2nd Session: Measures to Address Climate Change in Developing Countries

Keynote Speech

by Mr. Shinya EJIMA, Global Environment Department, JICA

Distinguished guests, ladies and gentlemen,

It is my great pleasure to welcome all of you here on behalf of JICA, Japan International Cooperation Agency, at the opening of JICA secession. Please allow me say a few words on this occasion representing as a director of global environmental department: main department of addressing to climate change issues in JICA.

JICA is an executing agency of Japan's official development assistance. JICA has 26 offices and deployed many JICA related people in Africa region

JICA responded to drought, natural disaster, water and climate change related issues in Africa by fully utilizing experience and knowledge of JICA human resources in the field of Africa. For example, JICA quickly responded to crisis in the horn of the Africa providing emergency supplies and prepares middle and long term measures for crisis.

JICA is providing a wide range of assistance to mitigation and adaptation projects such as Energy, Forestry, Water Resources, Water Supply, Natural Disaster Prevention, Agriculture etc. These are crucial sectors for sustainable development in many developing countries. This shows how JICA is committed to help developing countries simultaneously tackle the two urgent challenges of climate change and development.

Global environmental department is a core department of JICA for implementing Japan's "First-Start Financing" in the field of forestry, environmental management, water resources, and natural disaster prevention. As mentioned in other presentations, JICA assists many climate change related projects in Africa. Such assistance is based on needs in the field and not for discussion in the conference room. For example, JICA has been working with many African countries to reform CDM procedures for micro-scale energy projects over the past several years. This effort is not merely for exchange of views in climate conferences, but is targeted to solve actual problems on the ground – an on-going attempt in Zambia to register rural electrification and micro scale hydro power projects as CDM.

JICA approach to achieving a low carbon and climate resilient society can be summarized as follows:

1. Promoting integrated cooperation addressing climate change measures in development cooperation.
2. Aligning climate change and development based on the co-benefit and climate risk-based approach.
3. Realizing tangible development projects from the perspective of climate change mitigation and adaptation

JICA also emphasize:

1. Cross sector approach based on policy dialogue.
2. Utilize Japans' private cutting edge technology effectively
3. Promote globally conductive research

I hope this session will contribute to formulate direction of JICA support on climate change in Africa in terms of TICAD process through your ideas suggestions and discussion.

Finally, I convince that this seminar enhances relationship between you and JICA and, this strong tie promotes "Low carbon growth and sustainable development strategy in Africa".

Thank you.




JICA's Assistance to Africa and Climate Change Challenges

November 1, 2011
Ichiro Tambo/Ryuichi Kato/
Kei Yoshizawa
Africa Department, JICA

What is TICAD?

<u>T</u>okyo <u>I</u>nternational <u>C</u>onference on <u>A</u>frican <u>D</u>evelopment (TICAD)

1993: Inception of TICAD

- International flow of ODA moved to former East bloc countries following the end of the Cold War
- Aid fatigue of the international community
- Japan and UN initiated an Open Forum to raise awareness and call on aid for African Development

1998: TICADII

2003: TICADIII

2008: TICADIV in Yokohama hosted by Japan, UN, WB

2013: TICADV to be hosted by Japan, UN, WB and AU as announced by Prime Minister Noda in UNGA Sept. 2011

TICAD IV (Yokohama, May 28-30, 2008)

Towards a Vibrant Africa: Continent of Hope and Opportunity


(Source: Kantei hp)

- 51 African countries represented (41 Head of States/Governments)
- 33 partner countries
- 77 regional / international organizations

Focus areas of the Yokohama Action Plan

I Boosting Economic Growth

1) Infrastructure
2) Trade, Investment and Tourism
3) Agriculture and Rural Development



II Ensuring Human Security

1) MDGs (Community Development, Education, Health)
1) Consolidation of Peace, Good Governance

