Reduced congestion Improved connectivity Efficient technology enhances energy security	Scalability in Delhi and replication in a number of cities has happened Incremental carbon finance is expected to help replication under NAMAs framework Delhi Metro co-benefits

(continued)

Table 8.3 (continued)

Sector/ scale	Measures for direct CO_2 benefits	Sustainability Co-benefits	Elements of replicability and scalability to gain sustainability and low-carbon benefits
			assessment provides methodology and benchmarks for replication and scalability elsewhere
BRTS Focus: mass transit *Scale*: city	Modal shift delivers CO_2 mitigation System efficiency delivers CO_2 mitigation	Air quality co-benefits Saves time due to rapid mobility Higher safety from dedicated lanes	Replicated in several other cities in India Better integration with other public transport systems, into the city development plan, and within the larger regional context PPP model is suitable for BRTS and it is replicable an scalable
Dedicated freight corridor Sector: freight *Scale*: regional	CO_2 savings due to shift to efficient rail mode away from road transport Low-carbon electric traction will mitigate CO_2 in low carbon future	Facilitates development of industrial parks along the corridor leading to regional and national economic benefits Promotes industrialization along the corridor	Comprehensive view of economic and environment benefits Improve efficiency of freight movement Scaling up to facilitate national economic development and deliver sizable mitigation benefits Integration of coastal and landlocked areas which is very essential for balanced national development and global integration

leverage additional funding from climate finance instruments like Green Climate Fund as well as Nationally Appropriate Mitigation Actions (NAMAs). The additional funds can be the lever for fast-track replication and upscaling of current best practices. Globally, cities have proposed projects under NAMAs that include implementation of low-carbon mobility plans and demand management including road pricing, parking policies, investing in mass transit, and increasing the share of non-motorized and public transport.

The overarching vision of the case studies in the chapter is largely focused on aligning national transport policies in line with the global target of 2 °C temperature stabilization by the end of the century. However, given the climate risks to infrastructure projects, the protection of transport assets from the future climate change is one of the areas where more attention is needed. While climate risks are not formally factored into the existing transport policies and projects, the methodologies to identify and mitigate major climate risks to the transport projects by improved design and construction methods is gaining attention.

The case studies presented in the paper represent just a few of the promising interventions. There are equally promising initiatives such as investing in non-motorized transport. Recently, India's Ministry of Urban Development has released the bicycle sharing toolkit to promote non-motorized transport in cities. Several cities including Ahmedabad, Delhi, Vishakhapatnam, and Chennai have initiated construction of infrastructure for non-motorized transport and cycle-sharing schemes. This is an important focus area as it can deliver multiple gains of mobility, safety, emission reductions, and social inclusion.

The "best practice" assessment presented in this chapter shows promise of delivering multiple objectives and the possibility of replication and upscaling. The policies and projects represented in the case studies show that urbanization is the key driver of future transport system choices in India. Rational transport system therefore needs integration of inter- and intracity transport choices. The lessons from these studies provide important learnings for designing policies and projects elsewhere. The assessments of case studies show that successful implementation of national policies at the subnational level requires widely agreed goals and targets and support from the national government. The support can be in the form of capacity building, technology, or finance. Overall, the chapter argues for (1) integrating transport policies with local, national, and global objectives, (2) a comprehensive assessment of the impacts (co-benefits and risks) of policies and project from the planning to the post-implementation stage, and (3) cooperation and knowledge sharing among cities and regions facilitated by the national government for cross-learning and transfer of best practices.

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Chapter 9
Potential of Reducing GHG Emission from REDD+ Activities in Indonesia

Rizaldi Boer

Abstract Loss of forest cover in large scale in tropical region will have impact on climate significantly. This will change air pressure distribution and shift the typical global circulation patterns and change rainfall distribution. Its contribution to the increase of greenhouse gas emission will also enhance global warming and may increase the frequency and intensity of extreme climate events. Deforestation in the three tropical regions, Amazon, Central Africa, and Southeast Asia, still continues. Without significant change in forest protection efforts, the loss of forests in these three regions by 2050 will reach about 29, 98, and 44 %, respectively.

Indonesia has the largest tropical forest in SEA; the contribution of emission from land use change and forest (LUCF) reached 60 % of the total national emission, much higher than energy sector. During the period 1990–2013, the total loss of natural forest reached about 19.7 million hectares or about 0.822 million ha per year. Without significant change in forest protection program, within the period 2010–2050, Indonesia may lose 43.4 million ha of forest or equivalent to deforestation rate of 1.08 million ha per year. Potential of reducing emission from REDD+ activities is quite big. By increasing expenses of the government by 1 % annually on top of the external investment for technology change, without necessity of direct forest protection (e.g., increasing agriculture productivity reduces pressure on forests), the deforestation rate could reduce to about 0.337 million ha per year.

The issuance of innovative financing and incentive policies for improving land and forest management may further increase the potential of reducing emission from REDD+ activities. Some of the policies include the use of debt-for-nature swap (DNS) scheme for accelerating the development of forest management units in open access area, incentive for permit holders for accelerating the development of timber plantation on degraded land, and increase community access to fund for green investment. The incentive system for the permit holders is for handling land tenurial issues or conflicts. The incentive could be in the form of reducing or exemption of administration/retribution fees for certain period of time depending on the level of conflicts. Policy allowing for transferring the funds to a financing system is relatively easy to be accessed by the community such as blending

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financing, a financing system that synergizes all financial sources such as CSR funding; government funding such as state budget (APBN); and local government budget (APBD) funds, banking, and international funding. This system can help leverage private funding and supports regional development by supporting community activities in urban agriculture and agroforestry including building human resource capacity through assistance and training activities.

Keywords Extreme weather/climate events • Tropical forest • Greenhouse gas emissions • REDD+ activities • Financing policies • Incentive and disincentive policies

Key Message to Policy Makers

- Loss of large scale of tropical forest will bring more and intensify extreme weather/climate events.
- Loss of forest in Indonesia 1990–2013 accounts for most of deforestation in Southeast Asia with average loss of about 0.822 Mha per year.
- From the period 2010–2050, Indonesia potentially can reduce its deforestation rate more than half of the current rate to 0.337 Mha per year.
- The potential reduction of the deforestation may be achieved by facilitating changes in technologies without necessity of direct forest protection.
- Implementation of innovative financing policies and incentive/disincentive system may further reduce emission from REDD+ activities.
- The payment from REDD+ activities might offset the government additional expenses incurred in facilitating the changes.

9.1 Introduction

Forest plays a significant role in regulating our climate. Regional climates were sensitive to change of types and density of vegetation (Dickinson and Henderson-Sellers 1988; Shukla et al. 1990; Dale 1997; Avisar and Werth 2005). Loss of forest cover in large scale directly alters the reflectance of the earth's surface, induces local warming or cooling, and finally changes air pressure distribution. The changes in air pressure distribution shift the typical global circulation patterns and change rainfall distribution. At present, deforestation of tropical regions continues at high rate (Houghton et al. 2012). The major impact of tropical deforestation on precipitation may occur in and near the deforested regions themselves. However, a strong impact will be propagated by teleconnections along the equatorial regions and to mid-latitudes and even high latitudes even though not as strong as in the low latitude. Based on climate modeling analysis, deforestation of tropical regions (Amazon, Central Africa, and Southeast Asia) significantly affects precipitation at mid- and high latitudes through hydrometeorological teleconnections (Avisar and Werth 2005). Without

significant change in forest protection efforts, the loss of forests in these three regions by 2050 will reach about 29, 98, and 44 %, respectively (Schmitz et al. 2014).

Deforestation will also contribute to the increase of GHG emission to the atmosphere. In the long term, the increasing GHG concentration in the atmosphere will cause an increase in global temperature and global climate. New finding from the 5th AR of IPCC indicated that agriculture, forest, and other land uses represent 20–24 % of global emission. Without mitigation efforts, the contribution of this sector may increase to 30 % by 2030. The three tropical regions, South America (TSAm), Southeast Asia (SEA), and tropical Africa (Af), are the main contributors to the global emission from land use change and forestry (Fig. 9.1). In the last 50 years, the rate of the emission from this sector tended to increase, except in South America (Houghton et al. 2012), and it is the largest and most variable single contributor to the emission from land use change (Le Quere et al. 2013). It is clear that deforestation in the short term will affect the regional climate and in the long term enhances global warming causing the increase in frequency and intensity of extreme weather and climate events.

Among Southeast Asian countries, Indonesia has the largest forest area. Rate of deforestation fluctuates from year to year; however, in general it tended to increase. GHG emission from land use change and forest (LUCF) has been found to be the major contributor to the total national emission. It accounted for about 60 % of the total national emission, much higher than energy sector (MoE 2010). Efforts for reducing national emission have been prioritized on this sector (Bappenas 2010). Potential of reducing emission from REDD+ activities, i.e., reducing deforestation and forest degradation, maintaining role of forest conservation, implementing

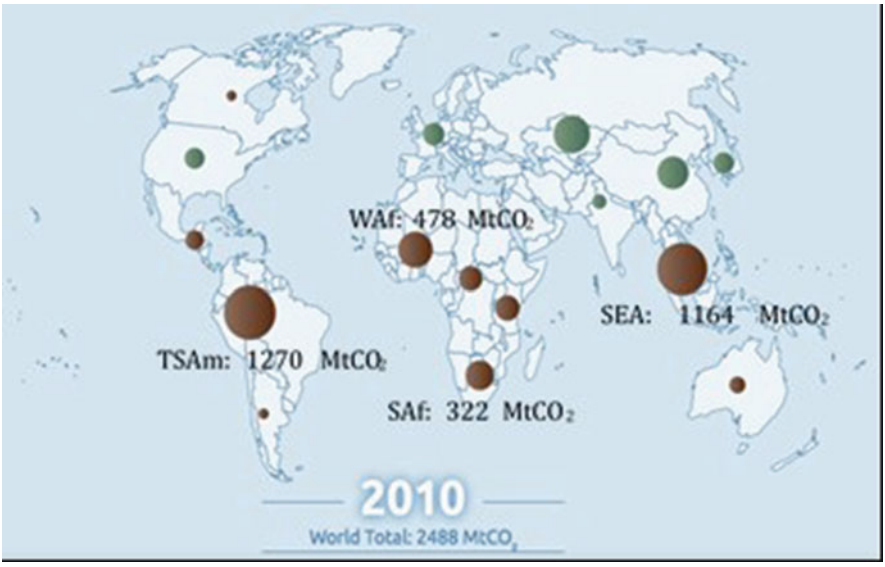

Fig. 9.1 CO2 emission from land use change and forest (http://www.globalcarbonatlas.org)

sustainable forest management, and enhancing forest carbon sequestration, is quite big. Potentially the LUCF sector can become net sink by 2030 (MoE 2010). However, a number of innovative policies are required to realize this.

9.2 Indonesian Forest

In 2013, Indonesia has forest area of about 128.4 million ha and 59.4 million ha of non-forest area (APL; MoFor 2014). By function, the forest area is classified into 5 categories, namely, conservation forest (HK), protection forest (HL), limited production forest (HPT), production forest (HP), and convertible production forest (HPK). Conservation forest is designated for conservation purposes (Act No. 5/1990, Sanctuary Reserve area, Nature conservation, and Game Hunting Park), while protection forest to serve life support system, maintain hydrological system, prevent of flood, erosion control, and seawater intrusion, and maintain soil fertility. Production forest is aimed for timber and non-timber production, while convertible production forest (HPK) is for non-forest-based activities such as agriculture, settlement, etc. Thus, this forest can be released to become a non-forest area (APL).

Referring to its function, forest clearing and conversion of forest land in HK and HL to other land uses are not allowed. Deforestations occurred in these forests mostly from illegal activities such as logging, forest encroachments, and forest fires. On the contrary, forest clearings are permitted within HP and HPT, especially over unproductive forested areas for the purpose of establishing timber plantation. Unproductive forests comprised of forest areas with less than 25 core tress/ha with dbh of 20 cm up, less than 10 parent trees/ha, and insufficient/very few regeneration (numbers of seedling are less than 1000/ha, sapling less than 240/ha, and poles less than 75/ha). It is thus obvious that not all degraded forests could be converted into plantation forests. HPK is legally designed for other uses, mainly for agriculture, transmigration, plantations, and settlements, thus all forest clearing activities.

Deforestation and forest degradation occurred in all types of forest functions either due to legal or illegal activities. Level of degradation of the secondary forest also varied from heavily to lightly degraded. With proper treatments, lightly to medium degraded forests can recover to reach climax forests. On the other hand, due to improper management and less strict law enforcement, degraded forests continue deteriorating resulting in severely degraded forests and meet unproductive forest criteria. In 2012, many of forest areas are not covered by forests, particularly in the production forest, and more than half of the remaining forests were secondary forests with various levels of degradation (Fig. 9.2).

High lost of forest cover in forest and implementation of unsustainable land management practices in non-forest area also caused serious damage on land. Forest functions as water retention, erosion control, nutrient cycling, microclimate regulator, and carbon retention were completely depleted. Many of the lands in both forest and non-forest areas are critical. Based on the level of damage, the critical

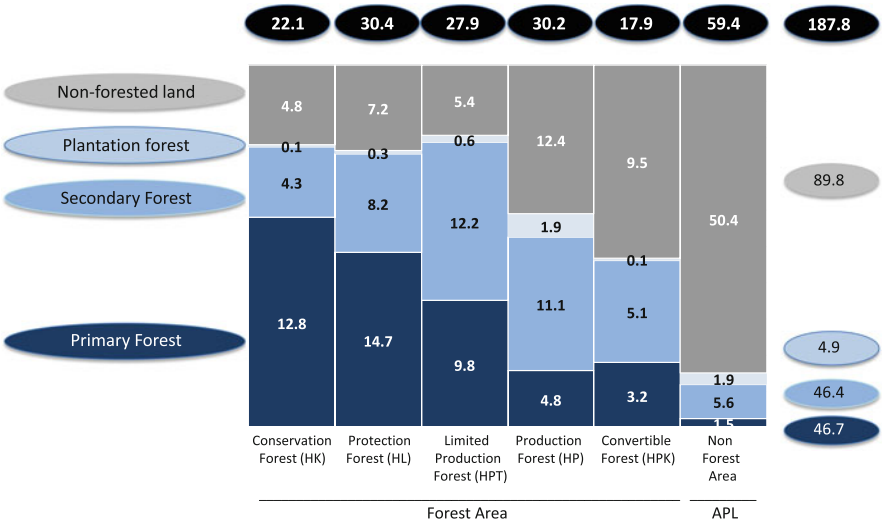

Fig. 9.2 Area and forest condition in 2013 (MoFor 2014)

lands are classified into five categories, i.e., very critical, critical, rather critical, potentially critical, and not critical. In 2011, the total area of critical lands had reached 27.3 million ha, comprised of 22.0 million ha critical and 5.3 million very critical (MoFor 2014). The critical and very critical lands have been prioritized for the implementation of land rehabilitation program.

9.3 Deforestation and Trend of CO2 Emission

Factors causing deforestation and degradation varied among islands. In Sumatra in the early 1980s, the main driver of deforestation was the establishment of settlement through transmigration program, while in Kalimantan, it was mainly due to excessive timber harvesting (MoE 2003). Logging is not responsible for the deforestation of Indonesian forests. However, road network systems that have been developed during timber harvesting have opened the access of community to the forest area. Attractiveness of timber products, high agriculture income, and open access market have increased the insecurity of the forest. Combination of high logging extraction coupled with community encroachment has caused high rates of forest degradation and deforestation.

Based on recent data published by the Ministry of Environment and Forestry (MEF) during the period 1990–2013, the total loss of natural forest reached about 19.7 million hectares or about 0.822 million ha per year. The rate of the deforestation quite varied between periods (Fig. 9.3). The highest rate occurred during the period of 1996–2000 and the lowest in the period 2009–2012. The highest period

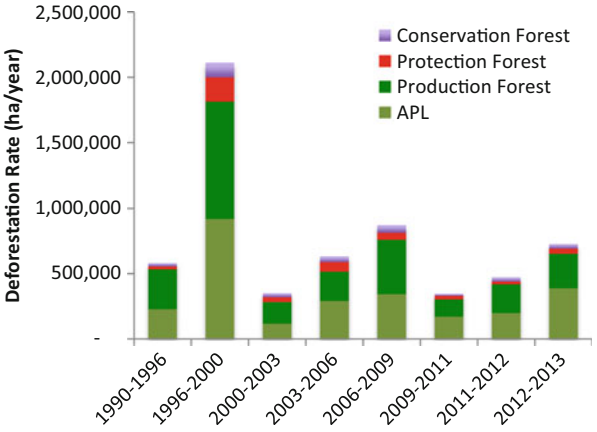

Fig. 9.3 Rate of deforestation in Indonesia between 1990 and 2013 (Directorate of Forest Resource Inventory and Monitoring 2015)

occurred during government transition period between new order ("*orde baru*") to reform ("*reformasi*") government.

Further analysis to land cover data of 1990–2013 showed that cropland conversion was found to be one of the key drivers causing deforestation (both commercial and subsistence agriculture). The loss of forest for the establishment of forest plantation, including expansion of settlement and other lands, is also quite significant even not as large as cropland (Fig. 9.4). Nevertheless, the area of grassland (including shrubs) also increased quite significantly during the period. This indicated that conversion of forest was not always used for meeting the land demand for development (for productive uses), but some were left as nonproductive lands. The data suggest that about half of the conversion of forest to non-forest lands ends up to grassland (including shrubs). In addition, the conversion of forest in the peatland for other uses tended to increase recently, particularly for the expansion of cropland, other lands, and establishment of timber plantation (Fig. 9.4). The rate of forest loss in the peatland is relatively higher than that in the mineral soils (Fig. 9.5).

The removal of biomass at the time of deforestation and forest degradation during the period of 1990–2013 was responsible for emission of about 0.693 Gt CO_2 per year.[1] Emission from peat decomposition of the forest lands deforested and degraded since 1990 reached about 0.115 Gt CO_2 per year (Fig. 9.6). Thus, in total the average emission due to deforestation and forest degradation occurred from 1990 to 2013 was 0.807 Gt CO_2/year. Busch et al. (2015) estimated that the average CO_2 emission from deforestation and peat decomposition in the period of between 2000 and 2010 was about 0.859 Gt CO_2 per year. Compared to this analysis, the rate of emission from deforestation and forest degradation during this period was about 0.884 Gt CO_2 per year.

[1] Stock carbons of primary and secondary forest were about 156 and 126 tC/ha respectively. The assumption was that all the removed biomass are emitted at the time of deforestation which is called as potential emission.

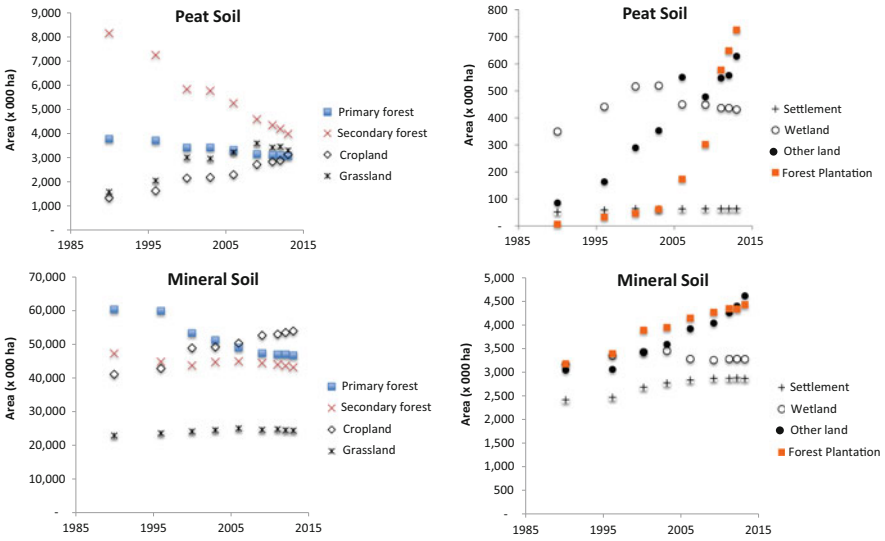

Fig. 9.4 Changes of forest land and non-forest lands in peat and mineral soils from 1990 to 2013 (Based on data from Directorate of Forest Resource Inventory and Monitoring 2015)

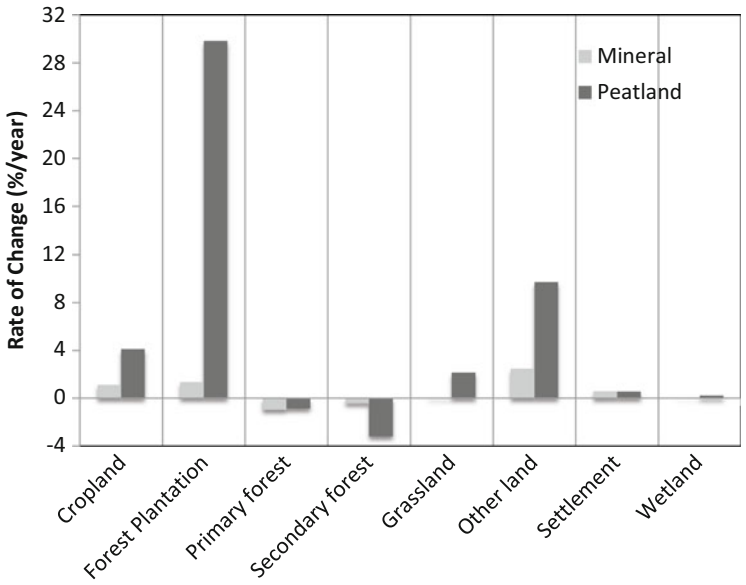

Fig. 9.5 Annual rate of change of forest lands and non-forest land areas in the period of 1990 to 2013 (Based on data from Directorate of Forest Resource Inventory and Monitoring 2015)

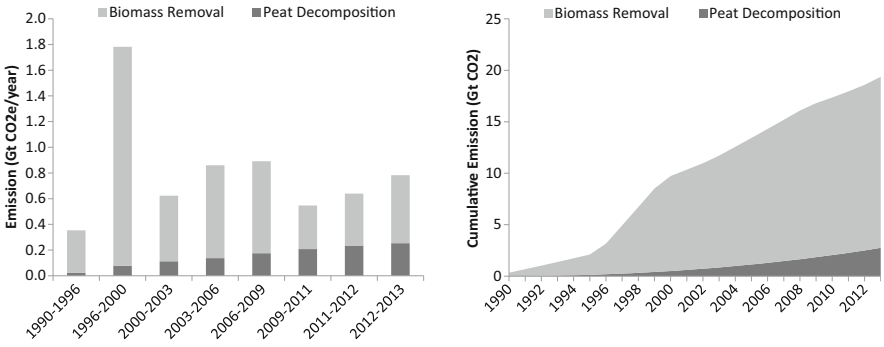

Fig. 9.6 Estimated gross CO_2 emission from deforestation and forest degradation from 1990–2013 (Emission was from biomass removal at the time of deforestation and forest degradation (biomass loss from change of forest state from primary to secondary forest) and from peat decomposition (occurred from secondary forest, timber plantation, cropland and grassland and emission factor was taken from Hergoualc'h and Verchot, (2014). The carbon sequestration after the deforestation was not taken into account.)

9.4 Low-Carbon Policies on Forest and Land Use Sector

The Government of Indonesia has issued national policies and action plan for reducing emission from land use change and forestry defined in the Presidential Regulation Number 61/2011. In general there are four main policies and actions toward low carbon (Boer 2012). *First* is accelerating establishment of forest management unit (FMU) to improve the management of land and forest resources in all forest areas. *Second* is pushing adoption of sustainable management practices in production forests by implementing mandatory forest certification systems. *Third* is reducing dependency on natural forests in meeting wood demands through acceleration of establishment of timber plantation on community lands and state lands and enhancement of sink through restoration of production forests ecosystem and land rehabilitation. *Fourth* is reducing pressure on natural forest through optimization of the use of land and improvement of land productivity. To support the implementation of these policies and actions, it is crucial to develop financing/incentive policies and development of financing system that can support their adoption and implementation by related stakeholders.

9.4.1 Forest Management Units (FMUs)

Key factors driving deforestation in Indonesia might originate from forestry sector and also from outside the forestry sector. These factors intermingle in complex processes, which are difficult to separate, which includes long drought period and characteristics of land that are rich in mineral resources but susceptible to fire

interlink with management practices as well as political decision and economical considerations in the allocation of land uses, its utilizations and enforcement of rules. They both intend to pursue the goal of national development in forms of economical growth, political stability, as well as social equity and ecological sustainability. It is difficult to identify which key driver comes first and further stimulates the emergences of others. Some key drivers observed from current practices and have consequences on land use and land cover changes are forest fire, logging, timber plantation, agriculture expansion, mining, and political administration expansion.

Establishment of forest management unit (FMU) at site level has been considered as a prioritized program for improving management of forest resources and controlling deforestation and forest degradation. Urgency of FMU development especially outside Java[2] is driven by the fact that (Nugroho et al. 2011):

1. Intensive management of forest resource at site level is required as mandated by Act No. 41 Year 1999 on Forestry which states that "All forests within the territory of the Republic of Indonesia, including natural resources contained therein is controlled by the State for the greatest prosperity of the people".
2. Management of forest resources given to the private sector through the licensing mechanism for forest (IUPHH) has limited time, and when it is over, the forest area becomes unmanaged. In addition, nature of the transfer of rights to holders of the license also required close monitoring from government over the behavior of the license holders.
3. Many of investments for land and forest rehabilitation implemented in forest area (GERHAN) often fail as due to the absence of manager in the site who will manage the maintenance of the planted trees.
4. Programs for giving access to public in playing active role in managing forest resources such as community-based plantation forest (HTR), village forest, and community forest (HKm) are slowly realized, due to the absence of companion at the implementation level.

Duties and functions of the FMU (*PP. 6/2007 jo PP. 3/2008*) include (1) implementing management of forest resources which includes forest arrangement and management plan, utilization of forest area and resources, rehabilitation and reclamation of forest area, and protection and conservation of forest area; (2) translating national, provincial, and district/city forest policy to be implemented at site level; (3) implementing forest management activities in the region starting from planning, organizing, implementing, and monitoring and control; and (4) implementing the monitoring and the assessment of implementation forest management activities in its territory and opening investment opportunities to support the achievement of forest management objectives.

[2] FMU had already existed long before in all forest area in Java under the management of State Forest Company Perum Perhutani and called KPH (*Kesatuan Pemangku Hutan*).

FMU is targeted to be developed 600 units throughout forest area, and by February 2014, only 120 units were established. However, operationalization of these first 120 units remains problematic (Nugroho et al. 2014). Some of the problems include:

1. Scope and authorities of FMU in managing forest area. FMU authority is actually very powerful, but this is supported by a number of different regulations, not summarized in one single regulation. So KPH management team is not functioning optimally. As an example, annual working plan of concession holder (RKT) should be approved via KPH once a respective area has established its KPH. Articles 71–78 of government law No. 6/2007 regulate this issue. However, none of RKT now is submitted to KPH. Its function on monitoring and evaluation of concessions does not work. Therefore, it is necessary to compile a list authority of KPH mandated by regulations and laws and issue a strategic regulation on this.
2. Capacity of stakeholders and supports from local government (Province/district) are still diverse. Dynamics of local politics also very much influence their commitments in running FMU.
3. Sectoral ego does exist. There is a doubt that some functions of forestry-related agencies will be taken over by FMU.
4. Regulation No. 23/2014 about local government authority on forestry issue (incl. KPHP and FMU for protection forest (KPHL)) results a concurrent between central government and provincial government (Article 14 (1)). The regulation also indicates less role of district government. However, sites are located within administrative authority of district government.
5. Many FMUs have been legalized by MoF decree, yet do not have any organization at site level (8 out of 120 units).
6. Barriers in regulating concessions incl. RHL and issue of coordination between FMU and concession holders.
7. Independence of FMU needs to be improved. A number of regulations such as No. 61/2007 about technical guidance of general service budget management (PPK – BLUD).
8. Lack of human resources and funding.
9. Need a synchronized policy and coordination among Echelon 1 at ministry of forestry to support operationalization of FMU.
10. Socialization of FMU development has been concentrated to forestry agency at provincial level. While communication on FMU policies by central government has not touched strategic decision making at local level.
11. Mechanism on national budget is not flexible for supporting FMU.
12. Land tenure conflicts as a consequence of non-FMU area rights. Local community often claims those areas. Ministry of forestry has very weak power on this type of areas.
13. Lack of leadership and entrepreneurship in FMU directors/heads.

As mentioned above (Problem No. 7), FMU independence is needed because often local government, i.e., majorly ask for benefits – specifically financial benefits

Table 9.1 Budget management at BLUD and non-BLUD working units

	Description	Non-BLUD	BLUD
1	Administrator	Civil servant (PNS)	PNS and professional non-PNS
2	Tariff of service	Based on fair/proper norms	Cost per service unit
3	Medium-term document	Medium-term development plan (*Rencana Pembangunan Jangka Menengah – RPJM*)	Business strategic plan (*Rencana Strategis Bisnis, RSB*)
4	Budgeting	Budget work plan (*Rencana Kerja Anggaran – RKA*)	Business budget plan (*Rencana Bisnis Anggaran – RBA*)
5	Budget allocation	After DIPA (national budget) is authorized	Independent from national budget
6	Financial activities	Petty cash and all other financial activities are conducted via PEMDA bank account	Independent and has its own bank account
7	Income	Transferred to state account	Usable for operational
8	Surplus	Transferred to state account	Usable for operational
9	Debts	Not allowed	Allowed
10	Financial reports	Government accounting standard (*Standar Akuntansi Pemerintah – SAP*)	Government accounting standard (*Standar Akuntansi Pemerintah – SAP*) and financial accounting standard (Standar Akuntansi Keuangan – SAK)
11	Financial reports	Audit by BPK	Audit by independent auditor
12	Long-term investment	Not allowed	Allowed
13	Purchasing	Based on presidential regulation	Has its own regulation
14	Cooperation	Major/governor (local government)	Head of working group

Source: Nugroho et al. (2014)

of KPH for their district. On the other side, running FMU needs independent financial support. State budget is limited, while to develop FMU as a full business entity will violate main objective of FMU. Proper format of FMU would be a quasi-government body like BLUD. Central government should pay attention more on strategic regulation for this PPK BLUD then.

According to the ministry of domestic affairs regulation No. 61/2007, BLUD is SKPD or nonprofit working unit under local government, which is established to support and provide services for the respective areas. BLUD has flexibility in budget management compared to conventional working units (Table 9.1). Legal procedure for retribution mechanism of BLUD is also rather less complicated compared to conventional working units (Regulation No. 28/2009). Retribution mechanism usually should be supported by local regulation – approved by DPRD (local parliament) but for BLUD only need major or governor decree.

In terms of giving more authority to FMU, based on inputs from local stakeholders, FMU which currently is only authorized to manage state forest area should also be given authority to manage non-forest area (CER Indonesia and CCAP 2010). By giving this authority, FMU can assist in managing REDD activities both within and outside forest areas. FMU should take the form of BLUD (*Badan Layanan Umum Daerah* – Local Service Unit). Having effective, strong, and independent FMU might be a key factor to the success of implementation of sustainable forest management.

9.4.2 Forest Certification System

Degradation of production forest is mainly triggered by the higher demand of wood for industry. Supply of timber from natural forests is not enough to meet the capacity of timber industry, and this leads to the increase of illegal logging activities. It is estimated that an additional supply of timber from illegal logging may be equal to that from the legal logging. The highest logging activities occurred in production forests (60 %) and then in the protected forest (30 %) and forest conservation (10 %). The level of illegal logging is estimated to be very high in the non-concession forest area of production forests (*Tim Pokja Kementrian Kehutanan* 2010). In other Asian countries, fuel wood collection and charcoal production for meeting domestic and local demand are also drivers of forest degradation (Hosonuma et al. 2012), even if their impact is not as much as that of illegal logging.

To reduce trading of illegal logs and to push application of sustainable forest management practices, the Government of Indonesia has established Timber Legality Assurance System (TLAS) through the issuance by the Minister of Forestry of Regulation Number P.38/Menhut-II/2009 on Standard for Evaluating Performance of Implementation of Sustainable Production Forest Management (PK-PHPL) and Verification of Legality of Logs (SVLK). This regulation is followed by the issuance by the Directorate General of Production Forest Regulation Number P.06/VI-Set/2009 and P2/VI-Set/2010. In TLAS, the assessment and verification of the timber products were done by independent third party, i.e., Entity for Evaluation of Performance and Independent Verifier (LP and VI) accredited by National Accreditation Committee (KAN). Other independent third parties such as Civil Society Organization and NGOs do the monitoring, i.e., for accommodating complaint from communities to the results of works from the LP and VI. With such process, TLAS will meet the good governance principles (transparency, accountability, and participatory), credibility (do not include government institution), and representativeness.

PK-PHPL is mandatory for all permit holders in state forests (IUPHHK-HA, IPPHHK-HT, IUPHHK-RE, HKm, and HTR) and private forests (Hutan Rakyat or

HR), and SVLK is mandatory for all permit holders in state forests and private forests and also for all upstream and downstream wood industries (IUIPHHK). In principle, permit holders who already have certificate of PHPL will not require to have SVLK. Validity of the certificate is only for 3 years, and every year it is subject to surveillance. Up to January 2013, total forest areas that have been granted for IUPHHK-HA (logging concessions), IUPHHK-HT (Industrial Timber Plantation), and IUPHHK-RE (Restoration of Production Forest Ecosystem) were 20,899,673 ha, 10.106.540 ha, and 397,878 ha, respectively. community forest plantations (HTR and HKm) were 752,297 ha (MoFor 2014).

In addition to the mandatory certification, there are also some voluntary certifications of SFM using standard *Lembaga Ecolabelling Indonesia* (LEI), Forest Stewardship Council (FSC), and some others. However, the progress of the implementation of certification is quite slow. Since June 2011, the total number of companies who already have mandatory certification of SFM had only been 230 certificates covering a total area of about 19 million ha and for voluntary certification had only been 25 certificates (Table 9.2). A number of factors that need attention for accelerating the achievement of SFM are (Bahruni 2011):

1. Governance and regulations which promote forest good behavior and reduce inefficiency of bureaucracy, encourage professionalism in forest management, push high responsibility of forest management units in using their given rights and authorities, and implement improvement program in organization capacity and forest management skill including resolving land uncertainty issues (tenure and spatial layout)
2. Provision of incentive and disincentives for forest management units with good performance and bad performance (SFM and non-SFM units) and allowing non-SFM units to improve their performance by planning and conducting concrete actions within clear timeline to meet SFM
3. Development of carbon accounting system to evaluate the performance of forest management units in minimizing forest degradation

Table 9.2 Number of companies who already have certification of SFM

Category	Total concession area (ha)[1]	Mandatory certificates (up to June 2011)[2]		Voluntary certificates (up to June 2011)[3]	
		Number	Area (ha)	Number	Area (ha)
IUPHHK-HA	22,710,256	140	14,225,443	5	834,452
Very good-good	*na*	*31*	*3,449,955*	*na*	*na*
Average	*na*	*35*	*3,307,789*	*na*	*na*
Poor or expire	*na*	*74*	*7,467,699*	*na*	*na*
IUPHHK-HT	9,963,770	90	4,914,301	3	544,705
Good	*na*	*19*	*2,499,280*	*na*	*na*
Expire	*na*	*71*	*2,415,021*	*na*	*na*
HR	1,570,315	Na	na	17	242,931

To encourage the concession holders applying for the certification, the government needs to revisit the SFM performance indicators used by forest management units (FMUs) that have different nature of activities, i.e., between management of forest resources (IPHHK-HA) and management of forest ecosystem (IUPHHK-RE; Nugroho et al. 2011). Different from IPHHK-HA, holders of IUPHHK-RE will have no cash inflow for a number of years until forests are restored as the timber will be harvested after reaching the equilibrium of ecosystems (e.g., 35 years). Applying for the certification will increase the cost, while the IUPHHK-RE holders are burdened with the obligation to pay various fees as applied to IUPHHK-HA. It is understandable that none of IUPHHK-RE (restoration of ecosystem) holders apply for the mandatory certification. A number of studies have proven that applying SFM practices will ensure the sustainable wood production and reduce the degradation (see Box 9.1). The reduction of emission from forest degradation by applying SFM practices could reach 9.79 $tCO_2\ ha^{-1}\ year^{-1}$.

On the other hand, to conserve forests particularly forested land in forest area that have been released for non-forest-based activities, the Government of Indonesia also plans to apply mandatory certification system for palm oil called Indonesian Sustainable Palm Oil (ISPO). With this policy, all palm oil plantation companies will be obliged to conserve High Conservation Value (HCV) areas in their concession and to apply good practices in reducing GHG emissions. This policy is expected also to reduce deforestation. The ISPO will be officially effective as of March 2012, and it is targeted that all oil palm plantation companies will obtain the ISPO certificates by 2014. ISPO is launched to speed up the implementation of sustainable palm oil. ISPO is the same as existing sustainable standard RSPO (*Roundtable on Sustainable Palm Oil*); the only difference is that ISPO is compulsory, while RSPO is voluntary. Companies that have been certified by RSPO can receive ISPO certification after fulfilling some additional criteria. The regulation of ISPO is defined in the Ministry of Agriculture Regulation No. 19/Permentan/OT.140/3/2011. ISPO is a response of the Government of Indonesia to meet increasing demand of market for sustainable and green products and participate in mitigating climate change.

The mandatory certification system may also be followed by other non-forest-based activities that may directly affect forest resources such as mining. It has been well known that Indonesian forests store mineral deposits underneath which are needed to develop the country. Rights to use the resources are granted by the government through the scheme of *pinjam pakai* or land leasing for certain period of time. Mining of the deposit starts by clear off not only woody biomass of the forest but also other biomasses stored underneath the soil. The activities produces high emission which will be difficult to restore them back as fertility of the soil will be gone. In many cases, most of forest areas left by the mining after the termination of its permit are under heavily degraded condition.

To ensure the implementation of sustainable management principles and community economic development in exploiting natural resources (including mining), it may be necessary to introduce policy for limiting GHG emission (emission cap) from certain forest industries/concessionaires. The cap could be determined based on the result of the environmental impact assessment (EIA). Under current regulation, all forest industries/concessionaires obliged to conduct EIA. With the introduction of this policy, each entity must include the assessment of GHG emission level from their activities given all mandatory environmental management activities are met. Once the level of GHG emission is defined and estimated, this level of emission will be treated as "emission cap" of these entities. Theoretically entities that implement their environmental management plan defined in the EIA, the level of emission, should be low. Thus, companies that release more than the allowable emissions (emission cap) shall offset the excess.

Box 9.1 Impact of Sustainable Forest Management (SFM) Practices on Carbon Stock Change at Logging Concession Companies (Source: Bahruni 2011)

Based on data collected by Bahruni (2011) from five concessions (three concessions with SFM certification and two with non-SFM certification), it is quite clear that implementation of SFM practices can reduce emission from forest degradation. In non-SFM concessions, the volume of wood extracted relative to the annual allowable cut decreased significantly from year to year indicating continuous degradation of the forest, while in SFM concession, it is relatively constant (Fig. 9.7). Rate of forest degradation in SFM concessions was found to be between 0.17 % and 0.37 % per year and non-SFM between 2.35 % and 2.61 % per year and this equivalent to CO_2 emission reduction of 9.76 tCO_2 ha^{-1} $year^{-1}$ (Table 9.3).

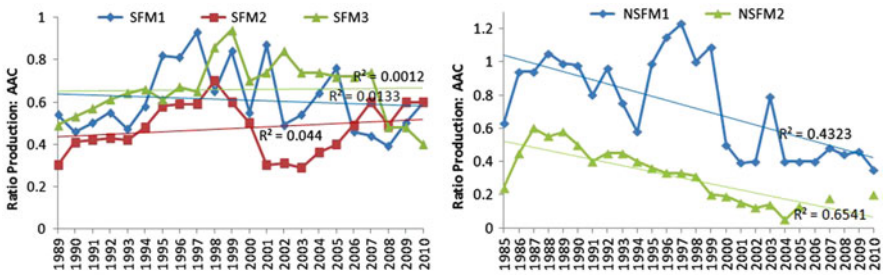

Fig. 9.7 Ratio between volume of wood extraction and annual allowable cut in SFN and non-SFM concessions

Table 9.3 Estimated CO2 emission reduction from forest degradation

Time period	The rate of degradation (%)		
	SFM	Non-SFM	Difference SFM and non-SFM
1992–2011	0.37	2.35	1.98
2000–2011	0.17	2.61	2.44
The benefit of SFM		1992–2011	2000–2011
The reduction of loss stand (m^3 ha^{-1} $year^{-1}$)		1.85	2.28
The reduction of emission (tC ha^{-1} $year^{-1}$)		2.16	2.66
The reduction of emission (tCO_2 ha^{-1} $year^{-1}$)		7.93	9.76

9.4.3 Reduction of Dependency on Natural Forests for Wood Supply and Sink Enhancement

In meeting wood demand, Indonesia already has begun to issue Timber Forest Product Utilization License (TPFUL) since the early 1970s, called as forest management right particularly for timber (forest concession or HPH). The highest number of concessions was in 1980 which is more than 500 units of concession with an area of 60 million hectares. After the enactment of Law No. 41 of 1999, forest concessions (HPH) were renamed as IUPHHK. Until now, the number of holders of IUPHHK for natural forests (HA) is declining to only about 256 units IUPHHK-HA. On the contrary IUPHHK for timber plantation (HT) increased from only a dozen units to 215 units by 2011, and community timber plantation (HTR) is also emerging with newly established plantation of about 0.63 million hectares involving more of 63 000 heads of households (HH).

HTI management unit is currently growing rapidly with total area more than 9.4 million hectares and targeted to grow to about 15.9 million hectares by 2030 (RKTN; Kemenhut 2011). Nevertheless community forest management (CFM) does not show significant development even though the Ministry of Forestry has set up high target (Table 9.4). So far IUPHHK-HTR that has been issued was only less than 100,000 hectares. Similarly both HKm and village forest also do not show significant improvement (Table 9.4). The schemes of HKm and HTR aim to revitalize the traditional wood-processing sector such as plywood and sawn-timber, in addition to increase the supply of raw materials for round-wood and paper and pulpwood industries. The program will enrich stock of carbon inside forest area by plantation activities done by smallholder farmers. It is expected by 2016 the plantations will meet its target to rehabilitate and improve productivity of degraded 5.4 million hectares of forest lands. Enrichment of forest carbon stock could be strengthened by investing the expansion of agroforestry system into the HKM and HTR schemes. On the other hand, private forest (Hutan Rakyat or HR) increased significantly only in Java, which is now reaching approximately 2.8 million hectares with production of about 6 million m^3 timbers per year. HR will continue to expand along with the proliferation of timber processing industry.

For increasing carbon sequestration, the Government of Indonesia has also implemented a number of programs for rehabilitating the degraded forest and

Table 9.4 Target, allocation, verification, and license issuance of community-based forestry up to 2010

Community-based forestry program	Target up to 2014 (Ha)	Allocation (Ha)	Verification (Ha)	License issuance by the Ministry of Forestry (Ha)	License issuance by the governor/ head of district (Ha)
Community forestry (HKm)	2.000.000	400.000	203.573	80.181	30.485,55
Community forest plantation (HTR)	5.400.000	631.628			90.414,89
Forest village (HD)	500.000	179.187	144.730	13.351	10.310,00
Total	7.900.000	1.210.815		93.532	120.910,44

Source: Sub-Direktorat HKm, HD dan HTR Kemenhut (in Nugroho et al. 2011)

Table 9.5 Condition of production forest

Category	Production forest condition	Area (million ha)
1	Production forests with medium to very low level of degradation and now are still under management of concessionaires (IUPHHK-HA)	6.75
2	Production forests with medium level of degradation (no concessionaires operate in the area)	6.40
3	Production forest with medium to very high level of degradation (no concessionaires operate in the area)	14.15
4	Production forest with very high level of degradation (not meet forest definition anymore)	27.33
Total		55.62

Source: Based on MoFor (2014) and Bahruni (2011)

lands. At present due to the unsustainable practices of forest management, about 55.62 million hectares of production forest have been degraded (MoFor 2014). The level of degradation can be seen in Table 9.5. Production forests under categories 2 and 3 are allocated for restoration of production forest ecosystem. Up to 2013, total area of degraded production forests that have been granted with IUPPHK-RE was only 397,878 ha. To increase the interest of private sector to invest in the restoration of production forest ecosystem (IUPHHK-RE), the government may need to revisit its policy and regulations as RE activity has different nature of activities with IPHHK-HA. An incentive system should also be introduced.

As previously mentioned, the holders of IUPHHK-RE may not have cash inflow for a number of years until forests are restored as the timber will be harvested after reaching the equilibrium of ecosystems (e.g., 35 years). On the other hand, before the business permit is issued, they are burdened with the obligation to pay many fees as applied to IUPHHK-HA. In most cases, the holders of IUPHHK-RE can

survive as they received grants from foreign donors who request for preservation of the forest ecosystem. Nugroho et al. (2011) recommended restructuring the regulations on forest ecosystem restoration by involving the managers of ecosystem restoration, government, and society. First is that ecosystem restoration business is not profit-oriented business so that the treatments should be different from IUPHHK-HA. Second, the current regulations PP. 3/2007 jo PP. No.03/2008 and ministry regulations should be revised to incorporate fundamental substantial changes, particularly on rights and obligations of license holders. Third is introducing incentive system for holders of IUPHHK-RE as they actually carry out government obligation in restoring, conserving, and preserving forests that nearly have no beneficial products.

Policy to prioritize the use of degraded forest for establishment of timber plantation will enhance sink as carbon stock of timber plantation is much higher than the degraded land and forest. In addition, the government for many years has also implemented a program for rehabilitating lands in forest area (*program reforestasi*) and non-forest area (*program penghijauan*). In the last 10 years, the Government of Indonesia has accelerated this program through GERHAN (*Gerakan Rehabilitasi Lahan dan Hutan*). In the period of between 2003 and 2008, total areas planted through GERHAN reached 1,767,559 ha or equivalent to about 300 thousand hectares per year or almost double than those implemented before this period. In the National Forestry Plan (RKTN; Kemenhut 2011), it is estimated that total degraded land in forest area that needs to be rehabilitated until 2030 is about 11.6 million ha. Therefore, rehabilitation of degraded land will be accelerated. Annually, it is targeted that at least 580 thousand hectares of degraded land is planted for rehabilitation.

Based on past experience in the implementation of the land rehabilitation program, it was found that the level of success of this program is still low due to lack of maintenance system (see Box 9.2) and no responsible management unit exists to maintain the planted trees. Without changing strategy in the implementation of GERHAN, the target being defined in the RKTN will not be achieved. For future program, the targeted area for GERHAN should be implemented in area where the FMU already exists, and whenever possible, its implementation should be integrated with CBFM program.

9.4.4 Reduction of Pressure on Natural Forest by Optimizing Land Use and Improving Land Productivity and Community Livelihood

In many regions, conversion of forest is mainly for agriculture activities either by community or by company. Community normally encroached to forest area illegally for planting annual crops or plantation, while company converted the forest to agriculture plantation after having permit. The encroachment occurred in all forest

function but mainly in production forests. Therefore, many of forest areas are not covered by forest. On the other hand, the Ministry of Forestry releases conversion forest to local government to be used for non-forest-based activities where part of the area is still covered by forest, while the other part is already deforested and used by community. This condition often creates conflict between the community and company when local government issued permit to a company to use the land for plantation. Local government normally leaves the problem to company to solve, and this creates high social cost for the company. When this problem is not properly handled by companies, community will find new land and do encroachment again. In other case, communities expand their agriculture land through encroachment when their demand for land increases as the number of family increases. Looking at this condition, pressure on natural forest will continue if integrated efforts across related ministries and local governments are not in place.

Box 9.2 Survival Rate of Trees Under GERHAN Program

Based on assessment conducted by an independent consultant, PT Equality Indonesia on GERHAN Program implemented in 2006/2007 at West Java Province, it was found that the planted trees that can survive and form forest stand were only 20 % even the total area planted over 80 % of the target. On average based on evaluation in 13 districts in West Java Province, realization of GERHAN program reached 84 %, but the ones that survive were only about 53 % (note: *based on regulation from the Ministry of Forestry, the GERHAN program is considered to be successful if the survival rate over 56 %, without considering the condition of the trees*). Further evaluation indicated that of the 53 %, the survived trees with healthy condition were only 42 % (Fig. 9.8). Based on this condition, number of trees that can survive until forest stand on average will be about 18 % (0.84*0.53*0.42).

(continued)

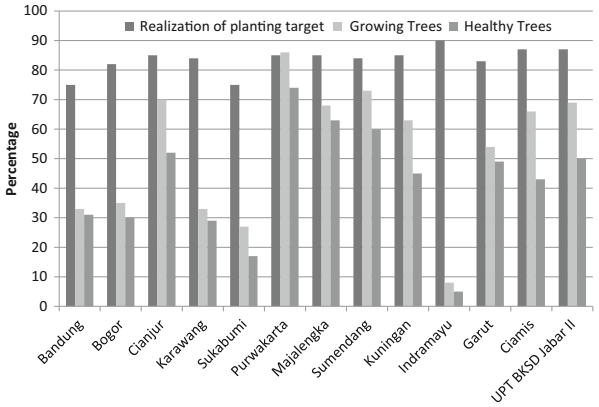

Fig. 9.8 Percentage of realization of planting area, survive trees, and healthy trees (Analyzed from data of PT. Equality Indonesia 2007)

Box 9.2 (continued)

Based on observation, implementation of GERHAN program in Java islands was relatively better than those outside Java. Considering these findings, it can be estimated that the level of success of GERHAN program may be around 20 %. If there is no change in the implementation system of the GERHAN program, with average planting rate of about 300 thousand hectares per year, GERHAN areas which are able to form forest stand will be only 60 thousand hectare.