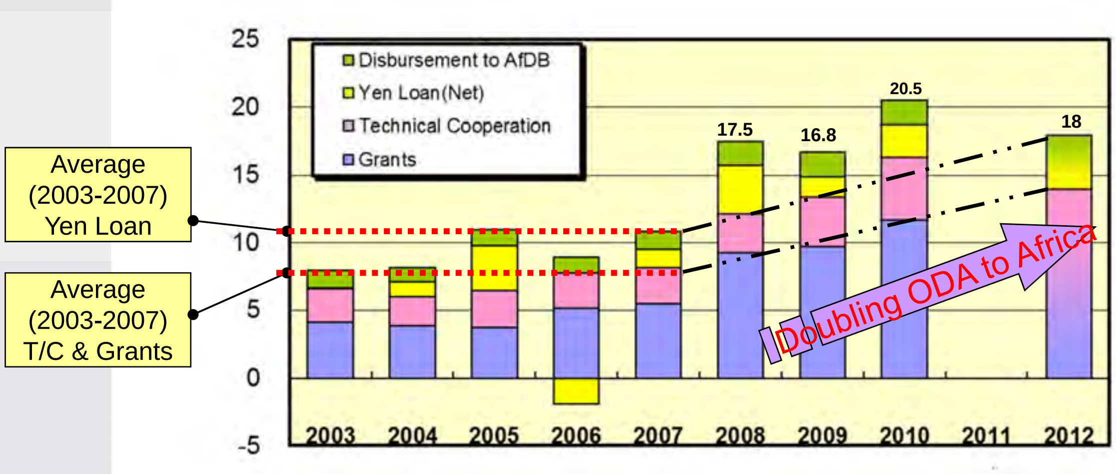

III Addressing Environmental Issues and Climate Change

IV Broadening Partnership

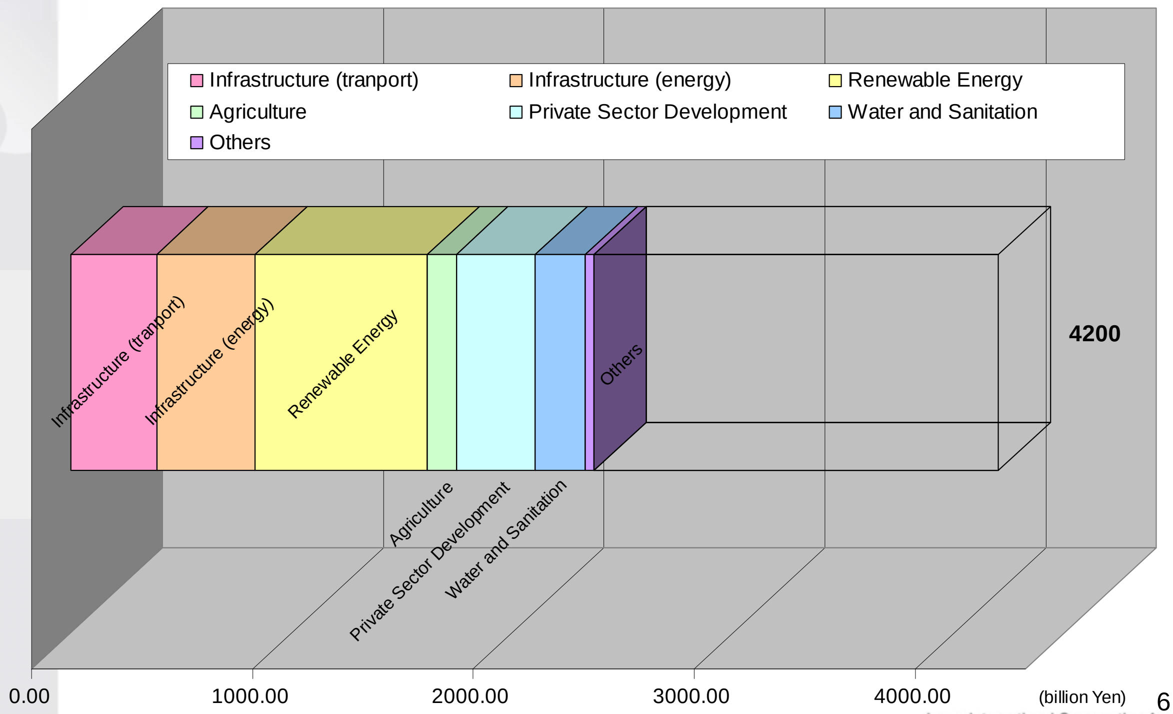
Japan's commitment

"Doubling total ODA to Africa by 2012"

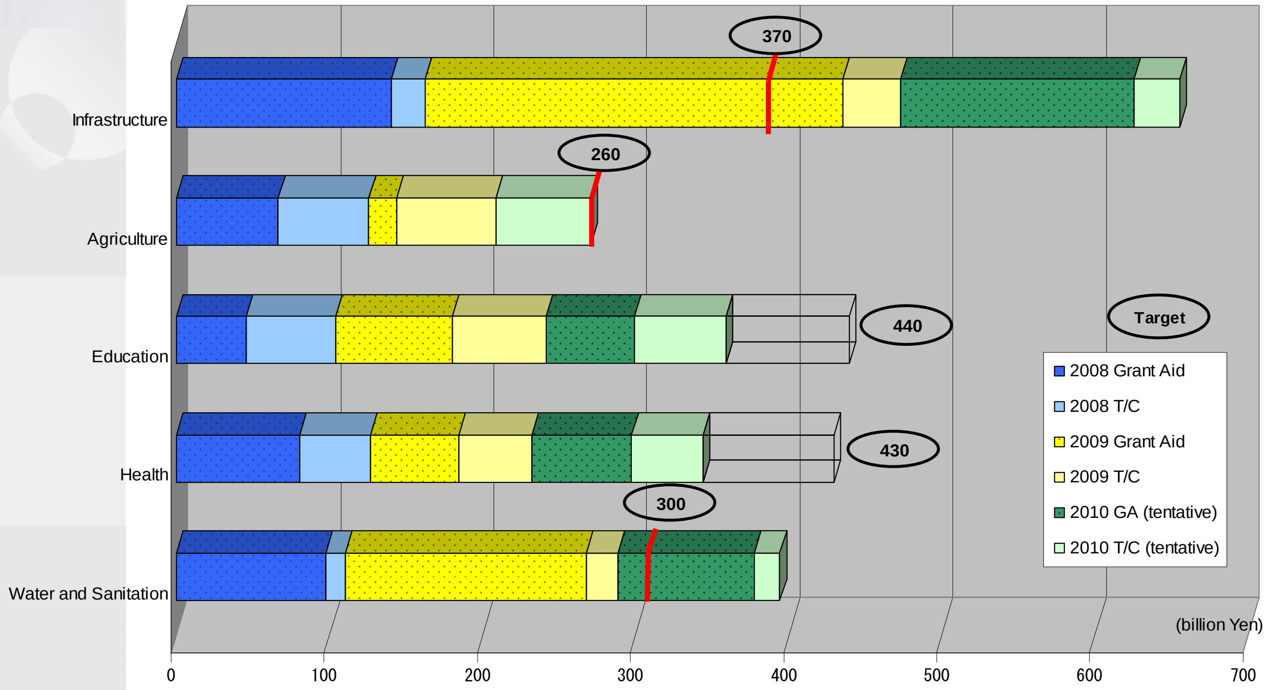
ODA by Modality	Average Annual Level (2003-2007)	Targeted Amount in 2012 (Cumulative)
Grants (Bilateral)	USD 0.7 billion	USD 1.4 billion
ODA loan (Net)	USD 80 million	Over USD 160 million
Disbursement to AfDB	USD 120 million	USD 240 million
Total ODA to Africa	USD 0.9 billion	USD 1.8 billion