Policies and potential programs that have been discussed and proposed by stakeholders in reducing threat on natural forests and deforestation include the following:

1. Enforcement of plantation companies to engage community in their plantation as plasma farmers. Regulation on this is already available, i.e., Ministry of Agriculture Regulation No. 26/Permentan/OT.140/2/2007 about Guidance on Permit for Agriculture Plantation. In this regulation every plantation company is obliged to establish plasma plantation at least 20 % of the total plantation area. However, many companies have not met this obligation. Following the implementation of mandatory certification system for plantations such as ISPO for palm oil, all companies are very likely to meet their obligation. In the case, where a company has already used all its land for plantation, the company will need to find land outside their plantation. If agriculture plantation commodities are allowed to be planted in forest area, this can be nicely integrated with community-based forest management (CBFM) program such as community timber plantation (HTR), community forest (HKm), and hutan desa (village forest). At present, one of agriculture plantation commodity allowed to be planted in forest area is rubber tree, while palm oil is still not allowed. In South Sumatra, HTR program has been implemented in reforesting production forest area using rubber tree.
2. Improvement of crop productivity of small holder farmers. Most of communities that occupy forest area for agriculture activities are poor farmers and have little knowledge in good agriculture practices. For example, based on discussion with farmers who occupy Kerinci Seblat National Park (KSNP) in South Sumatra, it was stated that community tended to expand their agriculture lands to meet food demand and income of their family as their family is growing. By increasing crop productivity, the demand for land is expected to decrease (see Box 9.3). Creation of other alternative income for this community as well as their institutional capacity can increase the effectiveness of this program in reducing pressure on the forest. Development of synergy or integration of community empowerment programs from various sector and private (CSR) would be needed to enhance the effectiveness of this program.
3. Optimization of the use of non-forested land for agriculture activities by changing forest function. As shown in Figs. 9.1 and 9.2, more than 10 Mha of land in conversion forest is forested land, while about 20 Mha land in production forests is

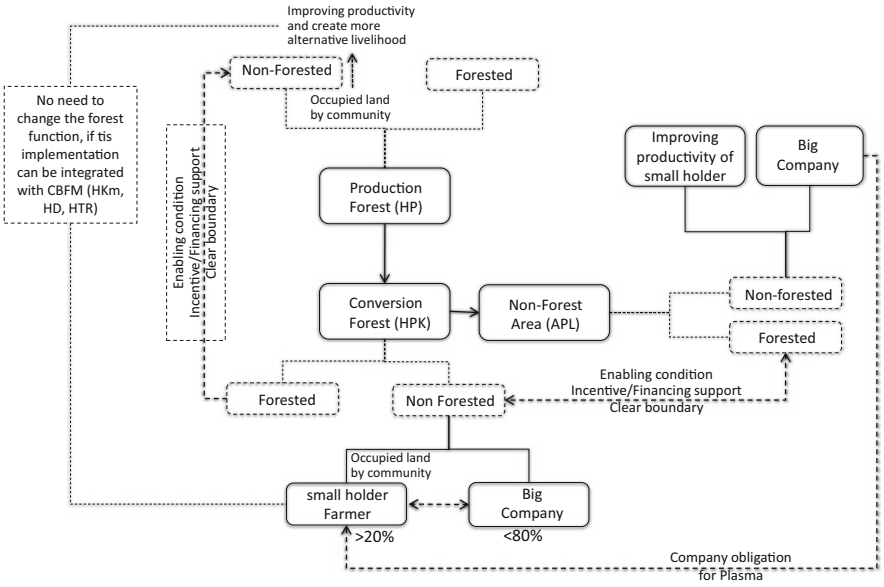

Fig. 9.9 Process for implementation of policy and program for reducing threat on natural forest and rate of deforestation (Modified from Boer et al. 2012)

non-forested land. In non-forest area, almost 7 Mha is forested land. Changing functions of forested conversion forest to production forest, and non-forested production forest to conversion forest which later can be released for non-forest-based activities (mainly for agriculture plantation) or swapping forested land in APL with non-forested conversion forest, would reduce future deforestation. Based on discussion with the staff of Planning Agency at Central Kalimantan Province, swapping forested land in non-forest area with non-forested production forest will be very difficult. It is suggested that before this land swap policy is applied, the status of non-forested production should be changed first to conversion forest. The Joint Minister Decree may be needed to implement this policy (Ministry of Forestry, Ministry of Internal Affairs, and National Land Agency). New direction on the utilization of forest area has been issued by the Ministry of Forestry in the RKTN (National Forestry Plan for 2011–2030), and this may need to be revisited if the policy is to be implemented. This land swap policy will also be potential to be integrated with mandatory certification and CFM programs. Obligation for agriculture plantation companies to develop plasma plantation with community with minimum area of about 20 % of the total plantation may need additional lands. If agriculture plantation commodities are allowed to be planted in forest area, there is no need to change the status of forest function, and this program can be integrated with the CFM programs. Collaboration between the Ministry of Forestry and Ministry of Agriculture is required to facilitate this program.

Figure 9.9 summarized the process of implementing policy and programs for reducing threat on natural forest and deforestation.

9.5 Financing and Incentive Policies for Supporting the Implementation of SFM and REDD+

To support the implementation of the above four key policies and actions, there are a number of financing and incentive policies that may need to be considered. These include (1) financing policies for the acceleration of FMU establishment, (2) incentive policies for the certification system, (3) financing and incentive policy for accelerating the establishment of timber plantation on degraded land and CFM for sink enhancement, and (4) incentive and financing policies for conserving forest carbon and land swap.

9.5.1 Financial Policy for Development of FMUs

As discussed above, the total number of FMUs that need to be established in Indonesia is about 600 units. Following target defined in the National Action Plan for reducing GHG emission (Appendix President Regulation 61/2011) within 5 years (2010–2014), the total number of FMUs that will be established is 120 units. With the total number of 600 FMUs, the time required to complete the establishment of FMU all over Indonesia would be 25 years. It is long process, with assumption that rate of deforestation in the future under the absence of FMUs follows historical rate; within the next 25 years, about 25 Mha of forest may be lost. Following Bappenas' assumption that the cost for establishing an FMU with self-funded capacity is 40 billion IDR (5 years), total cost required for the 600 units will be about 24 trillion IDR or 2.7 billion USD. Considering that this program will be a key for the success of REDD+, acceleration of FMUs establishment is necessary. Clear Roadmap on the Establishment of the all FMUs should be developed with secure budget. The Government of Indonesia may negotiate with donor countries to use debt-for-nature swap (DNS) scheme to secure budget to support the establishment of the FMU.

Box 9.3 Reducing Pressure on Kerinci Seblat National Park (Source: CER Indonesia and CCAP 2011)

Kerinci Seblat National Park (KSNP) is a part of the Bukit Barisan Mountain Range, stretching north to south along Sumatra Island. The park's location makes KSNP one of the richest conservation areas in terms of biodiversity. However, KSNP is under great threat of deforestation and forest degradation. A number of square kilometers of forest have been lost annually in the national park, severely reducing the natural environment for animals and other forest-dwelling life. The main drivers of deforestation and forest

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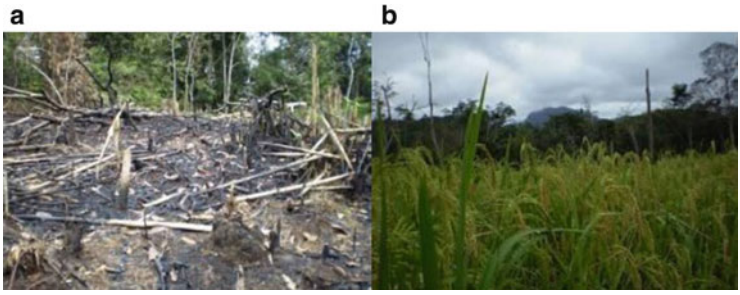

Fig. 9.10 (**a**) Slash and burn activity in KSNP, (**b**): agricultural land inside KSNP

Box 9.3 (continued)

degradation in KSNP are encroachment by the community for agricultural activities, illegal logging, and fires (Fig. 9.10).

Most of the villagers surrounding KSNP are involved in agricultural activities such as rubber and coffee production. Each household has 1–25 ha of land for agriculture; although illegal, some of this is done inside the KSNP area. Villagers enter the park because they need a large amount of land for agriculture. The productivity of coffee is very low, i.e., only 0.4 ton/ha or about one twentieth of normal yield (6–10 ton/ha). By increasing productivity of the crop just up to 4 t/ha will reduce the demand for land by ten times from the usual one. At least there are four programs that can be implemented for improving communities' agriculture practices, namely, (1) improving seed quality as in the usual practices communities get seed from forest or from their garden, (2) improving maintenance and inputs as in the usual practices farmers do not use fertilizer and there are no regular weeding and spraying, (3) improving timing for harvesting to improve quality of coffee as in usual practices farmers tend to harvest the coffee before it gets mature, and (4) improving post-harvest management.

Enhancing capacity of farmers for improving agriculture practices could increase productivity and their income and thereby reduce the demand for land. This can be expected to reduce deforestation in KSNP. Strong assistance for the community will be essential to maintain KSNP.

The roadmap for the establishment of FMU may include at least the following aspects: (1) development of criteria and indicator for prioritizing forest area for FMU's establishment, (2) strategy on FMU institutional capacity building, (3) development of strategic work plan of the FMU, and (4) monitoring and evaluation system. The first aspect is very important to develop as level of risk and problems vary across regions. The availability of criteria and indicator will help the government in putting priority where FMU should be first established and

ensure the presence of FMU will have significant impact on the improvement of performance in forest management or keep good forest management system to continue. The second aspect refers to steps of actions that would be implemented in developing capacity of the FMU organization. The third aspect refers to readiness of the FMU to carry out its role and function, and the fourth aspect refers to development of system to monitor and evaluate the performance of the FMU which will be needed for the development of improvement plan of the FMU. Kartodihardjo et al. (2011) proposed at least eight criteria for evaluating the FMU development performance, namely, (1) area stability, (2) forest use planning, (3) management plan, (4) organizational capacity, (5) inter-strata relations within government and regulations, (6) investment mechanism, (7) availability of access and community rights, and (8) forestry dispute settlement mechanism. In each typology indicators need to be developed for these criteria.

In terms of FMU organization capacity, capacity development should enable the FMU (1) to promote forestry professionalism and be able to perform management that can produce economic value from forest utilization that is balanced with the conservation, protection, and social functions of the forest; (2) to develop investments and provide work opportunities; (3) to prepare spatial-based planning and monitoring/evaluation; (4) to protect forest interests (including the public interest in the forest); (5) to respond to the range of local, national, and global forest management impacts (e.g., the forest's role in mitigating global climate change); and (6) to adjust to local conditions/typology as well as strategic environmental changes affecting forest management (Kartodihardjo et al. 2011).

9.5.2 Incentive System for Certification

As discussed above, the Government of Indonesia has issued a number of mandatory certification systems. These mandatory certification systems as mentioned previously are applied for all forest management/business entities (from large to small scale), namely, IUPHHK-HA, IUPHHK-HT, and IUPHHK-RE, and community forest management (CFM),[3] namely, HTR and HKm (with permit utilization) and/or village forest/Adat forest (with management rights) and Hutan Rakyat (private forest, forest management on an owned land) as well as wood industries. For community-based forest management entities, obligation for doing certification may add burden as this will increase cost of production. On the other hand, some also argued the effectiveness of applying mandatory forest certification system, such as SFM/SVLK, in reducing illegal logging may also not be significant as the

[3] Community forest management (CFM) combines two things: a type of resource (forest) and a group of owner/manager (community). The term CFM broadly refers to various forms: Participatory Forest Management (PFM), Joint Forest Management (JFM), joint forest management (forest co-management), and Community-Based Forest Management (CBFM).

certified company only able to manage the illegal activities within its company site, while market for illegal wood still exists.

Applying same rules for IUPHHK-RE (ecosystem restoration) as applied to other wood business forest activities in certification process may also be counter-productive. In the IUPHHK-RE, forest management units (concessionaires) are not allowed to do wood logging until forest reaches equilibrium conditions (may take time for about 35 years). Thus, in the short term, there will be noncash inflow to the concessionaires. While at present, treatments in term of fee and procedure for getting the permit (IUPHHK-RE) are similar to IUPHHK-HA (HPH) and IUPHHK-HT (timber plantation) as well as obligation for having certification. Without changing this policy, interest of private to do investment for production forest ecosystem restoration will be very low. Based on data from Purnama and Daryanto (2006), more than 10 million ha of production forest is suitable for IUPHHK-RE, while until now the total area of degraded production forests granted with IUPPHK-RE was only 185,005 ha.

Another mandatory certification system for agriculture plantation such ISPO which will oblige plantation companies to develop plasma farmer with minimum area of 20 % of the total area of the plantation will also face dilemma. For new plantation, it may not be difficult to establish such plasma; however, for old plantation, this will be difficult as all their plantation areas are already planted. The only alternative ways is to find additional lands to be used for plasma. This will be very costly if no support mechanism from government.

Considering the above dilemma, incentive system for certification may need to be expanded. Some of potential incentive policies in supporting the mandatory certification system may include the following:

1. Expanding type of incentive for small business entity in getting certification. In the context of SVLK, program for increasing awareness of community on the importance of using certified wood product for saving environment should be progressively implemented. In reality, many wood consumers in developing nations do not care too much on this issue; the consumers are more interested in buying cheaper products. Based on discussion with stakeholder in East Java, price of illegal wood could be half of that the legal ones, so that wood products produced from these will be much cheaper. At present, the government has provided support for small holder company via government budget (APBN) to cover the cost for certification. This subsidy is still not enough as the cost for producing one unit product from certified timber is still higher than the one used illegal ones. In this regard, the incentive[4] for small holder may need to increase so that the price of certified wood product can compete with the non-certified one. At the same time, the awareness-raising programs for community for consuming certified wood products have to be promoted. The subsidy can be

[4] Incentive could also be given in form of direct inputs subsidy.

gradually reduced when domestic market for certified wood products increases. This type of policy could be also negotiated for debt-for-nature swap program.
2. Providing subsidy for business entities focusing on ecosystem restoration in having the mandatory certification.
3. Providing incentive for plantation companies in getting lands for plasma farmers as support for the company in meeting certification obligations. Implementation of this policy could be integrated with CFM programs.

9.5.3 Incentive and Financial Policy for Accelerating the Establishment of Timber Plantation on Degraded Land and CFM for Sink Enhancement

Many of degraded lands in forest area are claimed by community. When permit for using the land has been granted to an entity, conflict on the land normally emerges between the entity and the communities. For this reason, private entities prefer to use forested land in forest area for timber plantation or peatland as these areas normally have no or less conflict (no community claim on the land). Ideally, the government should issue permit on safe and conflict-free (clean and clear) forest areas. However, in most cases this is not the case, and the permit holders have to solve this land conflict problem. Level of conflict varies between regions, and social cost that has to be covered by the permit holder in the establishment of plantation will also vary. The high social costs prevent the permit holders to establish plantation. In this regard, the government needs to create incentive system for permit holders in handling this land conflict problem, and the types of the incentive may be varied depending on level of conflicts. The incentive could be in the form of reducing or exemption of administration/retribution fees for certain period of time depending on level of conflict. With this incentive policy, establishment of timber plantation in degraded land can be accelerated, and the dependency on natural forest for supplying wood will also reduce.

In managing the land conflict issue, the MoF also implements CFM program. The program gives access and right to communities to use the forest area or formalize/legalize the use of the land by the community. The communities have to apply for getting the permits (HTR, HKm, village, and Adat forests). However, the process for getting the permits is too complex for communities, and it is also a lengthy process. Without any assistance from their partners, communities are mostly unable to have the permits. Financial support from the government to communities in implementing the CFM is also available via BLU-P3H (General Services Agency). The amount of funding available for supporting the CFM is also huge, i.e., over a billion of USD. However, the absorption of fund is also very low, less than 1 %. Simplifying the process of getting permit and accessing fund from the BLU-P3H will also be crucial for accelerating the implementation of the CFM. As mentioned above, up to now the realization of the CFM program is far from target (see Table 9.4).

Acceleration of the ecosystem restoration program which will have significant contribution to sink enhancement also needs incentive from the government. Incentive in the form of reducing administration/retribution fees for certain period or exemption from some of administration/retribution fees is recommended.

9.5.4 *Incentive and Financial Policies for Conserving Forest Carbon and Land Swap*

Implementation of land swap policies and exchange of forest functions in order to avoid deforestation (conserving carbon stock in forest) will need incentive and financial policy supports. Nurrochmat (2011) proposed a number of incentive and financial policy for supporting local government in implementing the policies. These include:

1. Financial policy on special allocation fund (Dana Alokasi Kusus, DAK) for conservation. This policy is an incentive from the national government to local government that commits to conserve forest for environmental services. Special allocation fund given to the conservation region should compensate the benefit loss coming from natural resource extraction or forest land conversion (conversion value). The Ministry of Finance plans to accommodate this in revision of Act No. 33/2004 (Ministry of Finance 2011).
2. Revision of fiscal balance law to enforcing "liability rule." The present fiscal balance law regulates the benefit sharing of natural resource extraction between national and local governments, as well as among local governments. The magnitude of sharing depends on the magnitude income that comes from the extraction of natural resources. In this case, the higher the number of the natural resources extracted by certain region, the bigger the benefit sharing received by the region. Revision of the existing fiscal balance law to be a more green fiscal balance is needed to avoid overexploitation and further destruction of natural resources in the regions due to short-term economic interest. A green fiscal balance shall give a proportional attention both in the reward side and in the punishment side to ensure the sustainability of nature resource management.

From the above discussion, it is quite clear that the issue of forest boundary (safe and conflict-free forest areas) and policy on the issuance of permit on the use forest area are two factors that will contribute to the achievement of SFM and REDD+ implementation. Development of boundaries between non-forest and forest areas needs acceleration. In regard with the forest boundary issues, Kemenhut (2011) reported that up to 2010 length of boundary between forest and non-forest areas and between forest functions reach 281,873 km covering area of about 14,238,516 Ha or about 10 % of total forest area of Indonesia. This condition is considered as one of the important factors causing conflict of land right and access in all provinces. At present there is about 22.5–24.4 Mha of forest area in conflict, and a number of

villages within forest area reach 19,420 villages (Dephut and BPS 2009 in Kartodihardjo et al. 2011).

The cost of developing forest boundary is quite expensive. Following the regulation from the MoF, cost for changing forest functions that include developing forest boundary is 3.4 billion IDR per 12,000 ha. To reduce the cost, the process of the development of the forest boundary could be integrated with the development of FMU and conducted through participatory mapping process. In line with recommendation from Kartodihardjo et al. (2011), in addressing this boundary issue in connection with FMU establishment, there are several strategic directives that should be adopted depending on conditions in the FMU. These directives include:

1. Localization of all areas that have serious tenurial conflict into areas of noneffective production as a transitional policy and gradually building a collaboration to optimize achievement of sustainable forest management objectives.
2. Development of micro-spatial arrangements together with the community in order to reach mutual agreement with the community on the utilization norms for each spatial function.
3. Recommendation of legal settlement through the mechanism of revising the spatial arrangements in areas with serious tenurial conflict that is unlikely to be retained as forest areas.
4. Accommodation of community access to forest resources by rearranging the norms for utilizing such resources in accordance with sustainability principles.
5. Development of a mechanism for recognizing community management rights in areas of serious/minor tenurial conflict in the context of sustainable forest management. This mechanism serves as the basis for FMU managers to prepare licensing recommendations for communities.
6. Engagement of law enforcement for all issues relating to illegal activities.

Another important key factor for achieving SFM is availability and accessibility of funds for supporting SFM practices, particularly for engagement of communities in CFM. With the current system, the available fund to support CFM managed by the BLU-P3H as discussed above is not easily accessed by community due to the administration procedure. Policy allowing for transferring the funds to a financing system relatively easy to be accessed by community is required. Two types of financing systems that can be generated at regional level and may meet this need are "blending financing" and "hybrid micro-financing systems" (CER Indonesia and CCAP 2010). Blending financing system is a financing system that synergizes all financial sources such as CSR funding, government funding such as state budget (APBN), and local government budget (APBD) funds, banking, and international funding. This system can help leverage private funding and supports regional development by supporting community activities in urban agriculture and agroforestry including building human resource capacity through assistance and training activities.

Unlike the blending financing model, the hybrid micro-financing system will utilize more government funds than private funds. Funding to support CFM (HTR, HKm, HD/HAd), which is currently managed by BLU-P3H, would be part of this

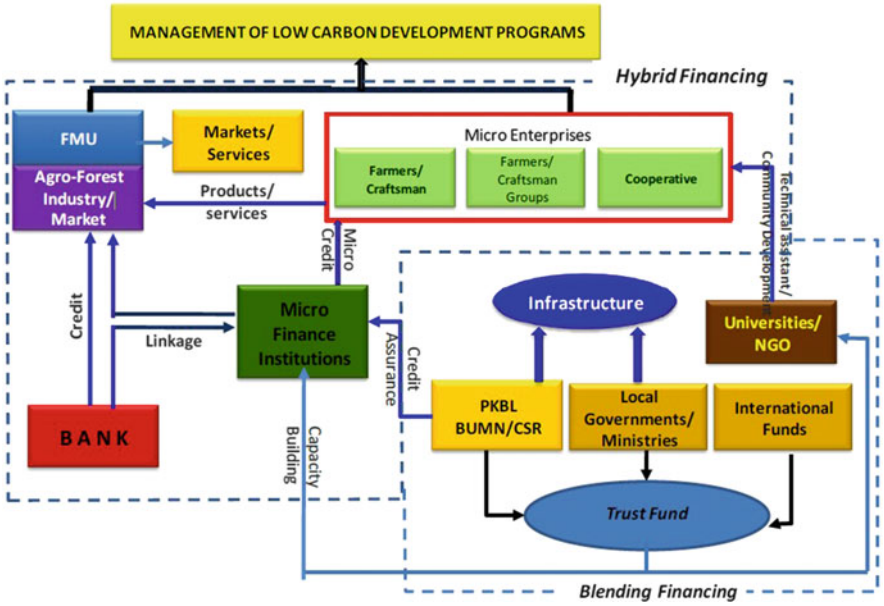

Fig. 9.11 Structure of financing systems to support low-carbon development (SFM and REDD+) (CER Indonesia and CCAP 2010)

financing system. In this system, government funds can be accessed by communities as capital fund assistance in the form of business credit. This system will require credit assurance institutions (LPKD – Local Credit Assurance Institution). The LPKD will provide government guarantees to banks so that if farmers are unable to pay on time, the LPKD will cover the credit and the farmers would pay later following rules as stated in Presidential Regulation No. 2/2008. This credit assurance institution has been developed in a few regions. The presence of this credit assurance institution is expected to support small- to medium-scale community business investments. Figure 9.11 presents the structure of the financing models and the connection with CSR and FMU. In the context of REDD+, both blending financing and hybrid micro-financing systems should provide positive incentives (low interest, tax deduction, concessional investment, etc.) for communities who propose activities that result in emission reductions from deforestation and degradation, conserving forest carbon, sustainable forest management practices, and sink enhancement.

Introduction of the incentive systems should not reduce the income of the government as the emission reduction which resulted from these policies will result in carbon payment. As decided by the Conference of the Parties (COP), payment from the implementation of REDD+ activities will be performance-based payment. This means that the party who decided to join the REDD+ scheme will be eligible to get the payment after the achievement in reducing the emission is measured,

reported, and verified by the third independent parties. The magnitude of the emission reduction is measured against the reference emission level being used.

The study of Schmitz et al. (2014) indicated that by increasing investment in forest sector for facilitating change in technology (TC) at rate of 1 % per year on top of the external investment, the forest destruction might decrease. The hypothesis of this scenario is that higher investments in TC can reduce the rate of forest destruction without any forest protection (e.g., investing in agricultural productivity reduces pressure on tropical forests without the necessity of direct protection; see section 9.6.5). Their study suggested that in the Pacific Asia (most of forest in Indonesia) without any significant change in forest protection program from Business as Usual (called as reference scenario), by 2050 the loss of forest cover might reach 43 % of that of 2010. If this figure is used for Indonesia, under the reference scenario, the remaining Indonesia forest cover by 2050 would be about 55.7 million ha or equivalent to total forest loss of about 43.4 million ha or about 1.08 million ha per year. This figure is slightly higher than the historical deforestation rate in the period 1990–2013, i.e., 0.822 million ha per year (see Sect. 9.3). With the increase of investment by 1 % per year from the top of the external investment for the TC, it is expected that the forest loss in Indonesia would be only 13.5 million ha or equivalent to rate of deforestation of 0.337 million ha per year. As discussed above, the implementation of the above innovative financing and incentive policies might improve land and forest management, and this may further increase the potential of reducing emission from REDD+ activities.