Progress on ODA Loan commitment up to $4 bln (420 bln JPY) (As of 31 December 2010)



Progress status of grant aid & T/C by sector （As of 31 December 2010）



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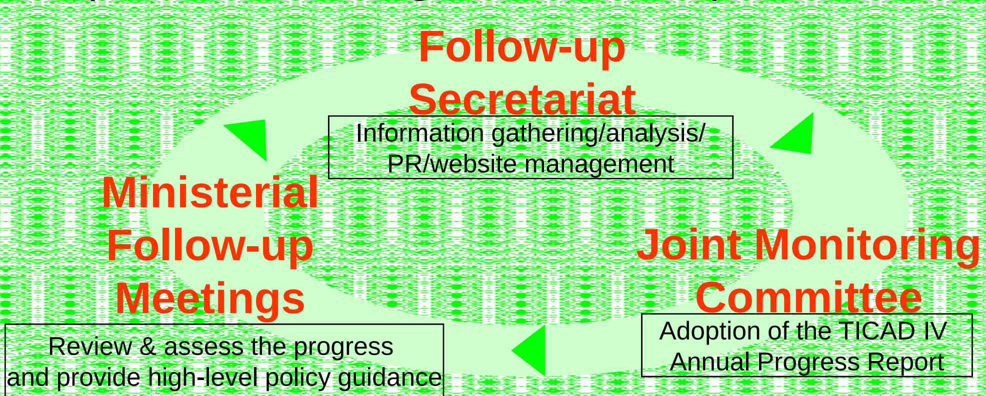
Achievements of TICAD IV: creation of the follow-up mechanism

1. Yokohama Action Plan (YAP)

Concrete targets and shared responsibility for action among Africa and partners

2. TICAD Follow-up Mechanism

Transparent monitoring of the YAP implementation



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Ministerial Follow-up Meeting in Dakar in May 2011

- Ministerial F/U Meeting each year since 2009 to monitor progress of Yokohama Action Plan implementation.
- In May 2011, Foreign Minister of Japan confirmed the commitments made by Japan in TICADIV despite the Great East Japan Earthquake.
- Japan also proposed to formulate a "Low-Carbon Growth and Sustainable Development Strategy in Africa" toward TICADV in 2013.
- Overview of the Meeting

⇒http://www.mofa.go.jp/region/africa/ticad/min1105/overview.html

Overview of Yokohama Action Plan

JICA Sector Strategy and Flagship Project of each pillar

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Infrastructure: Transport (strategic priority)

1. International Corridor

(1) Focus on regional infrastructure

(2) Various modes of transport (ports, bridges, urban transport, railway) in addition to roads

2. One Stop Border Post: OSBP

(1) Priority on key corridors

(2) Flexible combination of 'hardware' (infrastructure) and 'software' (legislation, CD)

Commitments (as set in YAP)

Up to 4 bln USD ODA Loan w/special focus on infrastructure and agriculture	Grant Assistance and T/A 37 bln JPY	Expand OSBP to 14 points

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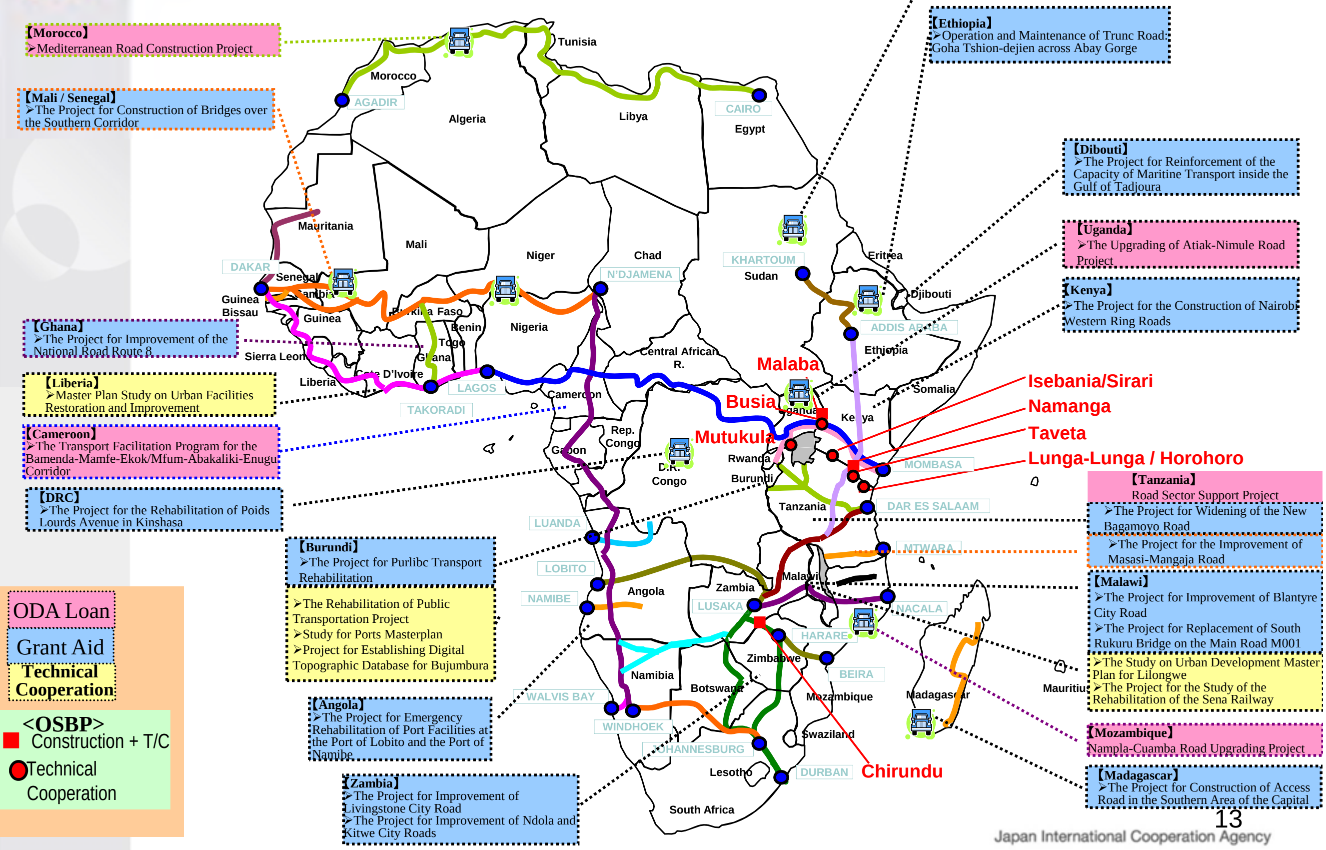
Infrastructure (transport)



List of Projects Approved in JFY 2008-2010

Infrastructure: Energy (strategic priority)

1. Sub-Sahara Africa
   With focus on power pools, support development of power generation, transformation and distribution with necessary technical cooperation for maintenance etc.
2. Countries emerging from conflict
   Extend technical cooperation to fulfill urgent power demand that contributes to stability and economic growth
3. Northern Africa
   Focus on renewable energy, energy efficiency

Commitments (as set in YAP)

Up to 4 bln USD ODA Loan w/special focus on infrastructure and agriculture	Grant Assistance and T/A 37 bln JPY

Japan's Assistance for Energy Sector in Africa

Update; 2011.09.20

North Africa

EGYPT

- Kuraymat Integrated Solar Combined Cycle Power Plant-II
- Energy Control System Upgrading in Upper Egypt (2008)
- Gulf of El Zayt Wind Power Plant (2009)
- Introduction of Clean Energy by Solar Electricity Generation System (2009)

TUNISIA

- Metropolitan Railway Electrification - II (2009)

West-Central Africa

GHANA

- Capacity Development for Electric Engineers in West African Countries
- the Project on Human Resource Development for disseminating PV systems

CAPE VERDE

- Power Generation, Transmission and Distribution Capacity Building Project on Santiago Island

SIERRA LEONE

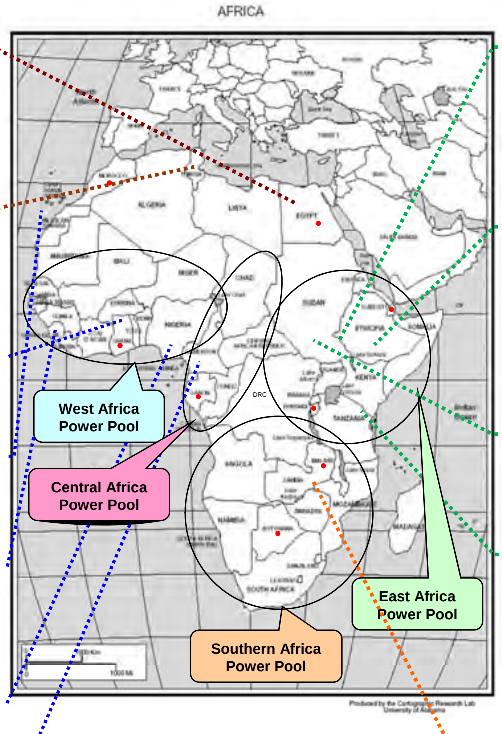
- Project for Urgent Improvement of Electric Power Supply System in Freetown
- Master Plan Study on Power Supply in Western Area
- The Project for Capacity Development for Maintaining Power Supply Facilities

NIGERIA

- Project for Rural Electrification in Cross River and Akwa Ibom States (PhaseⅢ)

CAMEROON

- The Project to Strengthen and Extend the Electricity Transmission and Distribution Networks



DJIBOUTI,BURUNDI,BOTSWANA,MALAWI,GHANA, GABON,EGYPT,MOROCCO

- The Project for Introduction of Clean Energy by Solar Electricity Generation System

Loans | Grant | T/A

East Africa

UGANDA

- Bujagali Interconnection Project
- Interconnection of Electric Grids of Nile Equatorial Lakes Countries Project
- Project for Rural Electrification (PhaseⅡ)
- Project for Master Plan Study on Hydropower Development

KENYA

- Sondu-Miriu Hydropower Project Sang'oro Power Plant
- Olkaria I Unit 4 and 5 Geothermal Power Project
- Olkaria-Lessos-KisumuTransmission Lines Construction Project
- Establishment of Rural Electrification Model Using Renewable Energy
- Project for Capacity Development for Promoting Rural Electrification Using Renewable Energies in