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Chapter 10
Fostering Capacity Development for Asia's Leapfrog

Sirintornthep Towprayoon

Abstract *Capacity Development Is the Basis for Asia's Leapfrog*

Most major development paths of Asian countries are moving toward green growth. Under the constraints of the energy crisis and climate change impact, future Asian growth, while appearing to be the most significant in comparison with other regions, needs a good knowledge-based pathway to light up and pave the road to a low-carbon society.

Capacity development is the basic need and a urgent issue to be explored in Asia. It is one of the effective tools for Asia to leapfrog to a low-carbon society with the concern of unlocked carbon intensity development.

A Bullet Train Model

Development needs to be done on several levels from communities to the subnational and national levels. To leapfrog from the current situation, capacities need to be built at many levels through various mechanisms of networking, research forums, initiatives, training, etc., in order to bridge, transfer and transform the results from research to policy and to implementation. Policy makers with good understanding, as the head of the bullet train, will lead society in the right direction, while scientists and researchers are the engines to back up and accelerate this movement. Finally, practitioners in communities play key roles as the fuel, enhancing the movement toward green growth through their activities. It is, therefore, essential to have these three components for a compatible basis of knowledge and comprehension through capacity development.

Asian Countries Need Collaboration

Asian countries are different in nature but rich in culture and resources. Low-carbon activities are various and depend on internal factors and situations. There are many good practices and philosophies that can be shared among the countries. The experience of learning from each other facilitates accomplishments and reduce risks in implementation. Collaborative activities in capacity development help Asian countries move toward green growth in their own ways with their own uniqueness while seeing the same goal in the future together.

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Keywords Capacity building • Collaboration • Asian leapfrog • Research to policy • Low carbon • Knowledge-sharing platform

Key Message to Policy Makers

- Capacity development is a basic need and an urgent issue for Asia's leapfrog.
- This can be done through knowledge transfer, research collaboration and joint education programs among Asian countries.
- A full loop of knowledge transfer from research to policy and to implementation is the key to success for capacity building in Asia.

10.1 Capacity Development Is Important in Asia—A Tool for Leapfrog

This chapter will explain the need to have capacity development (CD) in Asia, which is a so-called tool for leapfrogging to a low-carbon society. Comparison of emissions from the past and future projections will be drafted. The nature of Asian countries in terms of population and competition, resource utilization, understanding of the people on the ground, and some philosophies of implementation in specific countries will be illustrated. This will lead to the conclusion of capacity building for leapfrogging to a low-carbon society. Entering into a low-carbon society for developing countries is difficult. While there is the potential for Asia to lead climate change abatement, implementation is the key and this cannot be achieved if there is no capacity building at all levels.

10.1.1 The Power of Asia

The merging of 10 ASEAN countries (Brunei Darussalam, Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, Philippines, Singapore, Thailand, Vietnam) into the ASEAN Economic Community (AEC) from 2015 onward makes ASEAN become more important in the Asian region. These ten countries of the AEC contribute 9 % (585 million people) of the world's population while their GDP contributes 3 % (1275 billion USD) of the global GDP. In addition, the ASEAN +3, with the coverage of China, Japan and South Korea, increases the share of the world's population by 31 % (2068 million people) with 18 % (9.901 billion USD) of the global GDP. The immense contribution with a high impact on economics can be

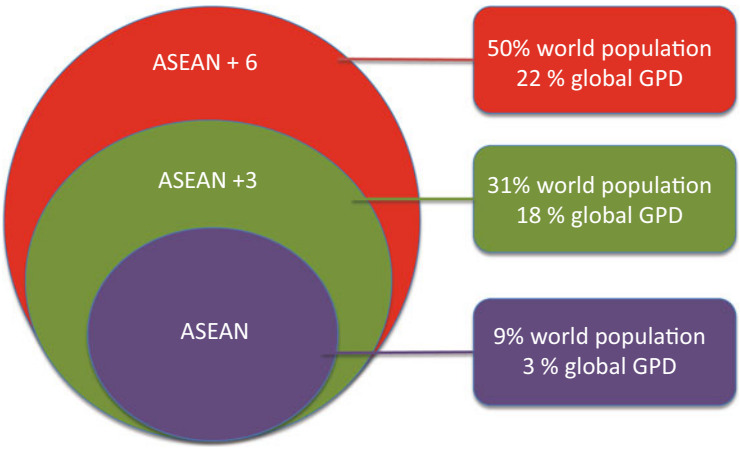

Fig. 10.1 Shares of population and GDP in the global situation

seen with the ASEAN +6 (Australia, China, India, Japan, New Zealand, South Korea) where the share of the world population is 50 % (3284 million people) and its contribution covers 22 % of the global GDP. Figure 10.1 indicates that the path of movement into the future of ASEAN and the Asian countries will have an impact on the world's development.

10.1.2 The Rise of ASEAN

The nature of the ASEAN countries varies, particularly their economic conditions. Regarding the classification of income in ASEAN countries, the composition of income classification is shown in Fig. 10.2. Four categories of income have been identified. Singapore and Brunei are identified as affluent countries while Malaysia and Thailand belong to the middle class. Three countries are in the process of transitioning to the middle class and the remaining three countries fall within the low-income range. The interesting aspect is that the ASEAN middle-income class is more than 25 % of the ASEAN population and in the year 2030 it is anticipated that the middle-income class segment in Indonesia will include more than 50 million people. While the share of the middle-income class increases, development of countries to move toward a middle-income trap has been raised in some countries like Thailand and Malaysia. How the rise of ASEAN can gear its direction toward a low-carbon society is challenging.

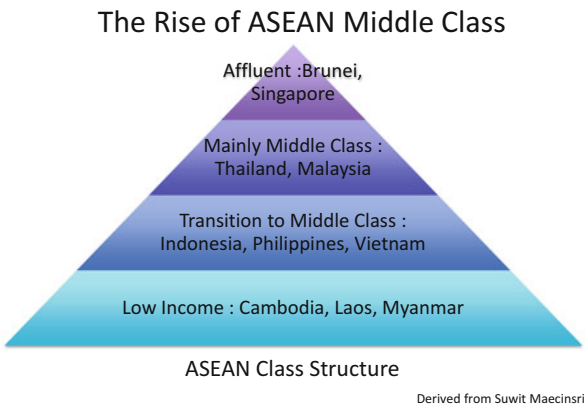

Fig. 10.2 Classification of incomes in ASEAN countries

10.1.3 Regional Development

While moving to middle incomes but aiming to avoid a middle-income trap, countries' development is still based on energy consumption. High energy use has been found to be related to the human development index as seen in Fig. 10.3. In addition, high carbon intensity, particularly in electricity production, is still evident. Although renewable energy and energy efficiency policies have been implemented in many countries in Asia, there is room for improvement toward a low-carbon path, taking into account the fact that greenhouse gas emissions in 2035 for the whole of Asia will contribute almost 50 % of global emissions (Fig. 10.4).

10.1.4 Decoupling of GHG and GDP

Entering into a low-carbon pathway means driving the country's development with low emissions of greenhouse gases. Decoupling of CO_2 emissions from GDP growth is one of the indicators showing that the path of development has to take low-carbon technology and activities into account (see Fig. 10.5). Many developing counties such as Japan, Germany, the USA, Australia, France and the UK have been through this disconnection while some prominent countries in Asia such as China, India, Malaysia and Thailand have not reached met the point of decoupling.

10.1.5 How Can Asia Leapfrog to a Low-Carbon Society?

In the situation of Asian development, green growth policies are promoted. However, looking back to the development from 1990 until 2010, as seen in Fig. 10.6,

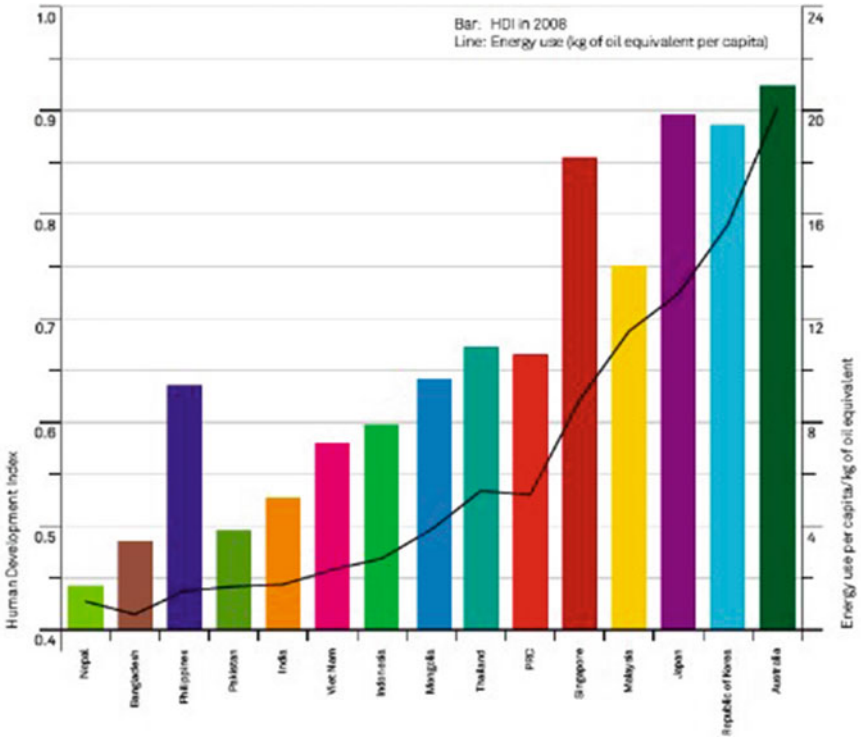

Fig. 10.3 Relation of energy used and human development index (Source: ADB 2013)

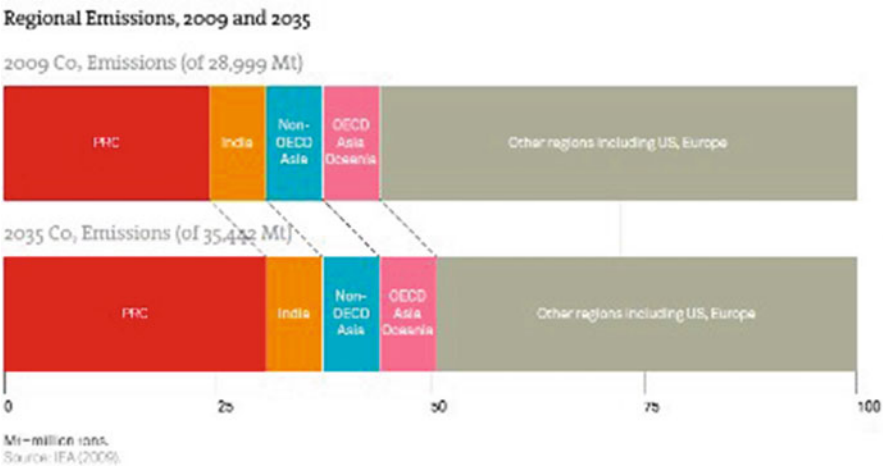

Fig. 10.4 Future emission contributions of Asia (Source: ADB 2013)

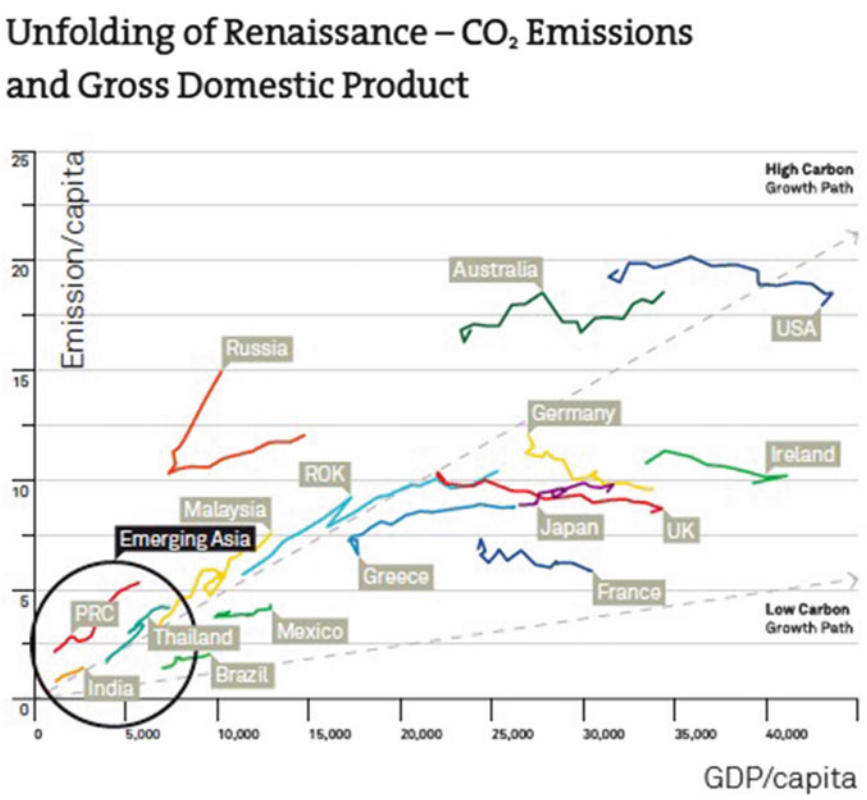

Fig. 10.5 CO_2 emissions and gross domestic product in selected countries (Source: The World Bank 2012)

real GDP growth has been increasing in parallel with CO_2 emission increases. The growth rate and emission rate have increased sharply. Conversely, population growth has increased at a slower rate when compared to other parameters. The implication of this figure is shown in Table 10.1, where the GDP of ASEAN, particularly four countries in Asia (China, India, Japan and South Korea) in the next 15 years (until 2030) will cover 38 % of the global GDP, which will be increased by almost 10 % from 2010. This potential growth in GDP is from 47 % of the world population, where its share has been constant since 2010. These constant population shares will take responsibility for the increasing GDP development of the countries. Therefore the future activities of these populations are crucial for the pursuit of low-carbon development. These activities will be integrated with technology-based and behavioral-based functions. Considering the various circumstances and the different natures of the Asian countries, comprehensive knowledge and technology transfers are essential in order to increase capacity at various levels. Understanding of climate change and its impact, as well as mitigation and abatement, are the key to initiating activity for unlocked carbon intensity development. Responsibility arising from understanding will lead to

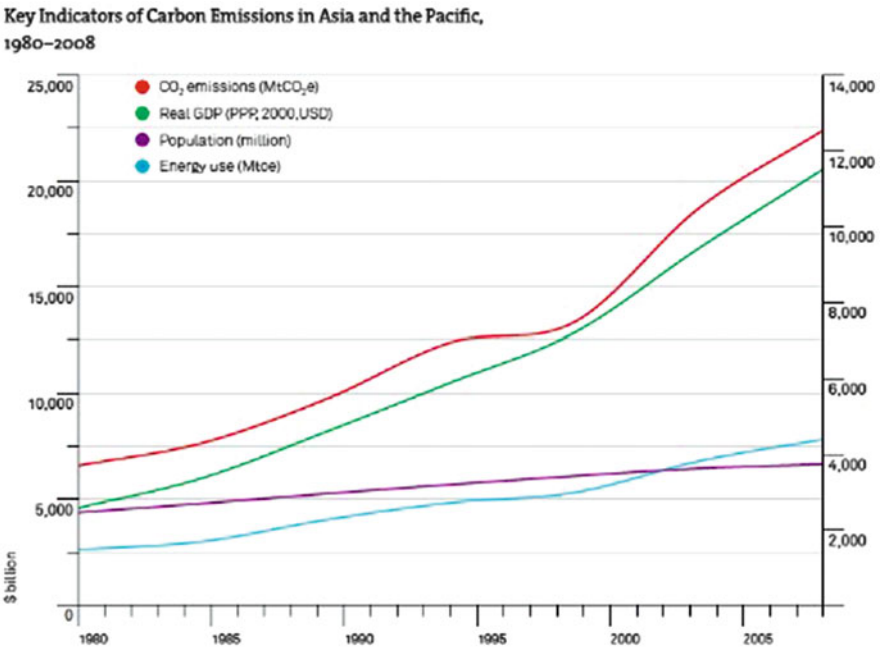

Fig. 10.6 Key indicators of carbon emissions in Asia and the Pacific (Source: ADB 2013)

Table 10.1 Changes of population and GDP between 2010 and 2030 for ASEAN + 4[a]

	Population (million)		GDP (billion USD)	
	2010	2030	2010	2030
ASEAN	592	704	1852	5587
ASEAN + 4	3206	3790	15,979	46,501
World	6641	7933	62,124	129,547
Percentage of ASEAN + 4 in the world	48 %	47 %	26 %	36 %

Source: Derived from ADB 2013, Low Carbon Green Growth in Asia
[a]+4 = China, India, Japan and South Korea

sustainable development. Capacity development to direct society to know what to do, and how to do it, is the key to success in order to leapfrog for a massive reduction in GHG.

10.2 Structure and Mechanisms of Capacity Development

In order to understand the low-carbon pathway that can help Asia unlock carbon intensity, a good structure and mechanisms of capacity building need to be designed across the region. The structure to develop capacity should have a broad space for

knowledge-sharing and a full loop of knowledge transfer which starts from research and leads to policy and to various level of implementation.

10.2.1 Knowledge-Sharing Platform

Sharing of knowledge should be done on both the horizontal and vertical levels. This means that knowledge is shared among the same level of society and through different levels of the related society. There are at least four levels of society, including the community, researchers, practitioners and policy makers. To accomplish capacity development, different mechanisms are applied in each society. The 'community' itself is the ground basis for implementation of low-carbon development. Mass media and direct communication to disseminate knowledge and information through the society are good mechanisms as this is a broad and heterogeneous society. Integration of a good knowledge management system into everyday life would be an effective tool of communication. The key function of the society is understanding of the facts and impacts of climate change as well as perception of their own adaptive capacity to be resilient to global change. In Asia, this society is mostly low-income to middle-income communities and they are the majority of the Asian population. Empowering this society is an effective strategy to leapfrog toward a low-carbon society.

A society of scientists and researchers is unique in the way that knowledge and information are developed from this society. The mechanisms of research and education should be promoted in order to find real solutions to the change and to cope with the change. This society is the key to fostering capacity development in this region through knowledge management. Collaboration among Asian countries needs to be strengthened in order to gain and exchange experience as well as joint research in the framework of the Asian region as climate change is a global issue but different coping situations can be learnt from each other. Nevertheless, the key issue of this society is to connect to other levels of society in order to disseminate the knowledge to the real implementers.

Practitioners are mostly people from government and industry who are involved in implementation either by planning or actions. This community drives low-carbon activities in the real sector to be implemented. They need to be equipped with skill and to be competent to initiate activity, suggest appropriate technology and solve any problems that may occur during implementation. The mechanism to promote LCD of this society is to improve their skill and enhance technology and knowledge transfer to facilitate their activities.

The top level is policy makers where their role is planning and laying down the strategies and policy. To enhance the capacity for low-carbon development, policy makers should have special mechanisms such as high-level dialogue or high-level executive training. Nevertheless the achievement of this will lead to a high impact of change. A key issue is dissemination of the right and most feasible information in a timely manner so that good policies will be executed in a timely manner.

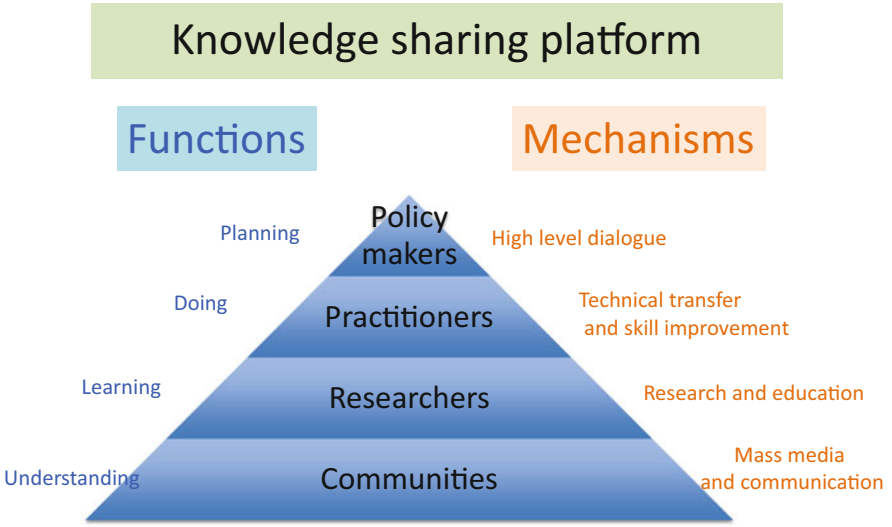

Fig. 10.7 A knowledge-sharing platform among different societies on their function and mechanisms

There is a need for Asian countries to have a knowledge-sharing platform to circulate the information at different levels of society so that they will all understand the same target and the reason for each policy and action to be pursued and implemented. Designs for connected pathways between these societies have to take into account how to stimulate the action of these sharing platforms for the greatest benefit of low-carbon development.

Figure 10.7 shows the linkage of four societies linked to the knowledge platform for both their function and mechanisms. Transforming of knowledge can be intra-society and inter-society.

10.2.2 From Research to Policy and Implementation

Not only the platform of knowledge-sharing but also the ability to make things happen both need a driving body. From research to policy, as mentioned in many scientific forums, it is not enough to unlock carbon intensity development. Figure 10.8 shows the linkage of research to policy and to implementation by the driving body in each component for clearer understanding. Usually, universities, research institutes and even non-governmental organizations that work on research are the main bodies to initiate knowledge, information and technology while the policy makers are the government itself or the ministry. Connections of the bodies

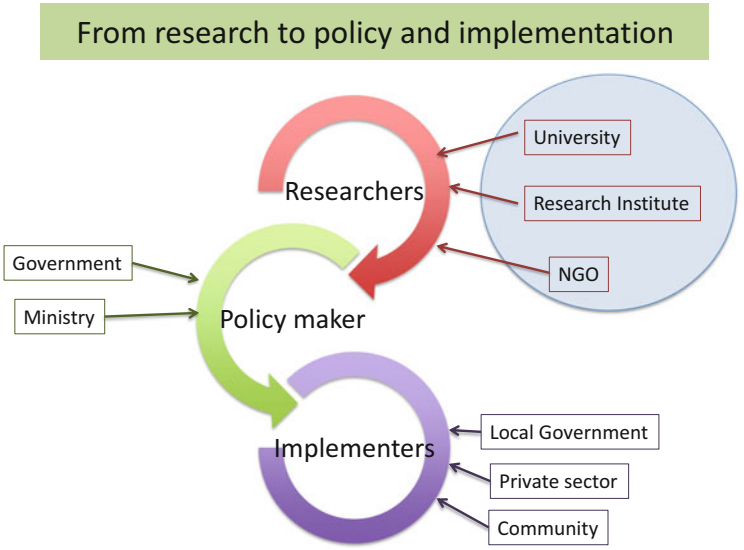

Fig. 10.8 Institutional body in the context of research, policy and implementation

of research to policy are established in some Asian countries such as Thailand where the Division of Science, Technology and Innovation Office of Planning and Policy (STI) and the Ministry of Science, Technology and Innovation initiate the MOU system with some universities and work together on how to launch the policy under the science and research support. The implementation of policy needs implementers. Local government, the private sector and communities are the different players in each role according to the policy formulation.

Institutional arrangements to cover the full loop of research to policy and to implementation can chain the different actions of the organizations mentioned above to implement low-carbon activity effectively. Any committee appointed to tackle low-carbon development should comprise the three figures of research, policy and implementation to push all action into full implementation.

10.2.3 Level of Low-Carbon Society Implementation

In order to show a good practice of capacity development that has shown potential for the leapfrog to a low-carbon society, some example of this scheme at different levels of implementation are shown below.

Community Level Ban Pred Nai Community on Environmental Protection and Energy Dependence

Ban Pred Nai is a small community located in the coastal area of the Trang Province in the eastern part of Thailand. This community, led by the Venerable Phra Subin Praneeto, who has preached the concept of truthful words which create "trust", has not only successfully preserved the local mangrove forest, but has also used improvisation from forest products and nature to generate both income and better wellbeing for the community. It is a unique knowledge transfer of the 'Sufficiency Economy Philosophy' (SEP) wisdom from this venerable monk to the community where rules and activities to protect the mangroves and energy independence have happened.

The SEP concept was introduced to the village by the Venerable Phra Subin Paneeto who endorsed the implementation of coexistence with nature to the community. In order to have an environmental management plan, the micro-credit saving fund called ' Sajja group' was operated and the revenue from this activity was raised to help community members replant mangrove trees while setting up local regulation to sustainably allow members of the community to have protection while living positively with the mangroves. The saving fund in terms of cooperation business was now operating with more than 700 million baht per year. By protecting the mangrove forest, it was shown that the Ban Pred Nai community could reclaim 2000 ha of forest back from the year 2001 onward after implementing the concept of coexisting with nature, which is one of the SEP concepts. In addition, after the mangroves had been restored, the local sea crab business was reactivated again, introducing big incomes to the community. In terms of climate change mitigation, it was found that through communal management, the mangrove forest in Ban Pred Nai absorbs 1.85 tonnes of carbon dioxide per person per year, when compared to the non-communal forest absorption rate of 0.91 ton per person per year. The reforestation activity in Ban Pred Nai creates a CO_2 sink of 2.0 tonnes of CO_2 per capita per year (Towprayoon et.al. 2011).