RWANDA

- The Project for Improvement of Substation and Distribution Network
- Project for Capacity Development of Efficient Transmission and Distribution

TANZANIA

- Preparatory Survey for Distribution Network Rehabilitation Project in Kilimanjaro Region
- The Project for Reinforcement of Power Distribution in Zanzibar Island
- The Project for Capacity Development of Efficient Distribution and Transmission Systems
- Iringa-Shinyanga Backbone Transmission Investment Project)

Southern Africa

ZAMBIA

- Project for the Capacity Development for Rural Electrification
- Study for Power System Development
- Increasing Access to Electricity Services Project

Agriculture (Strategic Priority)

1. Collaboration with CAADP (Comprehensive Africa Agriculture Development Program)
2. Improve production capacity
   (1) Establish CARD (Coalition for Africa Rice Development) to serve as a donor coordination platform
   (2) Capacity building to expand innovative approaches including NERICA
3. Promote sustainable water resources management and land use

Commitments (as set in YAP)

Grant Aid and T/A 2.6 bln JPY	Development and rehabilitation of irrigation 100,000 ha	Capacity building for 50,000 agricultural leaders

Coalition for African Rice Development (CARD)

Goal of the Initiative

Double rice harvest within 10 years from the present production of 14 million tons to 28 million tons

Approaches classified by agro-ecology

Irrigated Field	Rainfed Lowland	Rainfed Upland
Rehabilitation of Existing Irrigation Facilities, Strengthening of Water User's Association	Establishment of Rice Development Model	Expanding of NERICA Dissemination

21 Countries (12 countries as 1st Group, 11 countries as 2nd Group)

Implementation Framework

CARD Secretariat

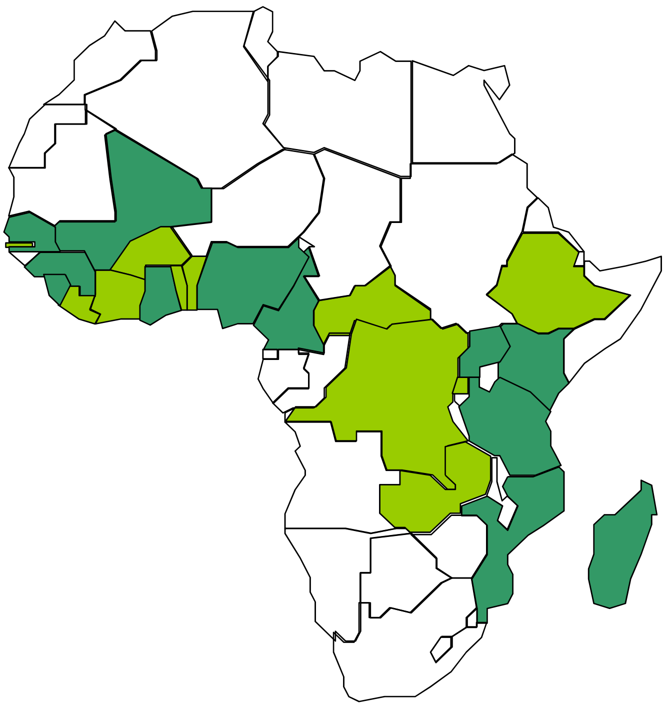
Located in AGRA office in Nairobi, 3 staffs from AGRA, JICA, FARA

AGRA,FARA,FAO, NEPAD,WARDA, IRRI,JIRCAS, JICA — **Steering Committee Members**

WB, AfDB, FAO, IFAD, WFP, UNDP, USAID, etc — **Supporting Partners**

CARD countries

【1st Group】
- Cameroon
- Ghana
- Guinea
- Kenya
- Mali
- Mozambique
- Nigeria
- Senegal
- Sierra Leone
- Tanzania
- Uganda
- Madagascar



【2nd Group】
- Gambia
- Liberia
- Cote d'ivoire
- Burkina Faso
- Togo
- Benin
- CAR
- DRC
- Rwanda
- Ethiopia
- Zambia

II Ensuring Human Security

- **Achieving the MDGs**
  (1) Community Development
  (2) Education
  (3) Health
- **Consolidation of Peace, Good Governance**

Education (Strategic Priority)

1. Basic Education

(1) Expand access, improve quality, improve school management

(2) TVET (Technical and vocational education and training)

(3) Skilled labor force development

(4) Human resource development in countries emerging from conflict (i.e. income generation)

3. Higher education

(1) Establishment and human resource development through Egypt-Japan University of Science and Technology (E-JUST)

(2) Science and technology

Commitments (as set in YAP)

Grant Aid and T/A 4.4 bln JPY	Expand 'School for all' to 10,000 schools	Construct 1,000 schools	Expand SMASE (Strengthening of Mathematics and Science in Education) for 100,000 teachers

Achieving the MDGs: Education

Support to the improvement of school management through Community Participation (School for all) Project / Niger

- School management improvement

⇒elected local community members to plan, manage and develop school activities in close consultation with local community + local government to monitor and evaluate

⇒ Improved community and parental awareness about schools, qualitative improvements in education, community empowerment

Health (Strategic Priority)

1. Health System Strengthening

(1) Improving quality and quantity of health related HR
(2) Improving working environment and quality of service provided through 5S-TQM
(3) Strengthening local health administration and community involvement

2. Maternal health

(1) Establishing comprehensive and seamless maternal care system, including developing skilled midwives
(2) Improving child health through immunization and nutrition control

3. Infectious disease

(1) HIV/AIDS prevention and patient care improvement
(2) Support to DOTS and prevention of superinfection (HIV/AIDS and TB)

Commitments (as set in YAP)

Grant Aid and T/C 4.3 bln JPY	Train 100,000 health/ medical workers	Improve 1,000 Hospital/health centers	Save the lives of 400,000 children

Health System Strengthening in Tambacounda and Kedug, Senegal

Target

(Within Tambacounda Province)	At 2007 (base year)		2011 (indicators)
MDG 4: under 5 mortality	200/1000 p.	→	120 (down by 40%)
MDG 5: maternal mortality	800/100,000 birth	→	To be reduced
MDG 5: delivery in the presence of health workers	27%	→	35% (up by 30%)
MDG 6: HIV/AIDS infection rate	0.4%	→	under 1.0%

Strategy

① Improvement of Access
- Emergency obstetric care faciliti
- Increase no. of health workers
- HIV/AIDS prevention

② Quality Improvement
- Support for normal delivery
- Continuous care for pregnant mothers.

③ Addressing health systems
- Increase no. of health posts
- Quality improvement of health service in provincial hospitals
- Training of health workers

④ Community based activities
- Advocacy activities
- Community empowerment

⑤Role of the central govt.
- Policy development
- Output dissemination

Mather and child health ward, Tambacounda Province Health Center

Activities of 5S

Training of 5S

Existing Health Center (new center under construction through grant aid)

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Peacebuilding (Strategic Priority)

1. **Reconstruction of social capital**
   Support return and reintegration of refugees and IDPs (basic social infrastructure, transport, electricity, IT network, health and education services, stable food supply)

2. **Reconstruction of economic activities**
   Improve economic environment and enhance employment opportunities

3. **Recovery of governance functions**
   Election support, media improvement, legal, administrative and financial system improvement

4. **Enhancing security**
   Security sector development, DDR, small arms, landmines and unexploded bombs issues

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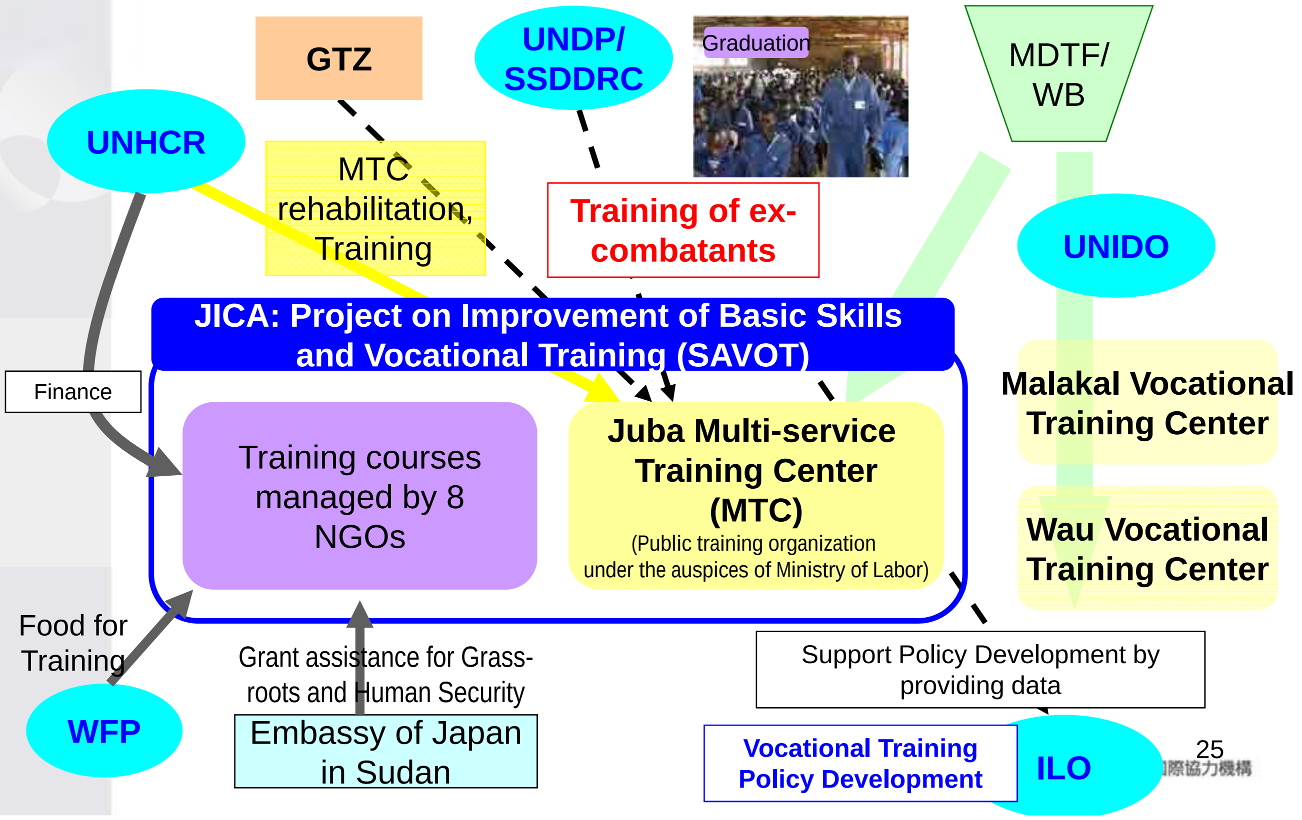
Sudan: Project on Improvement of Basic Skills and Vocational Training (*SAVOT*)