Not only environmental management but also implementation of SEP can help protect the environment. Being aware of the erosion of the coastal shoreline causing a loss of the mangrove area, sea water invasion and a reduced biological food chain, the Ban Pred Nai community initiated the local technology to prevent coastal erosion. A blockade made from used tires in a cubic shape has been placed along the mangrove shoreline since 1992. It was found later that this activity can protect against erosion of the shoreline, while the area of non-blockade placement failed to be maintained and collapse of mangrove trees and loss of shoreline occurred. In addition, the placement of the blockade became the routine work of the community. This indicated good understanding of self-sufficient living with self-development of the people in Ban Pred Nai. It was also a good demonstration of how the community can adapt themselves to the dimension of climate change and showed the coping capacity to deal with it.

The issue of climate change is not only related to adaptation but also to greenhouse gas mitigation. The reduction of carbon dioxide is not the major concern in SEP but to live sufficiently using fuel that can be accessed within the village is the key. Farmers in Ban Prai Nai earn their living with a mixed fruit tree orchard including rambutan, loongkang, jackfruit and durian. During the off season,

farmers have to clear their excess tree branches which become wood residue. In order to avoid residue burning, several locally designed charcoal kilns have been constructed throughout the village to produce in-house use of charcoal and wood vinegar. This activity helps to produce more than 16 tonnes per year of charcoal from 53.7 tonnes per year of wood residue. This can replace around 10 tonnes of LPG, avoiding an LPG cost of approximately 200,000 baht per year. It should be noted that the community in Ban Prai Nai is only 650 people and this avoid costs of approximately 2 % of their incomes.

Subnational Level Low-Carbon City at Muang Klang Municipality

The activities of the low-carbon city in the Muang Klang Municipality in the Rayong province of Thailand are a good example of knowledge transfer from research to policy and to implementation. The Muang Klang Municipality is a member of the ICLEI but the actions of the low-carbon activities were themselves in the spotlight after a researcher from the Thailand Greenhouse Gas Organization of Thailand and the Joint Graduate School of Energy and Environment, King Mongkut's University of Technology Thonburi, set up the program with the Mayor to estimate the municipality greenhouse gas inventory from four major sectors and set up the target of reduction including energy efficiency in building, transportation, agriculture and the waste sector. The nine-steps approach to estimate GHG was initiated by JGSEE and implemented for the first time in this municipality, as seen in Fig. 10.9. The nine steps take into account the action plan where all stakeholders from the governmental office, industry and education join together and identify activities together in order to reach the target set by the study (The Joint Graduate School of Energy and Environment (2011)). Below are some action plans that have been implemented.

Mitigation Actions in the Waste Sector in the Muang Klang Municipality

- Install a municipal waste separation belt to sort organic waste and recyclables from general waste prior to landfill disposal.
- Collect fat and oil food waste from restaurants and markets to produce solid fuel used in the municipality's own slaughter house.
- Collaborate with the Ministry of Energy to install anaerobic digestion in order to produce methane gas used for heat production.

Mitigation Actions in the Agricultural Sector

- Convert unused land areas to rice fields and construct a municipal rice mill for local processing and consumption to reduce emissions from transporting rice from elsewhere.

The direct and indirect benefits from mitigation actions in the Muang Klang Municipality are shown in Table 10.2.

Regional Level Climate Change International Technical and Training Center (CITC)

Fig. 10.9 Nine-steps approach to a low-carbon city by JGSEE

Table 10.2 GHG reduction and co-benefits

Mitigation measures	GHG emission reduction	Expected co-benefits
Installed municipal waste separation belt to sort organic waste and recyclables from general waste prior to landfill disposal	448.4 t CO_2 e avoided over 10 years from landfill methane	Lowered solid waste disposal costs for municipal authorities by 312,500 baht over lifetime of equipment (10 years)
		New revenues generated from sale of recyclables
		Extended life of municipal landfill
Constructed municipal rice mill for local processing and consumption	At least 61.6 tCO_2 e avoided from transport of rice from outside the municipality	New income generated from rice sales, benefiting smaller-scale farming households
		Reduced dependence on price in the rice market and purchases from outside the municipality
		Increased food security for local communities

There is a proposal by the Thailand Greenhouse Gas Management Organization (TGO), which is the responsible agency in Thailand for GHG mitigation activities, to establish a Climate Change International Technical and Training Center (CITC), which is aimed to be a "one-stop technical training center" and networking platform on mitigation and adaptation for ASEAN countries and other developing countries (Thailand Greenhouse Gas Management Organization 2015).

The main activities of the CITC are to provide a training service in the area of climate change mitigation and adaptation, establish a networking platform for ASEAN countries, disseminate knowledge on climate change mitigation and adaptation, and be a learning resource center on climate change mitigation and adaptation. The target groups of the CITC are governmental agencies, academic institutions, private companies related to mitigation and adaptation, and the general public. The center currently has four major courses including GHG inventory management, a mitigation mechanism, low-carbon society development and sustainable GHG management. The course are offered at different levels to include practitioners, executives and those who are interested. The CITC is supported by JICA and other international agencies including the Thai Government. It is expected that capacity building through this center will raise the standard of knowledgeable people in ASEAN.

10.3 Mechanism of Knowledge Dissemination

Capacity building at various levels can increase understanding and enhance the radius of perception but may not be enough to unlock carbon intensity over time. Dissemination of knowledge with such capacity as has been built can accelerate Asian countries' ability to fight the temperature increase of 2 °C. Knowledge dissemination can be through networks, forums or initiatives across Asia. These activities are illustrated below.

Networking Low Carbon Asia Network—LoCARNet

This network is a good example of regional collaboration in Asia and a platform to disseminate research for policy formulation.

LoCARNet is a network of researchers that facilitates the formulation and implementation of science-based policies for low-carbon development in the Asian region. It aims to facilitate science-based policies in order to realize a sustainable future based on a stabilized climate. The network endeavors to establish research capacity in the region based on South–South–North cooperation, and to reflect research findings in actual policies to achieve low-carbon growth (LCS-RNet Secretariat 2015).

With the success of the Low Carbon Research Network (LCS-RNet), the International Global Environment Study (IGES), which acted as the secretariat, has launched LoCARNet as an autonomous research network, operated through voluntary initiatives by researchers in various countries, sustaining close links with other

like-minded stakeholders. LoCARNet aims to promotes research to support the development of policies for low-carbon growth by enabling dialogue between scientists and policy makers and to help the Asian region to move forward with low-carbon growth, with a number of ongoing favorable conditions to turn challenges into opportunities.

LoCARNet conducts a platform of information exchange as well as updating research progress, including pushing joint research on climate change in Asia. The uniqueness of LoCARNet is the creation of a network of prominent researchers in science, science policy and dialogue. The ownership of the knowledge is by countries and strengthening the South–South–North collaboration on climate issues.

The success of LoCARNet has been reflected by the number of country collaboration platforms, joint research projects and publications.

Research Forum Established in 2006 with the leadership of Kyoto University, Japan, and King Mongkut's University of Technology Thonburi, Thailand, the Sustainable Energy and Environment Forum (SEE Forum) is an Asia–Pacific academic and science and technological forum that brings forward dialogue on the global climate and energy security issues of common concern. The primary objective of the SEE Forum is to seek academic and science and technological cooperation that will contribute to solving the global climate and energy security issues (Sustainable Energy and Environmental Forum, 2015).

There are ten member countries—namely Brunei, Cambodia, Indonesia, India, Malaysia, Philippines, Japan, Singapore, Thailand, and Vietnam—that participate in this forum. The SEE Forum members will, either individually or collectively, bring the spirit of our common understanding and resolve to the attention of relevant policy makers and other science and academic networks, at national as well as international levels. Ultimately, the goal is to provide government agencies and policy makers with the information required to make sound decisions on global climate and energy security issues.

The main activity of the forum is to establish a research network that can work together on relevant topics with a focus on Asia. Promotion of bilateral and multilateral research, as well as exchange resources, including students, researchers and professors, are also a focus. The forum has allowed young SEE Forum researchers from Asian countries to work together on research into the energy situation in Asia. Within this initiative, knowledge of low-carbon activities has been disseminated from competent and experienced researchers to the younger generation. Members gather every year to update information and seek research collaboration. Linkage with the Asia University Network (AUN) and joint research supported by the SATREP Program are some of the products of this forum. More information can be found at www.seeforum.net.

Initiative—Global Warming Forum (Thailand Research Fund) This is an initiative by the Multilateral Environmental Agreements Knowledge and Strategic Development Think Tank Project (MEAs Think Tank) supported by a Thailand

research fund (Global Warming Forum 2014). The forum frequently sets up dialogue and seminars on current topics on the low-carbon society with the right target group and consecutively updates information on low-carbon activities including negotiation and prominent scientific issues. The uniqueness of this initiative is the combination of participants comprising government, private industry, universities, NGOs and the community. This forum acts as a think tank and disseminates discussion papers, books and other output to policy makers and society.

Human Resource Development A leapfrog to a low-carbon society needs understanding of the real situation and problems in the region. This can be done collaboratively among countries in the region. An example of human development that answers the issue above is the Joint International Postgraduate Program on Energy and Environment (JIPP), which has been established by five leading universities in ASEAN, namely the Institute of Technology Bandung, Indonesia; University of Malaya, Malaysia; University of Philippines, Philippines; King Mongkut's University of Technology Thonburi, Thailand; and Hanoi University of Science and Technology, Vietnam. The program has led to a growing human resource and a network of experts who can drive energy technology and the energy market integration process in ASEAN. It will serve as a crystallization point to strengthen the cooperation in research and development among the universities in the member countries. The objectives of the program are to produce postgraduate students who can understand and find solutions to energy and environmental issues with the view of the ASEAN region and to support non-boundary competent human resources across the ASEAN region, as well as stimulating joint research and development among ASEAN universities. This program provides for students at the Masters and PhD levels in each university. The students have a chance to understand problems in other countries and collaborate on research topics under group supervisors from member universities. Mobility between universities is also encouraged (The Joint Graduate School of Energy and Environment 2014).

10.4 Conclusion and Key Messages

It is clear that the Asian countries will be an important region in the world in the future in terms of economic development and use of fossil fuels. While economic growth is projected to sharply increase by 38 % by 2030, the growth of the population is constant. Therefore, increased capacity of this region to cope with climate change is important, particularly given that the same population will drive global GDP growth for almost one third of the world. There are a number of activities currently that have shown their success and can be shared among countries. Capacity building can be done at the levels of communities, researchers, practitioners and policy makers in order to unlock from energy intensity and to leapfrog to a low-carbon society.

10.4.1 Capacity Development Is the Basis for Asia's Leapfrog

Most major development paths of Asian countries are moving toward green growth. Under the constraints of the energy crisis and climate change impact, future Asian growth, while appearing to be the most significant in comparison with other regions, needs a good knowledge-based pathway to light up and pave the road to a low-carbon society.

Capacity development is the basic need and an urgent issue to be explored in Asia. It is one of the effective tools for Asia to leapfrog to a low-carbon society with the concern of unlocked carbon intensity development.

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Development needs to be done on several levels from communities to the subnational and national levels. To leapfrog from the current situation, capacities need to be built at many levels through various mechanisms of networking, research forums, initiatives, training, etc., in order to bridge, transfer and transform the results from research to policy and to implementation. Policy makers with good understanding, as the head of the bullet train, will lead society in the right direction, while scientists and researchers are the engines to back up and accelerate this movement. Finally, practitioners in communities play key roles as the fuel, enhancing the movement toward green growth through their activities. It is, therefore, essential to have these three components for a compatible basis of knowledge and comprehension through capacity development.

10.4.3 Asian Countries Need Collaboration

The Asian countries are different in nature but rich in culture and resources. Low-carbon activities are various and depend on internal factors and situations. There are many good practices and philosophies that can be shared among the countries. The experience of learning from each other facilitates accomplishments and reduce risks in implementation. Collaborative activities in capacity development help Asian countries move toward green growth in their own ways with their own uniqueness while seeing the same goal in the future together.

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Chapter 11
Capacity Development on GHG Inventories in Asia

WGIA Workshop on Greenhouse Gas Inventory in Asia

Hiroshi Ito

Abstract The Greenhouse Gas Inventory Office (GIO) of Japan has organised the "Workshop on Greenhouse Gas Inventories in Asia (WGIA)" since 2003. The workshop is tasked to improve GHG inventory dataset credibility in Asia and help bind countries within the Asian region. Participating countries are Cambodia, China, India, Indonesia, Japan, the Republic of Korea, Lao PDR, Malaysia, Mongolia, Myanmar, the Philippines, Singapore, Thailand and Vietnam (14 countries). Since the 6th WGIA (WGIA6) in 2008, WGIA has been convened as part of the "Kobe Initiative" of the G8 Environment Ministers' Meeting. WGIA participants are government officials, inventory compilers, researchers and staff in international organisations. The workshops have been held in other Asian countries to help attract more attendees. Participants from many countries can conduct face-to-face discussions at WGIA. Many achievements were realised through the workshops, in particular:

- Establishment of the WGIA network platform to exchange information on climate change and mitigation of GHG emissions as well as GHG inventory
- Sharing of information and experiences that can be beneficial for other countries
- Identifying common problems and possible solutions
- Updating of the status of national inventory development

This collaborative approach may be applicable for other regions.

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Keywords WGIA • GHG inventory • Biennial update reports • Nationally appropriate mitigation actions • MRV • GIO of Japan • Capacity development • Mutual learning

Key Message to Policymakers

- GIO has conducted a Workshop on Greenhouse Gas Inventories in Asia (WGIA) annually for 12 years.
- Workshop continuity helps develop networks.
- WGIA operates to exchange information among inventory experts.
- Face-to-face workshops are necessary for developing relationships of mutual trust.

11.1 Introduction to WGIA

11.1.1 GHG Inventory in International Negotiations

The 5th Assessment Report published by the Intergovernmental Panel on Climate Change (IPCC) in 2013 stated that "the atmospheric concentrations of the greenhouse gases carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O) have all increased since 1750 due to human activity".

In accordance with Articles 4 and 12 of the United Nations Framework Convention on Climate Change (UNFCCC), all Parties to the Convention are required to submit greenhouse gas inventories to the Conference of the Parties (COP) under the convention as part of their national communications (NCs) at a frequency determined by the COP.

GHG inventories are important for ensuring the transparency and accuracy of each country's mitigation actions by quantifying anthropogenic GHG emissions. In this respect, national GHG inventories, which provide information on the GHG emissions and their trends over time, play a critical role as a basis for decisionmakers to design and implement strategies for mitigation actions and GHG emission reductions within their country.

Inventories form the basis of national policy development because they can be used to:

- Identify the major sectors where abatement will have a real impact.
- Predict and compare impacts of mitigation measures.
- Choose cost-effective options.

Inventories are essential to monitoring of impacts of mitigation policies and measures because:

- Policymakers need to know if policies are working.
- They need to reflect impacts of mitigation actions and thus require careful choice as regards method.

11.1.2 Responsibility of Developing Countries

Only developed countries, which are the main emitters of greenhouse gas, have climate change responsibilities and are mandated to create and submit GHG inventories periodically. However, recently, developing countries have achieved rapid growth, and the emissions of greenhouse gas caused thereby have significantly increased, which means developing countries will also have to start submitting GHG inventories. It is thus necessary for each country to urgently asses its national circumstances.

Since the Bali Action Plan, which states that Non-Annex I Parties should also take nationally appropriate mitigation actions in a measurable, reportable and verifiable manner, was agreed on at COP13 in 2007, the importance of greenhouse gas inventories has been recognised as a tool for supporting the developing mitigation measures and to verify their efficacy. From the Cancun Agreements, Non-Annex I Parties shall make the biennial update report every 2 years (see Table 11.1).

Table 11.1 Biennial update report, Decision 1/CP.16—Cancun Agreements (Reference: UNFCCC (2011))

	Frequency	Content
National communications	4 years	National circumstances
		GHG inventory
		Adaptation and mitigation action
		Relevant information
		Necessary support
Biennial update reports	2 years	GHG inventory
		Information on mitigation action
		Needs and support received

11.1.3 The Role of Greenhouse Gas Inventory Office of Japan (GIO)

The Greenhouse Gas Inventory Office of Japan (GIO) was established in July 2002 in the Center for Global Environmental Research (CGER) at the National Institute for Environmental Studies (NIES). Its mission is to compile the annual national greenhouse gas (GHG) inventory of Japan; to implement various GHG inventory-related tasks and activities, such as providing support and assistance for the technical review of the national GHG inventory of Japan for the UNFCCC and the Kyoto Protocol; and to contribute to capacity building of Asian countries in developing and improving their GHG inventories (see Table 11.2).

The "National GHGs Inventory Report of JAPAN (NIR)" and "GHGs Emissions Data of Japan", both of which are published annually, as well as information on and reports from the "Workshop on Greenhouse Gas Inventories in Asia (WGIA)" are available and posted on the GIO website.

Additionally, some members join the process of the technical review of other parties for the UNFCCC and the Kyoto Protocol in some countries such as Germany as a member of the expert review team (ERT).

11.1.4 One Part of the National System

The Ministry of the Environment of Japan (MoEJ), with the cooperation of relevant ministries, agencies and organisations, prepares Japan's national inventory and compiles supplementary information required under Article 7.1, which is annually submitted to the Conference of the Parties through the UNFCCC Secretariat in accordance with the UNFCCC and the Kyoto Protocol.

The MoEJ takes overall responsibility for the national inventory and therefore does its utmost to improve the quality thereof. The MoEJ organised the "Committee for the Greenhouse Gas Emission Estimation Methods" in order to integrate the latest scientific knowledge into the inventory and to ensure it reflects recent

Table 11.2 List of tasks of Greenhouse Gas Inventory Office of Japan (GIO)

Task of Greenhouse Gas Inventory Office of Japan
- Preparing annual national GHG inventory
- Providing support for Japan's national GHG inventory
- Support and assistance of political actions relating to GHG inventory
- Convening the Workshop on GHG Inventories in Asia (WGIA)
- International cooperation for improvement of GHG inventory
- Participation in GHG inventory review as reviewer

international provisions. The estimation of GHG emissions and removals, the key category analysis and the uncertainty assessment are then carried out by taking the decisions of the committee into consideration. Substantial activities, such as the estimation of emissions and removals and the preparation of Common Reporting Formats (CRF) and National Inventory Report (NIR), are performed by the Greenhouse Gas Inventory Office of Japan (GIO), which belongs to the Center for Global Environmental Research of the National Institute for Environmental Studies. The relevant ministries, agencies and organisations provide the GIO with the appropriate data (e.g. activity data, emission factors, GHG emissions and removals) through compiling various statistics and also provide relevant information on supplementary information required under Article 7.1. They then check and verify the inventories (i.e. CRF, NIR), including the spreadsheets that are actually utilised for the estimation, as a part of the quality control (QC) activities.

The checked and verified inventories determined as Japan's official values are then published by the MoEJ and submitted to the UNFCCC Secretariat by the Ministry of Foreign Affairs (Reference: Ministry of the Environment, Japan and Greenhouse Gas Inventory Office of Japan (GIO), CGER, NIES (2014)).

Figure 11.1 shows the overall institutional arrangement for Japan's inventory preparation.

11.1.5 The Objective of WGIA

Thus far, on the basis of Articles 4 and 12 of the UNFCCC, Annex I countries have compiled a GHG inventory annually, but Non-Annex I Parties have only done so once or twice and with the national communications (NCs).

However, at COP16 in 2010 and COP17 in 2011, it was agreed that, in addition to the NCs, all Parties to the Convention, including Non-Annex I Parties, shall submit information on GHG inventories as a biennial update report (BUR). It was also agreed at COP17 that developing country Parties should submit their first BUR by December 2014 and subsequent reports every 2 years. For this reason, more accurate inventories, which support the development of mitigation measures and the verification of the effectiveness of these measures, need to be reported at a higher frequency than ever before. The importance of periodical GHG inventories

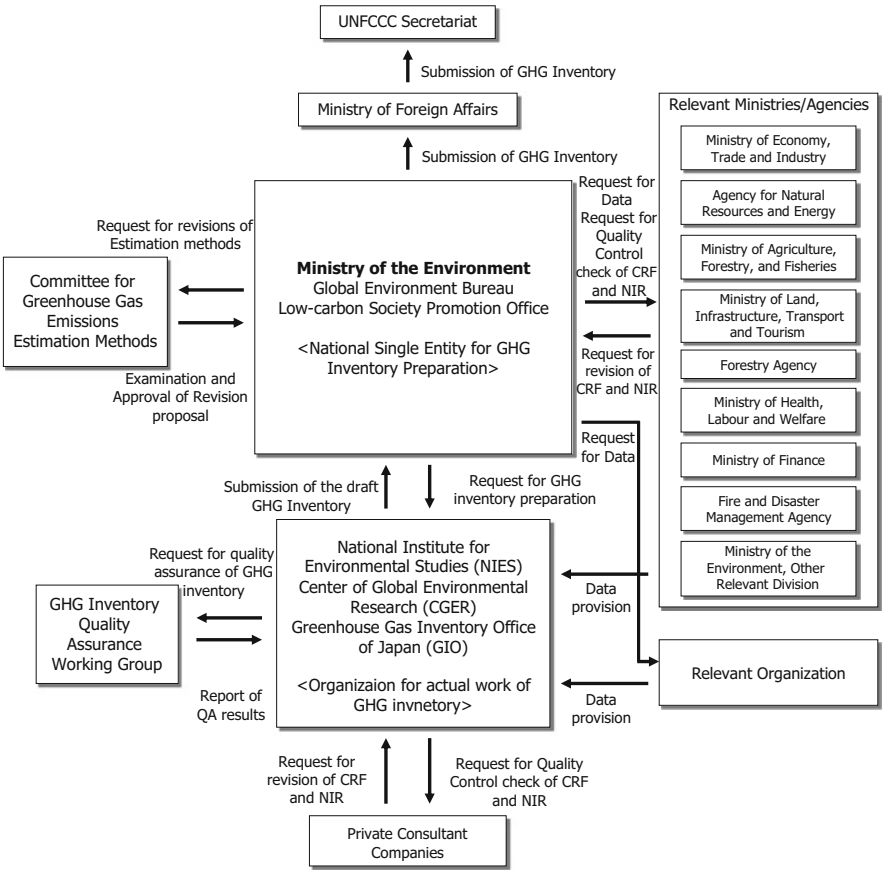

Fig. 11.1 Japan's institutional arrangement for national inventory preparation (Reference: Ministry of the Environment, Japan and Greenhouse Gas Inventory Office of Japan (GIO), CGER, NIES (2014))

is increasing on an international basis, which means Non-Annex I Parties unfamiliar with compiling the GHG inventory periodically will require capacity building.

With this aim in mind, GIO convened the Workshop on Greenhouse Gas (GHG) Inventories in Asia (WGIA) in 2003. In order to improve the quality of GHG inventories, it is important for the related countries to exchange information on them, as this will aid inventory compilers and administrators managing the compilation. Since 2003, government officials, inventory compilers and researchers directly involved with inventory preparation in the participating countries have met to exchange information at the workshop (Reference: Greenhouse Gas Inventory Office of Japan (GIO), CGER, NIES (2012)).

The objectives of the workshop are:

– To enhance sector-specific capacity for inventory compilation (mutual learning)
– To facilitate periodical national GHG inventory preparation for national communications (NCs) and biennial update reports (BURs)

- To discuss the possibility of inventories as a supporting tool for mitigation measures/NAMAs
- To explore issues on measurability, reportability and verifiability (MRV) at various levels
- To provide an opportunity for countries in the Asian region to cooperate and share information and experiences related to their own national GHG inventories
- To support countries in Asia in improving the quality of inventories via regional information exchange (Reference: Greenhouse Gas Inventory Office of Japan (GIO), CGER, NIES (2015))

Participating countries are Cambodia, China, India, Indonesia, Japan, the Republic of Korea, Lao PDR, Malaysia, Mongolia, Myanmar, the Philippines, Singapore, Thailand and Vietnam (14 countries).

WGIAs consist of the following sessions:

- Plenary sessions
- Sectoral working group sessions
- Mutual learning sessions
- Hands-on training sessions

Basically, each WGIA consists of three of the above four sessions.

11.1.6 History of WGIA

Japan is the only Annex I Party in Asia with experience in completing the periodical GHG inventory in Asia. Since Asian cultures and climates vary greatly from those of Europe and the USA, so do the methods of estimating emissions and removals and institutional arrangements. As Japan has constructed an appropriate methodology and institutional arrangement based on Asian culture and climate, it can share its GHG inventory information through WGIA with other countries in Asia, due to their cultural and climatic similarities.