Addressing Environmental Issues and Climate Change

JICA's actions in Africa since TICADIV and Challenges to be tackled toward TICADV

Environmental/Climate Change issues in Yokohama Action Plan

Climate change is one of the four pillars of YAP, comprising of the following four sub-pillars;

1. Mitigation

- Support developing an effective framework beyond 2012
- Promote CDM and support DNA
- Support sustainable forest management in response to REDD

2. Adaptation

- Measures against natural disasters
- Measures to combat desertification

3. Water and Sanitation

- Effective water resources management
- Access to safe and sanitation facilities

4. Education for Sustainable Development (ESD)

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"Hatoyama Initiative" – a Major Japanese commitment on Climate Change

"Hatoyama Initiative" is a financial assistance to developing countries, including Africa, taking measures of mitigation, as well as those vulnerable to the negative impacts of climate change.

Fast-Start Financing $15billion up to 2012	
ODA Approx. US$ 7.2billion Grant Aid Technical Cooperation ODA Loans Multilateral Funds	**OOF** Approx.US$7.8billion Closely cooperate with private sector by utilizing resources such as JBIC

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1.Mitigation

- "Climate Change ODA Loans", with more favorable terms and conditions than those of standard ODA Loans, provided to the following projects;

Ex)

- Kenya: Olkaria Geothermal Power Plant
- Egypt: Gulf of El Zayt Wind Power Plant Project
- Kenya: Olkaria-Lessos-KisumuTransmission Lines Construction Project
- Zambia: Increased Access to Electricity Services Project

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Kenya: Olkaria Geothermal Power Plant

- ODA Loan to Olkaria I Geothermal Power Plant to construct generation unit 4 & 5 (70MW each).
- The project aims to improve the demand-supply balance of energy in Kenya while promoting the use of renewable energy and reducing GHG emission

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Zafarana (120MW) and Gulf El Zeyt (220MW) Wind Farms in Egypt with financial support by JICA

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Zambia: Increased Access to Electricity Services Project

- This project aims to extend the existing power grid for an additional 459 km in seven provinces and establish a small hydroelectric power plant with a capacity of 1.4 MW .
- It will contribute to reducing GHG and carbon emissions.

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1.Mitigation (continued)

○ Grant Aid projects financed in the framework of "Fast-Start Financing" as follows;

Ex)

- The Project for Introduction of Clean Energy by Solar Electricity Generation System
  (Burundi, Malawi, Ghana, Gabon, Egypt, Djibouti, Lesotho)
- Forest Preservation Programme
  (Kenya, Uganda, Ghana, Ethiopia, Cote d'Ivoire, DRC)

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Supporting Sustainable Forest Management

- Seminar on the Protection of Tropical Forests in the Congo Basin (February 2009)
- Establishment of Sustainable Livelihood Strategies and Natural Resource Management in Tropical Rain Forest (Cameroon)
  - Science and Technology Research (SATREPS) Project by JICA-Kyoto University partnership
- Conservation of biodiversity in tropical forest through sustainable coexistence between human and wild animals (Gabon)
  - SATREPS project by JICA-Yamaguchi Univ.-Chubu Gakuin Univ.-Kagoshima Univ. partnership


Nature Trail in National Park (Gabon)

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2.Adaptation

- ○ Measures against natural disasters
- ○ Measures to combat desertification

Ex)

- Water Supply and Hygiene Improvement Project in Host Communities of Dadaab Refugee Camps (Kenya)
- Community-Based Flood Disaster Management in the Nyando River Basin (Kenya)
- Prediction of Climate Variations and its Application in the Southern African Region (South Africa)

Shore erosion in South Africa

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Community-based Flood Disaster management in the Nyando River Basin

- ○ Nyando River Basin suffers from constant flood, which takes not only lives of people but also of economic opportunity, during rainy season. To make things worth, because of the climate change, the frequency has increased, the consequence always being significantly tougher on the poor.
- ○ Recognizing that to materialize what community considers to be necessary for disaster prevention is the most effective means to protect people, JICA is engaged in the capacity building of the communities i.e. establishing Nyando River Forum, including flood management within its community development projects, drafting a master plan on disaster prevention.

Construction of bank protection works

Flood management training for evacuation

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Response to the Drought in the Horn of Africa

1. Humanitarian Response(Short-term)

- Emergency supplies to help refugees
- Ongoing projects to increase food production and provide safe-water

2. Investment in Drought resilience (Mid and long term)

- Disaster risk reduction measures in arid and semi-arid regions.
- Capacity Development for revitalizing the regional economy.

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Disaster Risk Management and Reduction

- In the Ministerial TICADⅣ FU Meeting in Dakar, Japan announced a new initiative on disaster risk management by sharing experiences of the Great East Japan Earthquake.

- JICA invited 13 African government officials to "Disaster Risk Management Seminar" to visit affected areas of the earthquake and discuss future action plans for development with resilience.