The WGIA and capacity building for measurability, reportability and verifiability were both initiated in 2003 with the aim of building capacity within Asia to develop a GHG inventory. Since its sixth meeting in 2008 (WGIA6), WGIA has been convened as a part of the "Kobe Initiative" of the G8 Environment Ministers' Meeting (Reference: Greenhouse Gas Inventory Office of Japan (GIO), CGER, NIES (2009a)).

WGIA has grown since its first meeting in 2003, from 27 participants to over 100 at WGIA7 in 2009 (Reference: Greenhouse Gas Inventory Office of Japan (GIO), CGER, NIES (2009b)) then to 130 at WGIA10 in 2012. The 2014 WGIA (WGIA12) was attended by 123 persons from 14 WGIA member countries and international organisations and is now one of the biggest climate change events in Asia. It has also received requests from countries such as Pakistan and East Timor, which are not currently members of WGIA, to attend future WGIA meetings. There is the possibility of expanding the scale of the workshop.

Table 11.3 List of host countries

Month, year	Host country	Theme
November 2003	WGIA1: Thailand	Identified problems and needs of support
February 2005	WGIA2: China	Shared information and experiences gained through inventory development
February 2006	WGIA3: Philippines	Discussed technical matters on each sector inventory
February 2007	WGIA4: Indonesia	Organised working groups and discussed sector-specific issues
September 2007	WGIA5: Malaysia	Identified needs for further inventory improvement
July 2008	WGIA6: Japan	Reaffirmed the importance of inventory development
July 2009	WGIA7: Republic of Korea	Shared information and experiences/discussed sector-specific and crosscutting issues
July 2010	WGIA8: Lao PDR	Shared information and experiences/discussed sector-specific and crosscutting issues
July 2011	WGIA9: Cambodia	Initiated "mutual learning"
July 2012	WGIA10: Vietnam	Shared information and experiences/conducted mutual learning
July 2013	WGIA11: Japan	Shared information and experiences/conducted mutual learning
August 2014	WGIA12: Thailand	Shared information and experiences/conducted mutual learning

The participating countries that acted as host countries for WGIA from 2003 to 2014 are shown in Table 11.3.

11.1.7 Contents of WGIA

1. Topics Discussed in Plenary Sessions

   The topics of discussion covered various categories on WGIA as shown below. WGIAs consist of the following sessions:

- Plenary sessions
- Sectoral working group sessions
- Mutual learning sessions
- Hands-on training sessions

Basically, as mentioned above, each WGIA consists of three of the above sessions. All participants join the plenary sessions and then choose sectoral working-group sessions as well as hands-on training sessions. Mutual learning sessions are closed sessions and are limited in participant number.

Plenary sessions deal with overall and cross-cutting issues on national GHG inventory preparation, such as data provision, institutional arrangements and introduction to countermeasures for climate change of Japan and host countries, as well as mitigation action such as NAMAs. Through discussions in the plenary sessions, participants in WGIAs share information from various data sources, which is useful for improving their inventory preparation systems.

The topics in plenary sessions were:

- Progress report on Non-Annex I Parties' national communications (NCs) shared by the UNFCCC Secretariat
- Progress of NCs and BURs in each participating country
- National systems for periodical national GHG inventory preparation
- Relationships between inventory and mitigation measures/NAMAs
- Enhancement of network for supporting measurability, reportability and verifiability (MRV)
- Quality assurance/quality control (QA/QC)
- Uncertainty assessment
- Time-series consistent estimates, etc.

In plenary sessions, UNFCCC provides information on the international framework and COP decisions. Participants welcome this presentation as cross-cutting issue such as QA/QC; UA and time-series consistency important for quality improvement of the GHG inventory are discussed.

2. Sectoral Working Group Sessions

Regarding the GHG inventory, there are many sectors and categories, such as energy, industrial process, agriculture, LULUCF (land use, land-use change and forestry) and waste. WGIAs provide the sectoral working group sessions in order to discuss particular sector-specific issues and find solutions to them. There are various issues for inventory preparation in each sector, and the sectoral working group sessions deal with sector- or category-specific issues.

Table 11.4 shows main topics containing sectoral working group sessions. The WGIA participants are government officials and inventory compilers or researchers directly involved with inventory preparation. Inventory compilers and researchers attended the breakout sessions for each expert sector or category; and government officials attended the breakout group of cross-cutting issues such as regional and/or city-level GHG inventories. Discussion of such sector-specific issues among sectoral experts is recommended in order to cover the issues thoroughly.

Table 11.4 Topics of sectoral working group sessions

	Crosscutting	Energy	Agriculture	LULUCF	Waste
WGIA6	Awareness raising of GHG inventories		Strategies to improve reliability of data	Use of remote-sensing data	Strategies to improve reliability of data
WGIA7		Statistics for energy sector	Emission factors utilized for NCs	Activity data from remote-sensing and GIS	Improvement of data collection scheme
WGIA8	Institutional arrangements for inventory preparation		Estimation methods and development of parameters	Follow up of WGIA7 (remote sensing and GIS data)	Information exchange on the current status of sectoral inventory preparation
WGIA9	Non-CO_2 gas estimation QA/QC systems	Estimation of CO_2 emissions from transport sector			Development of waste statistics
WGIA12	GHG inventory at various levels		Relationship between national GHG inventories and mitigation measures, specifically NAMAs		

3. Mutual Learning Sessions

The mutual learning (ML) session is an activity to improve the inventories of individual countries through the following processes: (1) exchanging inventories between two countries, (2) learning from a partner's inventory and (3) exchanging comments on each other's inventories. The primary purpose of ML is to improve GHG inventories by providing details of methods and data for GHG emission/removal estimation between two countries and exchanging comments on the methods and data. Studying a partner country's inventory and discussing it with its compilers provide useful information for inventory preparation and compilation. ML is also expected to foster and strengthen cooperation among GHG inventory experts in Asia. Since the aim of ML is not criticism or auditing, participants can freely communicate on a one-to-one basis as equals, rather than in one-way communication as is found with the examiner–examinee relationship (Reference: Greenhouse Gas Inventory Office of Japan (GIO), CGER, NIES (2015)).

ML was introduced to other participating countries in WGIA8 in 2010 and participants requesting mutual learning sessions between WGIA countries in the sessions of WGIA. Therefore, ML has been conducted since WGIA9 (Reference: Greenhouse Gas Inventory Office of Japan (GIO), CGER, NIES (2010)).

The ML sessions are closed sessions in order to ensure confidentiality of discussions in the sessions; only participants, chairpersons, facilitators and

rapporteurs for each ML session and the WGIA Secretariat are allowed to enter conference rooms for the sessions in principle (Reference: Greenhouse Gas Inventory Office of Japan (GIO), CGER, NIES (2015)).

Through the discussions, participants studied their partner country's methodologies for GHG emission estimations, which usually differ from their own, to receive hints on improving their own inventory. They also shared any technical issues (e.g. data collection, adoption of emission factors, national system) in order to better overcome them.

Several participants in past MLs stated that they had improved their inventory through the ML experience and in particular were able to refine their inventories before official submission to the UNFCCC such as NCs and BURs. The participants in WGIA11 acknowledged the efficacy of ML in improving their inventories and agreed that implementation of MLs should continue in future WGIAs.

In the case of WGIA12, the WGIA Secretariat notified the participants of WGIA of the ML and received applications from 29 teams from eight parties on December 2013. Considering the requirements of the applicants and an appropriate balance among sectors and feasibility of implementation, the WGIA Secretariat (GIO) organised them into pairs (Indonesia and Myanmar on energy sector, China and Mongolia on agriculture sector and Vietnam on LULUCF sector) on April 2014 (Reference: Proceedings of WGIA12 2014).

Thus, the ML sessions were conducted for the energy sector, agriculture sector and LULUCF sector, as shown in Table 11.5. Participating countries studied worksheets for emission estimates and methodology reports to estimate the emissions of partners and exchanged comments and answer sheets before the WGIA discussion. Many findings and hints to improve the GHG inventories were exchanged across the table in the session of WGIA12 in Bangkok (Reference: Greenhouse Gas Inventory Office of Japan (GIO), CGER, NIES (2015)).

Prior to WGIA12, only ten countries had attended the ML sessions. As mentioned above, ML is useful for improving one's own inventory and is considered a form of external quality assurance activity by some participants. It is hoped that more participants will join the ML sessions in future WGIA.

Table 11.5 List of countries participating in mutual learning

	Energy	Industrial processes	Agriculture	LULUCF	Waste
WGIA9	Indonesia–Mongolia			Lao PDR–Japan	Cambodia, Indonesia, RoK
WGIA10	Cambodia–Thailand	Indonesia–Japan	Indonesia–Vietnam		China–RoK
WGIA11	Lao PDR–Thailand		China–Myanmar		Malaysia–Vietnam
WGIA12	Indonesia–Myanmar		China–Mongolia	Vietnam	

Reference: Greenhouse Gas Inventory Office of Japan (GIO), CGER, NIES (2015)

Table 11.6 List of hands-on training sessions

	Topic
WGIA6	How to implement a key category analysis
WGIA7	How to fill data gaps
WGIA8	How to implement mutual learning for national GHG inventories
WGIA10	How to use the new IPCC Inventory Software (energy, industrial processes, waste)

4. Hands-On Training Sessions

Most WGIA participating countries have insufficient experience in GHG inventory preparation, especially in terms of technical issues such as key category analysis and IPCC Inventory Software. Technical issues on how to implement inventory preparation obviously need addressing with training, which is why WGIA is useful as it provides hands-on training sessions. In the sessions participants can attempt to actually implement some of the technical processes of inventory preparation.

Table 11.6 shows the topics of hands-on training sessions.

11.1.8 Latest Workshop on GHG Inventories in Asia (WGIA12), 2014

The Ministry of the Environment of Japan (MoEJ) and the National Institute for Environmental Studies (NIES) convened the WGIA as a capacity building workshop for measurability, reportability and verifiability (MRV) as a part of Japan's assistance for developing countries. Ever since 2003, the workshops have aimed at supporting Non-Annex I (NAI) Parties in Asia to develop and improve their GHG inventories.

In August 2014, the 12th workshop was held and attended by over 120 experts from 14 WGIA member countries (Cambodia, China, India, Indonesia, Japan, the Republic of Korea, Lao PDR, Malaysia, Mongolia, Myanmar, the Philippines, Thailand, Singapore and Vietnam), as well as representatives from the Secretariat of the UNFCCC, Technical Support Unit from the IPCC Task Force on National Greenhouse Gas Inventories (IPCC TFI TSU), the Regional Capacity Building Project for Sustainable National Greenhouse Gas Inventory Management Systems in Southeast Asia (SEA GHG Project), the United Nations Environment Programme (UNEP), the Food and Agriculture Organization of the United Nations (FAO), the Global Forest Observations Initiative (GFOI), the Asia-Pacific Network for Global Change Research (APN), the US Agency for International Development (USAID), the US Environmental Protection Agency (USEPA) and relevant Japanese institutes in Bangkok, Thailand.

The GIO (Secretariat of the WGIA12) both organises the programmes of WGIA, according to the needs and requests of the participants, and conducts the WGIA.

In WGIA12, the biennial update report (BUR) to be submitted by Non-Annex I countries by year end and the international consultation and analysis (ICA, part of BUR) were key topics on the discussion agenda. Also discussed were the importance of accurate GHG inventories and QA/QC activities; the importance of MRV at various levels, such as region and city levels, for verification of implementation and planning for NAMA; the necessity of consolidating stable systems of GHG inventory for applying high cost–benefit technology in the AFOLU sector; and the need to maintain ongoing correspondence with inventory compilers and researchers providing new technology.

Through WGIA12, the capacity development of participating countries for MRV and the network for BUR were enhanced, with the aim of creating BUR, conducting ICA and implementing the intended nationally determined contributions (INDCs).

WGIA 13 will be held in Indonesia, where BURs submitted by Non-Annex I Parties this year will be presented by the participants. Further, mutual learning and discussions concerning ICA will be conducted. (Reference: Greenhouse Gas Inventory Office of Japan (GIO), CGER, NIES (2015)).

11.2 Achievements of WGIA

11.2.1 Enhanced Relationships

The Workshop on Greenhouse Gas Inventories in Asia (WGIA) has been run since 2003 to provide an opportunity for countries in the Asian region to cooperate and share information and experiences related to the development of the national GHG inventory. In 2014, the WGIA12 was held in Bangkok, Thailand.

As described above, Japan, the only Annex I Party in Asia, has been sharing its experiences concerning compiling the periodical GHG inventory with WGIA participants, and the participants have been sharing information related to methodology, such as country-specific emission factors for Asian countries. Since the IPCC default emission factor was not appropriate for the climate of SE Asia, particularly for agriculture, LULUCF and waste, sharing specific regional emission factors is beneficial, and in this respect, Japanese researchers provided much data to assist in the development of regional- and country-specific emission factors. Governmental officials also shared information concerning institutional arrangements based on Asian culture, and this sharing of information ensures that the methodology and institutional arrangements of Asian countries are appropriate. Building a tighter network of Japanese researchers and Asian government officers and researchers is important for the GHG inventory, as well as for countermeasures against climate change.

As mentioned above, the first WGIA in 2003 had 27 participants, which rose to 130 in 2012. The latest WGIA (WGIA12) in 2014 had a participation of 123, from 14 WGIA member countries and international organisations in 2014. WGIA has become one of the biggest events on climate change in Asia. Requests have even been received from non-member countries, such as Pakistan and East Timor, to join future workshops. As regards the size of the event, in theory it could be scaled but could suffer due to insufficient budget or capacity of GIO, the WGIA Secretariat.

In the beginning, the main participants were researchers, and topics concerned the national system and technical issues of each expert. Recently though, the proportion of government officials attending has been increasing. At the latest WGIA, not only GHG inventory technical issues but also mitigation issues and regional- or city-level inventories were discussed. Many government officials and policymakers also evaluated measurements concerning climate change.

Further, advanced research and development on emission factors and climate change issues in Japan have also been introduced, the research of which has been helpful in creating the GHG inventory for Asian countries. The introduction of climate change research in SE Asia has enabled collaboration between Japanese researchers and local researchers in other Asian countries. Japanese researchers became aware of the needs of WGIA countries through discussions at WGIA. Furthermore, WGIA also enables government officials to access the latest information on climate change research, which illustrates the importance of the government–research relationship.

Relationships between researchers and government officials are bolstered at the GIO-held WGIA every year. Further, activities unrelated to WGIA have also been held, such as the initiation of mutual learning between Japan and Korea. Mutual learning is an opportunity to understand all the different GHG inventories and how they contribute to improving GHG inventories. Korea also mentioned that mutual learning is implemented as a form of external quality assurance in the WGIA sessions. As already described in Sect. 11.1.7, mutual learning has also been conducted between other countries in WGIA sessions every year. Lao PDR, which attended the mutual learning sessions in WGIA9 and WGIA11, also introduced a mutual learning programme that emphasises peer reviews of the LULUCF with GIO. Lao PDR commented that this enhanced both accuracy and completion of the inventory of the LULUCF sector of the Lao PDR.

WGIA is financed from a budget of the Ministry of the Environment, Japan. GIO, part of the National Institute for Environmental Studies, convened the WGIA and invites researchers to discuss the technical issues of GHG inventories free of international opinion or negotiations, an environment deliberately fostered so that researches can speak freely without being hindered by governmental or international bias. This forum for free discussion was built on a relationship of mutual trust, and as it moves from country to country every year and is not solely based in Japan, this enables host countries to participate more easily. As a result WGIA can be attended by many participants, enabling face-to-face contact crucial to carrying issues forward.

11.2.2 Sharing Information Such as Sector-Specific Issues and General Issues of GHG Inventory

1. International Negotiation

TSU and UNFCCC have attended WGIA since its inception, where they continue to disseminate information on the status of international negotiations and UNFCCC mandates based on the latest information on COP. WGIA also gave government officials a chance to catch up on progress in international negotiations, and the Q&A session provides a chance to better understand institutional arrangements and policy measures.

In the actual workshop, Japan and the host countries introduce countermeasures individually taken for climate change and participating countries share their NCs. Through such presentations, progress in countermeasures for climate change of WGIA countries—which share similar climatic, international position and economic circumstances—can be shared, thus clarifying the status of each country. WGIA is thus an effective means by which to evaluate the results of policy.

2. Sharing of Information and Experience

In WGIA, current internationally relevant information and estimation methodology are discussed, which benefits other countries. Further, common problems and possible solutions are identified.

11.2.2.1 Estimation of Time-Series GHG Emissions/Removals

Mongolia estimated its annual time-series GHG emissions and removals from 1990 to 2006, as can be found at http://www-gio.nies.go.jp/wgia/wg7/pdf/4.2.5.%20Dorjpurev%20Jargal.pdf

Thailand estimated its quadrennial time-series GHG emissions and removals from 1990 to 2003, as well as annual time-series GHG emissions excluding LULUCF from 2000 to 2005, which can be found at http://www-gio.nies.go.jp/wgia/wg7/pdf/4.2.6.%20Sirintronthep%20Towprayoon.pdf http://www-gio.nies.go.jp/wgia/wg6/pdf/3-3%20Sirintornthep%20Towprayoon.pdf

Indonesia estimated its annual time-series GHG emissions and removals from 2000 to 2005, as follows: http://www-gio.nies.go.jp/wgia/wg7/pdf/4.2.7.%20Rizaldi%20Boer.pdf

11.2.2.2 Development of Country-Specific Emission Factors

China developed country-specific emission factors for CH_4 emissions from paddy fields and N_2O emissions from cropland, which can be found at:

http://www-gio.nies.go.jp/wgia/wg10/pdf/2-2_5_AFOLU_China.pdf

India developed country-specific emission factors for CH_4 emissions from enteric fermentation by ruminant animals and N_2O emissions from agricultural soils:

http://www-gio.nies.go.jp/wgia/wg8/pdf/3-wg2-3_sultan_singh.pdf
http://www-gio.nies.go.jp/wgia/wg8/pdf/3-wg2-5_chhemendra_sharma.pdf

Indonesia developed country-specific emission factors for CH_4 emissions from rice cultivation:

http://www-gio.nies.go.jp/wgia/wg7/pdf/4.2.7.%20Rizaldi%20Boer.pdf

11.2.2.3 Establishment of National Systems for National GHG Inventory Preparation

Mongolia appointed the National Agency for Meteorology, Hydrology and Environment Monitoring as its designated professional authority for national GHG inventory preparation and structured its national system, in which the agency plays the central function, information on which can be found at:

http://www-gio.nies.go.jp/wgia/wg8/pdf/3-wg1-2_batimaa_punsalmaa.pdf

Korea established the GHG Inventory & Research Center of Korea (GIR) and improved existing national system by entrusting the GIR to act as central coordinator, as explained at:

http://www-gio.nies.go.jp/wgia/wg7/pdf/4.1.5.%20Jang-won%20Lee.pdf
http://www-gio.nies.go.jp/wgia/wg9/pdf/3-wg4-4_mihyeon_lee.pdf

Indonesia enacted Presidential Regulation 71/2011 as the foundation for Indonesian GHG inventory preparation and established a national GHG inventory system; see the following for more details:

http://www-gio.nies.go.jp/wgia/wg10/pdf/3_1.pdf

11.2.2.4 Development of Quality Assurance/Quality Control (QA/QC) System

Mongolia established a QA/QC plan for energy and industrial process sector, as explained at:

http://www-gio.nies.go.jp/wgia/wg9/pdf/3-wg4-3_dorjpurev_jargal.pdf

Korea developed a QA/QC system for the waste sector and applied bilateral peer reviews its GHG inventory with Japan as one of its QA activities, as explained at:

http://www-gio.nies.go.jp/wgia/wg9/pdf/3-wg4-4_mihyeon_lee.pdf

11.2.3 Related Activities and International Cooperation

1. SEA Project

The Regional Capacity Building for Sustainable National Greenhouse Gas Inventory

Management System in Southeast Asia (SEA GHG Project) was held back to back with WGIA every year. The project is ran with the UNFCCC as the lead agency and in collaboration with US Environmental Protection Agency (US EPA), US Agency for International Development (USAID), Colorado State University (CSU), Workshop on GHG Inventories in Asia (WGIA (GIO/NIES)) and USAID Low Emissions Asian Development (LEAD) programme. The participants of the SEA GHG Project and WGIA have the same aim, and holding similar activities at the same time has a synergistic effect for the relevant parties.

The aim of the SEA GHG Project meeting is to provide updates and feedback with SEA participating countries of their current status, gaps, challenges, barriers and capacity building needs (or technical assistance) in developing national GHG inventories for the third national communication (NC3) and first biennial update report (BUR1). There was also much feedback to WGIA.

2. Participation from USAID, USEPA and AusAID

The participants of WGIA are not only WGIA members—the US Environmental Protection Agency (USEPA), US Agency for International Development (USAID) and the Australian Agency for International Development (AusAID) have also attended. WGIA enables sharing of information on many donors' progress and the needs of the WGIA countries, which assists in coordination. The USA has conducted some projects, such as the SEA project, USAID Low Emissions Asian Development programme (LEAD programme) in Southeast Asia. Australia conducted a study tour for GHG improvement with Indonesia's government, which involved visiting facilities related to application of countermeasures for climate change through the WGIA network.

3. Mutual Learning Between Japan and Korea

The mutual learning between Japan and Korea is the first activity not involving WGIA and was held on the waste sector between GIO and Korea Environment Corporation (KECO) in the annual workshop in Korea in 2008. Korea's GHG inventory compiler invited Japan's counterpart to review its waste sector in terms of GHG inventory. Such mutual learning is a two-way process and does not involve one-way communication such as is found in the examiner–examinee relationship. As such, Japan checked Korean GHG inventories, but also Korea checked Japanese GHG inventories and gave Japan some comments. The comments from Korea contributed to improve the transparency of Japanese GHG inventories. The second mutual learning was held on the waste sector between Japan and Korea in Japan in 2009, and the third mutual learning was held on all sectors between Japan and Korea in Korea in 2010. Many findings resulted, which were not subjected to the

UNFCCC review, and thus also contributed to improved transparency of each other's GHG inventories.

The Secretariat of WGIA introduced this activity in WGIA8 in 2010. With the agreement of the participants, ML has been held in the WGIAs that followed as one of the sessions. For Non-Annex I Parties not mandated to be reviewed by UNFCCC, no particular attention needs to be paid to GHG inventories after submission. Previously, Non-Annex I Parties had never studied another's GHG inventories, which is where mutual learning provides an opportunity to study and learn from others' GHG inventories, which contributes to overall improvement of a country's own GHG inventories. Emission factors which other countries have developed and implemented to improve their GHG inventories, as well as issues concerning institutional arrangements which other countries face, and so on can be shared via ML. After ML, Non-Annex I Parties recognised the need both for the information in order to compile their own GHG inventories and the information on other countries, for comparison. Transparency and comparability are thus improved, and such findings lead to overall improvements in the GHG inventory.

4. Mutual Learning Plays a Role as External Quality Assurance (Korea and Lao PDR)

Korea, which is not included in Annex I Parties, does not have a responsibility to be reviewed by UNFCCC. And, as mutual learning does not employ any procedures such as UNFCCC reviews and only uses intercountry evaluations, it improves GHG inventories across the board. Korea implemented mutual learning as a form of external quality assurance in the WGIA sessions. Lao PDR, which attended the mutual learning sessions WGIA9 and WGIA11, also introduced mutual learning as a programme that emphasises peer reviews of the LULUCF with GIO. Lao PDR commented that this enhanced the accuracy and completion of the inventory of the LULUCF sector of Lao PDR.

5. Similarity Between Mutual Learning and International Consultation and Analysis (ICA) Procedure

Mutual learning involves "reading" a partner's GHG inventories in detail and studying other GHG inventories of other countries. As described above, mutual learning plays a role in the form of external quality assurance. In other respects, the ICA process of BUR is similar to quality assurance in that it is conducted by a third party, although it may not be regarded as quality assurance. ICA provides Non-Annex I Parties which lack sufficient human resources of quality assurance new opportunities to improve the quality of their GHG inventories

Mutual learning, just like ICA, contributes to improved transparency and comparability to evaluate the country-specific emission factors developed.

6. Cooperation with JICA Projects

GIO has collaborated with the Japan International Cooperation Agency (JICA) to build the capacity required to conduct periodical GHG inventories of developing countries. Projects have been implemented in Vietnam, Indonesia and Thailand to

date. GIO provides leaning of technical issues of GHG inventories and has formed a relationship between JICA officers, GHG inventory compilers and expert WGIA participants. An author of this paper worked in a project in JICA Indonesia named Project of Capacity Development for Climate Change Strategies in Indonesia and lived in Indonesia for 2 years. The Ministry of Environment of Indonesia was well acquainted with GIO and respected GIO's experience and capacity. Making GHG inventories requires a great deal of networking and good connections, such as with ministries and researchers, as such can enable work to proceed smoothly.

In 2014, the Workshop on Capacity Development on Greenhouse Gas Inventory in the Southeast Asia Region entitled "How can CITC break through GHG inventory barriers?" was held as a back-to-back session of WGIA12, and GIO supported Climate Change International Technical and Training Center (CITC) and Thailand Greenhouse Gas Management Organization (a public organisation). This event represented the launch pad for CITC, and many participants of WGIA12 remained afterwards to attend this event. CITC is a training centre for other developing countries and was established by TGO as part of south–south cooperation.

11.2.4 Networks

1. South–South Cooperation: Thai–Myanmar Co-learning

A study visit of Myanmar's inventory compilers to Thailand for sharing information on measurement methodologies on the agriculture sector was held via the WGIA network. In the visit Myanmar learnt about measurement of GHG emissions from crop residue burning and rice straw burning from a Thai academic. Therefore, intercountry cooperation between neighbouring Non-Annex I Parties with similar socioeconomic or climatic conditions enhances regional cooperation and improves both parties' national GHG inventories.

2. Mutual Learning Between Australia and Indonesia

In 2012, Australia conducted a study tour for GHG improvement, which involved inviting Indonesia's government to observe a facility applying climate change countermeasures. In return, Indonesia's government invited Australia to check its GHG inventory in Indonesia. This is called mutual learning. The idea and importance of mutual learning to improve the quality of the GHG inventory originated at WGIA. Australia and Indonesia have communicated through the WGIA network.

3. Cooperation with Asia-Pacific Integrated Model (AIM)

GIO is part of the National Institute for Environmental Studies (NIES). A further Asian-related research team exists within NIES—the Asia-Pacific Integrated Model (AIM) team. The AIM team is involved with predictions of GHG emissions. The GHG inventory itself provides the key data needed for policy development to

identify the major sectors, and the data in the inventory is also needed for prediction of GHG emissions and removals. The function of GHG emission predictions is one of the key benefits of the GHG inventory; thus, the AIM team is invited to the WGIA every year.

Many government officials who perform policy development attend WGIA as they need information on GHG emission predictions. Further, in developing countries, many GHG inventory compilers and experts are also in charge of policymaking and prediction of GHG emissions; thus, the one-workshop discussion covering GHG inventory and prediction is very useful for them.

Furthermore, participants from Myanmar requested GIO to introduce AIM team to them in order to learn more about prediction of GHG emissions. WGIA is thus the hub of Asia's climate change network.

11.2.5 Achievements

WGIA has produced several publications, as below:

- Promoted WGIA activities at a side event of SB24, COP15, COP19 and COP20
- Published a WGIA activity report "Greenhouse Gas Inventory Development in Asia – Experiences from Workshops on Greenhouse Gas Inventories in Asia"
  - (a summary report of 1st–4th WGIA)
- Proceedings of every WGIA

11.3 Other activities of WGIA

11.3.1 Website and Mailing List

In order to share and archive the information, GIO developed a website which is updated by workshops. PDF files of presentations given at the workshop and proceedings of WGIA can be downloaded for each year. These documents contain valuable and unique information and are thus downloaded all over the world, especially the information on least-developed countries. Documents for downloading can be found at the link below:

http://www-gio.nies.go.jp/wgia/wgiaindex-e.html

A mailing list of persons related to GHG inventory in Asian countries is prepared and managed by GIO. This mailing list is used to announce COP events and other international meetings. If participants wish to distribute information, such as conferences and events in COP, this can be done so via WGIA-Mailing List. Information exchanged through WGIA-Mailing List may be posted on the WGIA

website for public access if so requested or considered useful. Also, the WGIA network platform can be used in parallel with other existing network platforms to complement them and should not be regarded as a replacement or competitor.

11.3.1.1 Brief Background Information on WGIA-Mailing List

The Greenhouse Gas Inventory Office of Japan (GIO) at the National Institute for Environmental Studies (NIES) developed the WGIA-Mailing List to serve as a primary support channel and to provide an opportunity for the WGIA community to share experience, knowledge and resources, voice concerns, seek advice and discuss topics of interest related to greenhouse gas inventories.

This is an initiative established for the WGIA community as an online regional network platform that all may take full advantage of through participation, according to the conclusions reached at Session III "Networking Experts in Region" at WGIA5. Currently, all participants in each WGIA subscribe to this mailing list.

11.3.2 WGIA-EFDB (Emission Factors Database)

In WGIA, participants share their experience with a focus on the estimation methods used in the GHG inventories, key category analysis and ways to address the problems faced in GHG inventory preparation and development to date.

In WGIA5, 2007, participants noted the utility of continuous and improved networking with stakeholders. Malaysia, Cambodia and Indonesia stated that a continuous database of emission factors for GHG inventory was needed. At that time no system for collecting GHG inventory data, such as activity data and emission factors, existed in developing countries. In Asia, some countries used emission factors of neighbouring countries with similar climate conditions, but there was no system or means by which to share such information. There was, therefore, a broad-based opinion concerning the need to develop a database for emission factors in order to share country-specific emission factors developed by WGIA participants.

Since WGIA7, GIO has collected a number of papers presenting country-specific emission factors developed for the various sectors. These values should be integrated in the Emission Factors Database (EFDB) being developed for the region.

One of the activities for the sectoral working group workshop during WGIA6 was to analyse data entered into the EFDB by closely scrutinising what environmental conditions, management practices or specific circumstances were developed for the EF. This meant that experts could discuss if an EF developed for another country may be "applicable" or "appropriate" for use in their own inventory. In this regard, experts could include, via adding remarks at the time of data entry in the EFDB, details as to what countries are "appropriate" for use of the EF factors, which would help other GHG inventory staff in the various countries in the region.

11.4 Conclusions

11.4.1 Importance of Ongoing, Face-to-Face Discussions

The Workshop on Greenhouse Gas Inventories in Asia (WGIA) has taken place annually since 2003 to provide an opportunity for countries in the Asian region to cooperate and share information and experience related to the development of national GHG inventories. WGIA is organised by GIO, a sustainable organisation. The 12th WGIA was held in Bangkok, Thailand, in 2014. Workshops were held in various host countries, as this leads to more attendees participating from Asian countries and enables more face-to-face discussion. The number of WGIA participants increased from 27 in 2003 to 130 in 2012. The latest WGIA (WGIA12) had an attendance of 123 from 14 WGIA member countries and international organisations in 2014. WGIA has become one of the biggest events for climate change in Asia. Through this ongoing face-to-face workshop, mutual trust among participants has been built.

11.4.2 Sharing of Information and Experience

In WGIA, the latest information and estimation methodologies are discussed, providing an opportunity for other countries to learn. Common problems and possible solutions are identified. This information helps participants compile transparent, accurate, time-series continuous, comparable and continuous GHG inventories. Many countries have overcome common problems and some countries have already developed country-specific emission factors, time-series GHG emission estimations and national systems as a result.

11.4.3 Network Utilisation

The WGIA network platform was established to exchange information on climate change and mitigation of GHG emissions as well as GHG inventory. WGIA's key function is to connect other activities among participants and Japan and also facilitate international cooperation; many collaborative activities, such as the SEA GHG Project, USAID, USEPA, AusAID as well as instances of mutual learning, have taken place as a result.

11.4.4 Continuity of WGIA

One of the reasons why WGIA can continue is its sustainability as an organisation (GIO/NIES). In addition, although the first workshop was just a small meeting, it has since grown, step by step, into something much larger. This environment of free discussion has built relationships of mutual trust among the participants. Holding WGIA every year has been enabled by the mutual trust built among and by the participating countries

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Chapter 12
Japan's Comprehensive and Continual Support Package for the Creation of Scientific Climate Policies in Asia

Tomoko Ishikawa and Shuzo Nishioka

Abstract The response to climate change is a matter of increasing urgency, and from 2020, every nation will be required to reduce its GHGs. The unified reduction policies of the central governments of each country form the core of reduction policy implementation. Actual reductions are planned and implemented for each region and sector. As climate policies are strongly related to the development strategies and energy policies of each country, it is thus necessary for each country to independently mobilise knowledge to formulate strategies and policies based on domestic natural and developmental conditions.

The response to climate change has brought about a major turning point in modern civilisation, which was founded, and yet is still heavily dependent on fossil fuel energy. As Asian countries are currently in a period of strong growth, Asia as a whole must set a course towards low-carbon development that differs from the paths taken to date by developed industrialised countries. Science-based initiatives are indispensable to the formulation of climate policies, and in order for individual countries to frame policies and maintain ownership of them, scientific bases will, respectively, need to be created by each country.

From 2020, part of all-country participation in climate change mitigation entails INDCs (Intended Nationally Determined Contributions) be formulated. It is here that the achievements of a series of scientific cooperation projects promoted in the Asian region by the Government of Japan, in particular the Japanese Ministry of the Environment, can fully be appreciated.

Reducing GHG via scientific policymaking involves following the sequence of reduction target setting, reduction policy design, policy implementation, continuation and feedback (see Fig. 12.2). In order to carry this out, it is necessary to (1) ascertain GHG emission volumes for all processes (GHG inventories); (2) establish approaches to create unified climate policies for central and local governments (technologies, energy and GHG policy integrated assessment model, IAM); and (3) develop mechanisms to foster related research communities and strengthen

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contributions therefrom to policy formulation (e.g. via strategic research programmes, fora for dialogue on policy and science).

In light of the growing importance of Asia in terms of global climate policy, the Government of Japan, together with other Asian countries, has promoted the creation of such scientific bases since the 1980s. These efforts have significantly assisted in policy formulation, including INDCs, in Asian nations. Further, the Low Carbon Asia Research Network (LoCARNet), comprising researchers directly engaged in climate policymaking processes in each country, was launched in 2012 in view of the rise in urgency of climate policy. LoCARNet has since organised relevant research communities based on ownership in each country to engage in the challenge of low-carbon development in Asia by facilitating knowledge sharing and cooperation throughout the Asian region.

Section 12.1 of this report describes the cooperation between Government of Japan and other Asian countries. Section 12.2 introduces in particular the activities of LoCARNet towards building research communities to promote concrete actions from 2020 as good practices to be disseminated throughout the world.

Keywords LoCARNet • Ministry of Environment of Japan • Scientific policymaking • Integrated assessment model • PDCA • Regional South-South-North Collaboration

Key Message to Policy Makers

- Asia holds the key to global climate stability.
- Science-based initiatives are indispensable to the formulation of climate policies.
- Government of Japan has promoted the creation of scientific bases in Asia since the 1980s, which has aided in formulating policy, including INDCs in Asian nations.
- LoCARNet has organised relevant research communities based on ownership in each country, to engage in the challenge of low-carbon development in Asia.

It is hoped Asia will take lead the way in a global transition to low-carbon societies, by establishing and implementing science-based policies.

12.1 Japan's Strategies to Support Scientific Climate Policymaking in Asia

12.1.1 Scope of Scientific Climate Policy

12.1.1.1 Scientific Context for Climate Policy

Based on observation results and model predictions, in the Fifth Assessment Report of the IPCC (AR5), Working Group I deemed that cumulative anthropogenic GHG emissions and global temperature increase have a proportional relationship (Fig. 12.1) (IPCC 2013: Summary for Policymakers. In Climate Change 2013: The Physical Science basis, p. 28). Carbon cycle research has shown that almost half of anthropogenic GHGs emitted are not absorbed and remain in the atmosphere. As the atmospheric lifetime of CO_2, which accounts for the majority of GHG, is thought to be more than 100 years, as long as emissions continue, the amount of CO_2 remaining in the atmosphere can only continue to rise. According to global warming theory, a rise in atmospheric concentration of GHGs directly results in a rise in temperature; therefore, as long as human-induced GHG emissions continue, so will the rise in global atmospheric temperature.

It is precisely because of the proportional relationship described above that we now face a critical issue—which is that whatever the temperature rise compared with the pre-industrial figure is, human-induced emissions must be brought to zero when such temperature is reached in order to stabilise climate. Ultimately, this means we must create a zero-emission world.

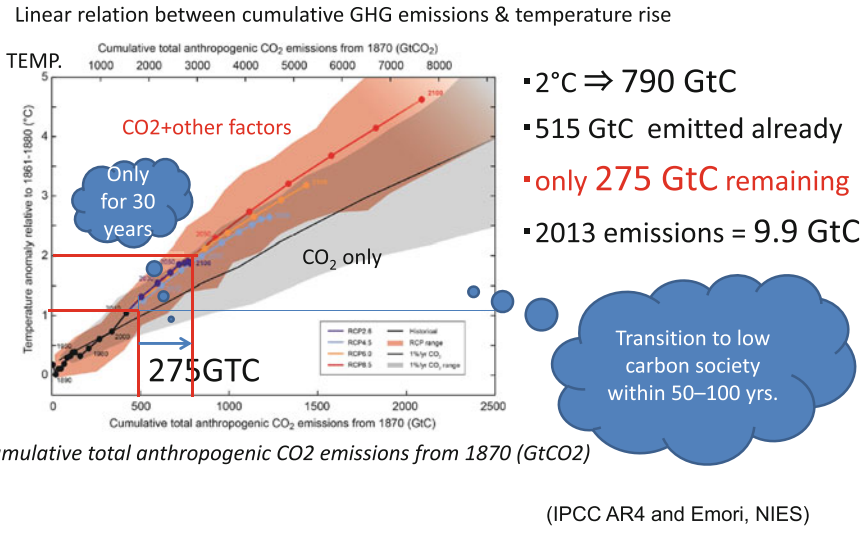

Fig. 12.1 Zero emission is the ultimate solution to stabilise climate

Agreements were reached at the G8 summit and UNFCCC COP16 (Cancun Agreements) of 2010 on a policy objective to limit the temperature rise to two degrees over pre-industrial levels, based on Article 2, 'Objective', of the Framework Convention on Climate Change, which calls for 'a level that would prevent dangerous anthropogenic interference with the climate system'. If the cumulative emissions corresponding to 2 °C are read from the IPCC/AR5 proportional graph, from which the cumulative anthropogenic emissions already released to date are subtracted, the amount of emissions permissible for a 2 °C increase is no more than around 30 years' worth of global emissions based on the emissions for 2010. Under these circumstances, the mission of the current generation should therefore be to be as frugal with this limited allowance as possible and, while evolving through the required stage of low-carbon society before this 'emissions budget' is used up (likely 50 to 100 years), also aim to create a zero-emission society for the whole world. The IPCC Working Group III has indicated the feasible emission pathway, namely, one that would reduce current global emissions (40 billion tonnes CO_2 equivalent) to half (20 billion) by 2050 (IPCC 2014: Summary for Policymakers. Working group III: Mitigation of Climate Change, p. 11).

If this 20 billion tonne allowance is distributed according to the projected population in 2050 of 10 billion, per capita CO_2 emissions are calculated to be about 2 tonnes. However, the reality is that per capita emissions have already topped 17 tonnes in the United States, 9 in Japan, 5.5 in China, 3 in Thailand, 1.6 in Indonesia and 1.4 in India. These figures reveal that almost all of these countries need to draw up policies to reduce GHG emissions. This represents a major transition challenge for developed countries, which were founded on, and at the same time are struggling to be free from lock-in of highly energy-consuming technologies, as they will need to overhaul their social infrastructure to one based on low-carbon society. Conversely, the major challenge for developing countries is their need to discover new, low-carbon development pathways that leapfrog over those utilised by developed countries to date.

12.1.1.2 Scope and Processes of Policy and Scientific Basis

What kinds of policies are needed when confronted with a major transition to a low-carbon world as described above? As energy policy is at the core of GHG emission reduction policy, it goes without saying that controls on energy consumption and a change in the structure of primary energy supply are required. However, policy cannot stop there—transitions are required in all sectors related to consumption and supply, including cities, land use, residential, transport and industry. The various sectors that must be covered by climate policy are indeed wide-ranging.

Formulation of long-term climate mitigation policies is carried out with the GHG emission reduction as an axis following the procedures shown in the middle of the figure below (Fig. 12.2): target setting, policy formulation, policy evaluation, monitoring of implementation results and feedback on the policy overall.

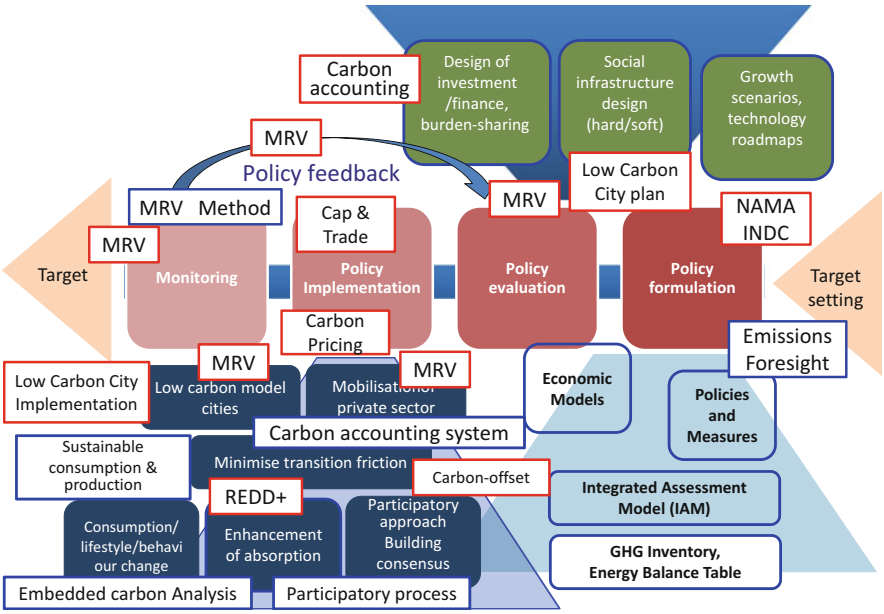

Fig. 12.2 Climate policy sequence and scientific support tools

Reduction targets are often decided a priori, as international agreements of the UNFCCC (e.g. reduction targets of the Kyoto Protocol) or as decisions by top management (e.g. the 26/41 % reductions of former President Yudhoyono of Indonesia). Leading up to these decisions are deliberations on approximate reduction outlooks and setting of rough targets based on such. When the world shifts its gaze in the direction of low-carbon society, as discussed above, the 2 tonne CO_2 per capita by 2050 figure will constitute a solid basis for reduction targets.

Subsequently, emission reduction scenarios based on reduction targets are needed. Based on economic growth rates and demographics, the necessary amount of services by sector for continuation of conventional policy (BaU: Business as Usual) and the energy needed to enable these services are calculated. These figures are then cross-referenced with the appropriate primary energy utilising an energy balance table, and then by multiplying GHG emissions per unit of primary energy, the GHG emissions for the entire nation can be calculated. Determining volumes of various activities mainly uses statistical data, and if the amount of energy per unit of activity and the amount of GHG generated per unit of energy are known, GHG emissions can be estimated. In sum, this series of estimations, termed 'inventory computation', is the bedrock for science-based climate policy.

These consolidated inventories as described above are made for each sector. In order to maintain consistency amongst sectors and create an integrated policy scenario, the Integrated Assessment Model (IAM) is indispensable. Included in this model group are the energy technology list and the GHG emission reduction

cost curve covering all technologies, allowing for calculation of additional investment amounts for the entirety of reduction policies and overall costs.

A range of measures are available to bring the BaU emissions calculated in this matter closer to the reduction target amount, including regulatory methods such as establishing emission caps by sector and economic methods, including a carbon tax. With the application of such policy instruments, the system of reduction policy is determined (see Fig. 12.2, bottom right). The resulting investment cost in the necessary infrastructure based on the overall reduction plan can be estimated (see Fig. 12.2, top right).

These measures are then evaluated according to their impact on long-term economic growth via CGE (Computable General Equilibrium) modelling, and efforts are made to coordinate them with higher level plans.

Measures to implement policies are entrusted to the parties involved in actual reductions (stakeholders), such as municipal and local governments, industries and citizens. Reduction measures are advanced in respect of actual situations; local governments execute them via city planning and administration, and rural villages do so through forest and land-use plans. Likewise, reform in industrial structure, resource efficiency in manufacturing and distribution in the industrial sector and energy conservation measures for offices and households take place. Measures in civil society include rational consumption—consumption based on maximised utility or benefit of products or services.

The PDCA (plan, do, check and action) assessment cycle is applied to the whole process; results of actions by each stakeholder group are consolidated periodically to undergo MRV (measurement, reporting and verification), whereby feedback is given on reinforcement of measures and changes to plans. Through PDCA, inventories and integrated assessment models used in the early stages of planning are effectively utilised as criteria to determine efficacy.

The above illustrates how substantial the scientific base is required to be for GHG reduction policy development. This base includes GHG inventories, policy formation based on integrated assessment models, economic assessment methods for policy, knowledge on policy formation and infrastructure building at the city level, calculation of resource efficiency by Life Cycle Assessment (LCA) methods and analysis of public behaviour. Further, as geographical, economic, resource and political factors vary across the region, so do the required scientific bases; therefore, each and every country needs to create domestic climate policies by fostering domestic research communities in order to realise scientific bases in accordance with domestic environments.

According to IPCC AR5, climate change is already progressing, and its impacts are evident around the world. Some countries have already been affected and have initiated adaptation activities. This makes the need to share scientific knowledge all the more important, not only in terms of mitigation but also adaptation.

12.1.2 Japan's Support for Climate Policies in Asia

12.1.2.1 Japan's Policy on Asian Cooperation

In the Business as Usual (BaU) case, Asia is expected to account for half the world's economy, energy consumption and GHG emissions by the year 2050, thus the region holds the key to global climate policy in both aspects of GHG emission reduction and adaptation.

Japan, with its strong ties to neighbouring countries in Asia, both geographically, culturally, historically and economically, has since the 1980s actively and continuously carried out initiatives in knowledge sharing to form scientific bases for climate change policy formulation. These efforts have already born fruit in Asia's developing countries and in the national communications and Biennial Update Reports (BUR) submitted to the UNFCCC. A strong foundation has also been laid for preparation of Nationally Appropriate Mitigation Actions (NAMA) and Intended Nationally Determined Contributions (INDCs), which are to start in 2015.

Japan's stance on climate change can be summed up in the following five principles: (1) adherence to international polluter pays principle (PPP), upholding Japan's responsibility; (2) active contribution as Environmental Nation, contributions that capitalise on Japan's capabilities in environmental protection; (3) full respect for partner's autonomy, support for self-reliance and autonomous environmental management of other countries; (4) contribution to global environmental diplomacy, exercising leadership in the environmental arena; and (5) positive facilitation of international agreements, preparing frameworks for international policy agreements.

The above five principles for action were discussed in the COSMO Plan (Nishioka, S., 1990: Policy scientific insight required for responding to Global Warming, Environmental Research Quarterly No. 77, January 1990, 14–20 (in Japanese)) in early 1990 (Comprehensive Strategies for Moderating Global Warming plan). Likewise, cooperation with other Asian nations on climate policy and support for policy formulation based on individual respective country ownership are also part of Japan's basic stance.

Japan's cooperation is based on forward thinking and long-term capacity building through sharing of scientific knowledge and world affairs, preparation of inventories, support for policy formulation and human resource development in science and policy. To such end, Japan believes countries in Asia should not rely on foreign consulting bodies and instead take ownership of policy formulation, based on the conviction that this will lead to enduring low-carbon development in Asia. This support from Japan has been acknowledged by Asian nations to date and has bestowed bonds of trust.

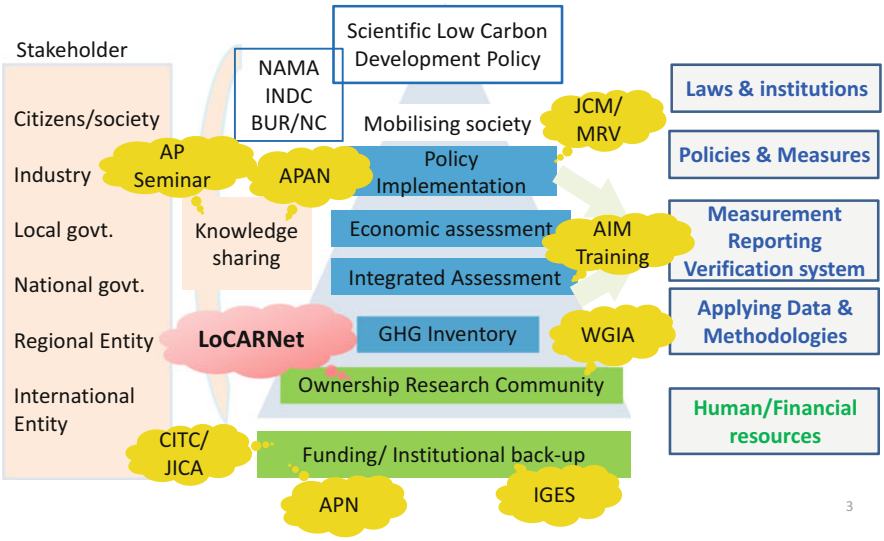

Fig. 12.3 Elements supporting scientific low-carbon development policy and Japanese collaboration with Asian countries

12.1.2.2 Support for Comprehensive, Continual and Systematic Creation of Science-Based Policies

The Ministry of the Environment of Japan has maintained, without interruption, its support for systematic science-based policy formulation in the Asian region, embracing all fields related to climate change (Fig. 12.3) (Table 12.1).

Climate change first caught the attention of science in the late 1970s, and in 1988, the IPCC was formed to evaluate its scientific aspects. In 1989, the Government of Japan held the 'Tokyo Conference on the Global Environment', which brought together experts from around the world to deliberate on how Japan would contribute to preserving the global environment and, in particular, how it could contribute to the climate change issue. While this event was over two decades ago, strong growth in Asia had already been anticipated at the time. Japan, with its strong ties in Asia, thus set out to form a system of technological and scientific cooperation based on the symbiotic viewpoint of mutual benefit.

Shared Recognition of Global Trends in Science and Policy Based on the fact that climate change is caused by human interference with nature, responses must begin by firstly deciphering what is happening in the natural environment and then sharing this insight—scientific knowledge. This is just what Japan did, as immediately after the release of the first IPCC report in 1990, GoJ launched the 'Asia-Pacific Seminar on Climate Change' for knowledge-sharing amongst Asian nations. The meeting, which convened environment policymakers from several Asian countries, was jointly sponsored by UNEP/UNCRD and included Chairman Bolin of the IPCC, as well as Chairman Izrael and Vice-Chairman Hashimoto of Working

Table 12.1 Japan's comprehensive, continuous and systematic support for science-based climate policy development in Asia

Objectives	Activities	Contents	Est. since		Outputs
Knowledge sharing	Tokyo Conference on the Global Environment and Human Response toward Sustainable Development (UNEP and Japanese Govt.)	Advisory meeting on global climate change	1989		
	Asia-Pacific Seminar on Climate Change (AP Seminar)	Knowledge sharing on IPCC results and UNFCCC progress	1991–	23rd meeting in 2014	Approx. 800 participants in total
		Support for developing plans addressing CC		Rotating presidency	
Formulation of basic grounds in research	The Asia-Pacific Network for Global Change Research (APN)	Promoting joint research and capacity development in Asia	1996–	Funds: 400 million yen (includes 120 million yen for new CAF projects in 2014)	Approx. 225 projects
		Low-carbon initiatives			
Common research funds		Climate adaptation framework			
	Institute for Global Environmental Strategies (IGES)	(Approx. 100 researchers)	1998	Constant research	White Paper, ISAP (annual conference).
		IPCC/NGGI/TSU	1999	Global standard	
	Activities as Regional/International Environment Research organisation at the initiative of PM in Japan				Many joint researches in Asia
Capacity development in forming the basis of climate policy	Workshop on Greenhouse Gas Inventories in Asia (WGIA)	Improving accuracy of GHG inventories in Asia	2003–	Annual meeting	Approx. 900 participants in total
		Sharing knowledge and experience amongst researchers and policymakers		12 times in total	
		Promoting regional cooperation			

(continued)

Table 12.1 (continued)

Objectives	Activities	Contents	Est. since		Outputs
	Asian Pacific Integrated Model (AIM) Int'l WS/Training workshop	Training on integrated models for developing climate mitigation policies	1995–	19 times (annually)/irregular, more than ten times	Approx. 500+ participants in total/ Approx. 100+ in total
			1997–		
		Organised by NIES and Kyoto Univ.			
	Asia Pacific Adaptation Network (APAN)	Asia-Pacific Climate Change Adaptation Forum	2009–	Biennial meeting	Approx. 1850 participants (First–third forum)
		Subregional/thematic meetings by APAN nodes			
	Low Carbon Asia Research Network (LoCARNet)	Formulating research community, policy dialogues between researchers and policymakers on climate policy, knowledge sharing	2012–	Third Annual Meeting in 2014	Approx. 250 participants
				20+ WSs	~800 part
Climate policy and technical training	Support for the Climate Change International Technical and Training Centre	Training on climate policies for policymakers in central/local govt., practitioners, businesses mainly in ASEAN countries	2014–	Starting from Oct. 2014	
	(CITC Thailand)				
		TGO established CITC by receiving support from JICA			

Group II. Following UNFCCC establishment, this seminar has focused not only on science and continues to function as a forum for knowledge exchange amongst Asia's climate change policymakers and related international organisations on responses to the UNFCCC. Meetings rotate within Asian nations and the 23rd was held in 2014.

A Permanent Research-Dedicated Institution to Lead Environmental Research in Asia Under a prime ministerial initiative after the 1992 Earth Summit in Rio de Janeiro, the Institute for Global Environmental Strategies (IGES) was established in 1998. IGES is an institute dedicated to conducting research on environmental issues in Asia. With a staff of about 200, including researchers from both within and outside Asia and management, it operates to maintain the various cooperative research networks and implement research activities that are mainly focused on Asia.

Sharing Scientific Bases for Policymaking As shown in Fig. 12.2, a substantial amount of scientific data and assessment methodologies are required for policymaking in response to climate change. Of such, accurate ascertainment of GHG emissions and inventory work are particularly important. In recognition of this—and of the importance of setting fundamental processes at an early stage—GoJ, upon the request of the IPCC, established the Technical Support Unit (TSU) of the IPCC Task Force on National Greenhouse Gas Inventories at IGES in 1999. The IGES research units, in cooperation with the IPCC TSU and researchers from other Asian nations, led the task of amassing emission factors for Asia's unique forest soil and rice fields. In 2002, the Greenhouse Gas Inventory Office of Japan (GIO) was established in the National Institute for Environmental Studies (NIES). Using this office as a base, GoJ, in cooperation with IPCC TSU and the UNFCCC, launched the 'Workshop on Greenhouse Gas Inventories in Asia (WGIA)' in order to build capacity with the goal of ascertaining of GHG emissions throughout Asia. This workshop, which is hosted in a round-robin fashion by Asian countries, pairs up policymakers and researchers to form research communities that can maintain scientific accuracy over the long term. The latest data shared at the workshops is also reflected in national communications and policy formation in each country. The year 2014 marked the 13th year of this workshop, and since 2013, when BUR became obligatory, it has attracted over 120 delegates. These workshops have greatly contributed to estimating GHG emissions in Asia based on sharing of QA/QC methods and mutual learning.

Consistent Support for Policy Formulation Based on Integrated Assessment Models The application of integrated assessment models is indispensable in refining and coalescing the ideas of disparate ministries and agencies into consistent plans and policies for individual countries, including NAMAs and INDCs. The National Institute for Environmental Studies and Kyoto University began developing the Asia-Pacific Integrated Model (AIM) for climate policy in 1990, the goal of which is to promote its use in Asian countries, and joint research with China and India has taken place. Based on five years of research from 2004, this model is at

present used in the drafting of Japan's plan for a low-carbon society. With the target of applying the model to ASEAN countries via 'Low Carbon Asia Research' from 2009, annual AIM Symposiums have been held jointly with researchers from each country to promote support for climate policy formation in each country. The model was applied to the creation of NAMA and INDC in Thailand and to the low-carbon city plan for Iskandar in Malaysia. In parallel with these activities, since 1994, 12 AIM training workshops (about 50 participants each) have been held, which are targeted at researchers and policymakers in Asia to foster development in climate policy at both the national and city levels.

Formation of a Research Community to Support Low-Carbon Development Policy in Each Country The Low Carbon Asia Research Network (LoCARNet: see Sect. 12.2 of this paper) forms a community for research on low-carbon societies with ownership by each respective country and aims to directly support policy in each country and to promote science-based low-carbon development policy throughout the region via mutual cooperation in the Asian region and South-South cooperation. The network was proposed at the ASEAN + 3 Environmental Ministers Meeting and has been active since 2012. Considering the urgent nature of climate policy, the network is led by researchers already deeply involved in policy support. Policy dialogue workshops between policymakers and research communities have been held in various countries. At the network's annual meetings, which began in 2012, discussions take place on key research topics for low-carbon development. At the annual meeting in Bogor in 2014, in the Bogor Declaration entitled 'Asia Is Ready to Stabilise Climate', researchers highlighted efforts towards climate stabilisation in Asia and also reported on the potential for reductions in Asia and good practices in Asia to provide input to international policymaking processes such as the UNFCCC. In order to become an independent leading network for low-carbon policy research in Asia, the formation of a CoE (centre of excellence) alliance is underway. The network aims to foster research communities in countries that currently lack them—Cambodia, Lao PDR and Myanmar—through South-South cooperation.

Funding for Climate Change Policy Research The Asia-Pacific Network for Global Change Research (APN) is a research fund that promotes not only research on climate change but also on the overall global environment, including biodiversity, transboundary air pollution and marine pollution. Activities were launched in 1996 on the initiative of Japan and with funds provided by the United States, Australia, New Zealand and the Republic of Korea. APN provides funding for joint research amongst Asian researchers. From 2013, the Low Carbon Initiatives (LCI) fund was established to accelerate low-carbon research in this region.

Knowledge Sharing on Climate Change Adaptation Upon the launch of the IPCC, Japan served as the Vice-Chairman of Working Group II (impact assessment) and was in charge of the chapter 'Technical Guidelines for Addressing Climate Change Impacts and Adaptations' of the Second Assessment Report in 1995. Utilising the Guidelines released in 1994, research on impacts and adaption was carried out in

many developing countries. Japan also took the lead in the chapter on impacts and adaptation in Asia for the Third and Fourth reports by forming a research community for the same in the Asian region based on APN research funds.

As the impacts of climate change vary from place to place, adaptation measures suited to each respective setting are needed, and such measures can be bolstered through shared experience. This was the concept behind the Asia Pacific Adaptation Network (APAN), which was proposed by the Ministry of the Environment of Japan and established in 2009 by a Thai prime ministerial declaration. This network is a forum for knowledge sharing between researchers, policymakers and experts engaged in the field of adaptation measures in Asian nations, and its activities are overseen by a secretariat in Bangkok. The influence of APAN as a role model of good practice has extended to other regions of the world—the creation in 2013 of the Global Adaptation Network (GAN) by United Nations Environment Programme (UNEP) is one example.

Developing Human Resources for Low-Carbon Policy Formation Since the 1980s, the Ministry of the Environment of Japan, in cooperation with the Japan International Cooperation Agency (JICA), has focused its efforts on human resource development to support environmental research and policy in Asia. Results of such are the Environment Research and Training Centre (ERTC) created in Thailand in 1989, the Environmental Management Centre (EMC) in Indonesia in 1990 and the Sino-Japan Friendship Centre for Environmental Protection in 1990. Recognising the importance of Asia's response to climate change, JICA provided assistance for establishing the Climate Change International Technical and Training Centre (CITC) under Thailand's Ministry of Natural Resources and Environment (MONRE) and the Thailand Greenhouse Gas Management Organisation (TGO). This centre, which began operating in May 2014, conducts training for policymakers, experts and industry representatives from the ASEAN in the areas of GHG inventories, low-carbon societies, mitigation measures and technology and adaptation measures. Leading researchers from the ASEAN region of LoCARNet have advised on training content and participated in curriculum development and lectures. Both IGES and the LoCARNet have participated as JICA experts.

12.2 The Low Carbon Asia Research Network (LoCARNet)

12.2.1 Science-Based Policy Formulation: LoCARNet Research and Policy Integration Activities

In keeping with trends in international discussions, the countries of Asia continue to make steady progress in developing low-carbon plans and strategies based on a green economy. The Low Carbon Asia Research Network (LoCARNet; secretariat:

IGES) supports development planning and strategy building by researchers and research institutes in various Asian countries in cooperation with the National Institute for Environmental Studies and Kyoto University. By setting up opportunities for researchers and policymakers to engage in discussion, each country can show how it is quantitatively reducing GHG and take planned actions to enable more effective policymaking for low-carbon development. Further, because countries in the region share a common economic footing and geographic location, researchers in each country can pool research results, carry out knowledge sharing and actively promote a system of mutual learning to facilitate South-South cooperation. Below is an overview of LoCARNet.

12.2.1.1 Background, Sequence of Events, Organisation and Policies

Background and Policies

LoCARNet is an open network of researchers, research organisations and like-minded relevant stakeholders that facilitates the formulation and implementation of science-based policies for low-carbon development in Asia.

A new international framework currently being considered by UNFCCC includes all GHG emitter countries from 2020 and beyond. In order to stabilise global climate, in addition to developed countries being required to drastically reduce their GHG emissions, those of developing countries will also need to be reduced based on their predicted increases. If trends in mass energy consumption and growth continue, by 2050 Asia will account for half of total global emissions, which will also cause heavy concomitant impact on the region's populations. On the other hand, if the substantial investments are redirected towards creating low-carbon societies, Asia could lead the world in low-carbon development. Right now, we are standing at the crossroads.

All countries in the Asian region are currently working on plans to achieve low-carbon development. Numerous policy steps are involved, and the formulation of such plans requires scientific knowledge spanning a broad spectrum of fields. It is thus plainly apparent that an interdisciplinary community for researchers and research organisations needs to be formed. Also, as policies for low-carbon development involve important decisions that determine a country's future potential, each country should have the right to self-determination in formulating these policies, therefore must have its own robust, scientific research footings.

While the above calls for establishing unique foundations, commonalities exist in the regional environment and in stages of development. In this regard, the exchange of scientific knowledge amongst researchers in Asian countries in respective areas of expertise will greatly promote science-based low-carbon policies, and reinforcing the scientific base to bolster the formulation of policies for low-carbon development in each country in the region will require a quantum leap in cooperation, not only from researchers and research communities but also

from international organisations, donor agencies, NGOs and other like-minded relevant stakeholders. The ultimate aim of LoCARNet is to promote regional cooperation to facilitate the formulation and implementation of science-based policies for low-carbon growth in the Asian region, together with relevant stakeholders.

LoCARNet effectively promotes research on low-carbon growth policy by enabling effective dialogue between scientists and policymakers and also encourages domestic collaboration amongst researchers whose research capacities and scientific knowledge are firmly grounded in their home countries (ownership in country by these researchers). LoCARNet also aims to increase research capacity in the region through knowledge sharing and information exchange, in the context of not only North-South cooperation, but also South-South regional cooperation (Box 12.1).

Box 12.1 Unique Characteristics of LoCARNet
Unique characteristics of LoCARNet

- LoCARNet is a network of leading researchers, research organisations and like-minded relevant stakeholders deeply involved in low-carbon growth policy processes in Asia.
- Science-Science-Policy Dialogue: LoCARNet promotes research on policies for low-carbon growth by enabling sufficient dialogue between scientists and policymakers.
- Country-based ownership of knowledge: LoCARNet encourages collaboration between researchers in-country whose research capacity and scientific knowledge are firmly grounded on home soil.
- Regional South-South–North Collaboration: LoCARNet aims to increase research capacity in the AP region through knowledge sharing and information exchange as a part of regional cooperation—not only North-South but also South-South cooperation.

Establishment of LoCARNet

From 2009, Japan's Ministry of the Environment and National Institute for Environmental Studies embarked on a research programme on low-carbon development in Asia. Under this coalition, IGES, together with NIES and Kyoto University, has been conducting workshops that promote dialogue between policymakers and researchers in Indonesia, Thailand, Cambodia and Malaysia, as well as networking amongst researchers in the region to encourage low-carbon development in Asia. During the course of these workshops, it became clear that low-carbon development in Asia must take place.

Considering the significance of Asia for global climate policy, the Government of Japan and IGES proposed the creation of LoCARNet at the October 2011 ASEAN + 3 Environmental Ministers' Meeting in Cambodia. The launch took place in April of the following year at a side event ('East Asia Low Carbon Development Knowledge Partnership', organised by three institutes—National Institute for Environmental Studies, Japan International Cooperation Agency (JICA) and IGES) one day prior to Japan's Ministry of Foreign Affairs' 'East Asia Low Carbon Growth Partnership Dialogue'. It was then officially reported to the Dialogue the following day. As IGES had been commissioned to organise the Secretariat of the International Research Network for Low Carbon Societies (LCS-RNet) based on a decision made at the G8 summit in 2008, it was also tentatively placed in charge of the Secretariat function of LoCARNet as well.

Recent trends point to initiatives in low-carbon, green growth taking place in many parts of the region, and such are supported by developed countries and international organisations. Concurrently, LoCARNet will facilitate the creation and accumulation of knowledge to help formulate and implement science-based policies for low-carbon growth in the Asia region.

Scope of Activities

The knowledge required and the issues related to promoting low-carbon growth policies are extremely diverse in nature. As such, the network needs to focus its sphere of activities on priority areas in order to provide efficient and effective results.

Regionally: ASEAN Core, Centred on Asia, Futuristically Global Although the significance of Asia was previously mentioned, China has already established a strong low-carbon policymaking process for itself and also leads the world in utilisation of renewable energies, both in terms of facilities and production. As regards India, its per capita GHG emissions are still low although it has the potential to become an emission giant in the future. Therefore, for the time being, the network will primarily focus on the parts of the ASEAN region that are undergoing striking development, with initiatives in this region making up its core activities. The network will, however, continue to promote research exchange that includes China and India.

Since the Copenhagen Accord, cooperation between developed and developing countries has intensified. In response to this, comparatively recently, momentum has been building for knowledge sharing around the world: initiatives similar to LoCARNet have been initiated by Europe, the United States and international organisations. In addition, LCS-RNet, promoted by Japan with the G8 countries, intends to expand its network to include emerging economies and developing countries, where GHG emissions are predicted to increase greatly in the future, while collaborating with LoCARNet in Asia. Further, as LCS-RNet has been requested to deal with integration of mitigation and adaptation, it is thought that

LoCARNet will assist in maximising collaboration in these initiatives to yield mutually beneficial and effective results.

Targets: Low-Carbon Research as the Core, Stronger Links with Policy and Industry The objective of the network is to further low-carbon development. To do so, it is necessary to promote scientific policy based on research. Hence, it is essential to first have a robust research community in each country. However, these communities are meaningful only when research is reflected in policy and industrial activities, making strong cooperation with government (both central and local government) and business sectors a must.

Stakeholders: Researchers at the Core, Cooperation with Policymakers and Participation of Supporters, Expansion of Related Parties The roots of the network will be grounded in its research capacity. The skills of researchers involved in low-carbon development must be consolidated and the research community expanded; as such, researchers will play the leading role. Deliberation on issues to be addressed must be made from the viewpoint not only of scholarly but also policy aspects. Also, support from policymakers and the role of funding agencies are substantial in terms of finance and organisational aspects. In order to disseminate outcomes and bring about impacts, the cooperation of a broad range of stakeholders, including international organisations and NGOs, is essential.

12.2.1.2 Activities and Outcomes

The activities of LoCARNet can be categorised under three pillars. Here again, the countries of Asia continue to make steady progress in developing low-carbon plans and strategies based on a green economy.

As the first pillar, LoCARNet has maintained policy dialogue between researchers and policymakers in selected countries, together with the National Institute for Environmental Studies and Kyoto University. For example, LoCARNet experts in Indonesia, working with the National Development Planning Board (BAPPENAS), have conducted an economic evaluation comparison of a low-carbon development draft plan; a LoCARNet expert in Thailand has worked closely with the Thailand Greenhouse Gas Management Organization (TGO) and reflected his analysis within Thailand NAMA development, and in Iskandar, Malaysia, a LoCARNet expert has been conducting low-carbon city planning and implementation in order to promote collaboration with local universities and implementing organisations.

Through these policy dialogue sessions, policymakers have gradually recognised the importance of in-country involvement of researchers and research communities in the policymaking process, and as a consequence, scientific policymaking has been promoted in these countries.

In parallel, as a result of bolstered human resources in Japan (National Institute for Environmental Studies (NIES), Kyoto University and IGES) engaged in

supporting low-carbon development in developing countries, a series of steps has been established for low-carbon development planning, including development of the GHG inventory, vision development, quantitative scenario creation, economic evaluation, action plan design and road map formulation.

As the second pillar, having conducted several workshops for capacity development in Cambodia, LoCARNet organised a trilateral workshop for Cambodia, Lao PDR and Myanmar in February 2014 in Phnom Penh, Cambodia. This workshop aimed to have Cambodia, Lao PDR and Myanmar each utilising its own capacity to present quantitative GHG emission reduction potentials, to advance the organisation of research communities in-country, to enhance policymaking in a more effective manner and to provide a forum for researchers and policymakers to engage in discussion. In addition, owing to the various commonalities shared by the participating countries, including level of economic development and geographical characteristics, this workshop also provided opportunities for researchers in each country to bring together their research results, carry out knowledge sharing and actively promote a system of mutual learning that facilitates South-South cooperation. Through such activities, countries such as Cambodia, Lao PDR and Myanmar are projected to be in a better position to implement the low-carbon plans discussed in the workshop.

As the third pillar, LoCARNet organised a series of annual meetings—the first being in October 2012 in Bangkok (Thailand), second in July 2013 in Yokohama (Japan) and third in October 2014 in Bogor (Indonesia). These meetings underscored the importance of networks as fora for sharing knowledge in order to bring about low-carbon societies and low-carbon development. Further, a number of urgent issues for research common to the Asian region were discussed, including 'the need for capacity development towards the framework for 2020', 'comparison of reduction potential of Asian countries towards achieving the two degree target', 'the role of cities as pioneers for LCS', 'low-carbon technologies required in Asia', 'Asian issues: emission reduction in the agriculture, forestry and land-use sectors' and 'integration of low-carbon issues and climate change adaptation'. It is likely that LoCARNet will transfer these outputs from the research community to the policy training centres planned for ASEAN countries (Thailand and Indonesia).

In addition, knowledge sharing at the annual meetings and South-South regional cooperation together increase momentum towards realising low-carbon development in Asia, which could realise a significant GHG reduction potential and sends a very positive message. In November 2014, LoCARNet organised its Third Annual Meeting, held in Bogor, Indonesia, where researchers in Asia issued the 'LoCARNet Bogor Declaration', which states 'Asia is ready to stabilise climate' (Box 12.2).

Box 12.2 LoCARNet Bogor Declaration (November 2014)

LoCARNet Bogor Declaration

Asia Is Ready to Stabilise Climate

Recognising the huge risk of climate change to human well-being as predicted by science communities; welcoming the start of a new global regime to avert it; confirming the growing importance of regional cooperation for low-carbon transition; and drawing upon Asian wisdom to contribute in stabilising climate, the participants of the LoCARNet Third Annual Meeting reaffirm that:

1. Asia has research capacity; Asia has research networks that support policymaking.
2. Asia has the potential for low-carbon transition which is adequate to contribute to the two degrees temperature stabilisation target.
3. Asia has the technological, financial and institutional capacity to facilitate low-carbon actions.
4. Many 'good practice' examples exist and their replication is challenging. Continued technological and institutional innovations are needed to support the transition to a sustainable low-carbon society.
5. Asia is ready to make due contribution to global climate stabilisation.

However:

1. Diversity amongst Asian nations poses challenges for framing uniform policies, but provides opportunities for discovering a range of options. Regional cooperation for low-carbon research is therefore challenging as well as rewarding.
2. Asia houses a sizable fraction of low-income families. Their development needs require special attention to ensure that their welfare is not compromised.

Low-carbon research in Asia shows that timing is critical; lock-ins must be avoided, and all 'leapfrogging opportunities' should be seized and realised by positive actions, supported by global climate policies, including technology transfer and incremental finance.

Asia is ready for low-carbon transition and awaits signals from the Paris Climate Change Agreement to deploy actions towards climate stabilisation.

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12.2.2 Future Plan

Three years have passed since LoCARNet's official launch. During this time, research institutes and organisations in Asia have exhibited considerable development, and based on cooperation activities conducted so far, now is time for Asia to

mobilise the necessary knowledge through its own capacity and to establish and manage an autonomous, regionally owned network.

Under the new post-2015 framework, respective governments in Asia should promptly develop long-term, low-carbon development plans and put them in effect. In order for Asia to develop its own policies with full ownership, the region must possess an autonomous regional research community. And, at the policy implementation stage, it is necessary for science (research) to be reflected in policies. Moreover, knowledge held in the scientific community must be leveraged to make relevant stakeholders, especially in business, and move towards low-carbon development. Under the LoCARNet scheme, several research institutes and organisations exist in this region, which are already working closely with policymakers and involved in the policymaking process in their respective specialised fields as centres of excellence (CoE). However, in the future, synergy effects amongst these institutes, as a CoE coalition or CoE alliance, must be maximised to drive progress in policies and in the business sector in this region.

In this transitional stage that includes 2015, it will be imperative to make policy proposals, in parallel, to each government, to the Asian region, to the global international community and to relevant stakeholders. This project will take the form of action research that develops the organisation through these kinds of on-the-job activities.

As regards future network activities, LoCARNet will focus on promoting priority research in fields common to the Asian region; facilitating financial and institutional support for fostering and strengthening research capacity in the region, in collaboration with donors, other institutions and organisations concerned; securing routes to reflect research results in policymaking; and activating networking and information dissemination with and to other like-minded stakeholders towards realising low-carbon societies and low-carbon development.

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