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3.Warter and Sanitation

- Provide safe drinking water to 6.5 million people
- Capacity building of 5,000 water managers/users

Ex)

- Loan: Rural Water Supply Project (Morocco)
- T/C: The Study on Rural Water Supply in Tabora Region (Tanzania)
- Grant: The Project for Rural Water Supply in Tigray Region (Ethiopia)

Water and Sanitation

Senegal: Safe Water and Support for Community Activities

Activity 1
Establishing system for the maintenance of water supply facilities

Activity 2
Developing capacity of Management Committees

Activity 3
Promoting hygiene and appropriate use of water

Sustainable safe water supply

Activity 4
Community Development

Toward TICADV

Next Agenda and Action Plan for Climate Change in Africa to be discussed through TICAD Process

Low-Carbon Growth and Sustainable Development Strategy in Africa to be incorporated into TICADV Agenda

Mainstreaming Climate Change Agenda in TICAD Process and International Development Agenda on African Development

Toward TICADV (continued)

What's next? For discussion;

- Promoting Green Growth, Clean Energy Development, Efficient Energy Use
- Conservation of Forest, Reforestation, Forest Management
- Adapting Climate Change, Efficient Water Resource Use and Management
- Disaster Risk Management and Reduction, including Agricultural Development for Food Security

Toward TICADV (continued)

- Climate Change Policy Capacity Building, i.e. MRV, CDM, NAPA/NAMA, meteorology, hydraulics, etc.
- Introducing Advanced Technology and Scientific Approach
- Mobilizing Financial Resources from Public/Private Sector
- Exploring Partnership with Aid Agencies, MDBs, Private Sector, Research Institutes etc.

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Policy Dialogue on Climate Change in Africa
October 31 – November 2, 2011
Session 2: Measures to address climate change in developing countries

Low-carbon and Climate Resilient Development in Africa

November 1, 2011

Masayuki KARASAWA (Mr.)
Director, Office for Climate Change
JICA Global Environment Department

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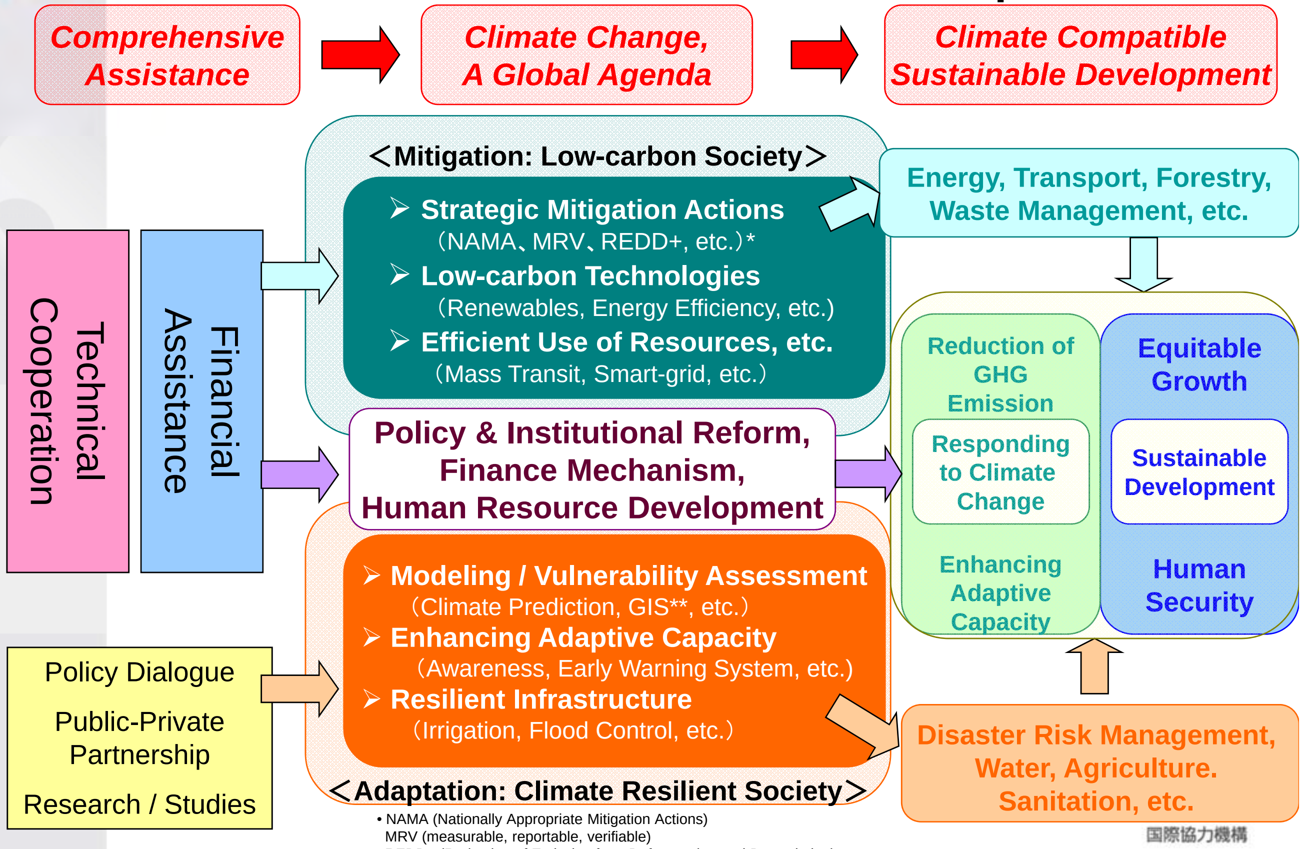
1. JICA's Approach: Development Cooperation for Low-carbon and Climate Resilient Development

2. Toward a Low-carbon Development

3. Toward a Climate Resilient Development

1. JICA's Approach: Development Cooperation for Low-carbon and Climate Resilient Development



• NAMA (Nationally Appropriate Mitigation Actions)
MRV (measurable, reportable, verifiable)
REDD+ (Reduction of Emission from Deforestation and Degradation)
**GIS (Geographic Information System)

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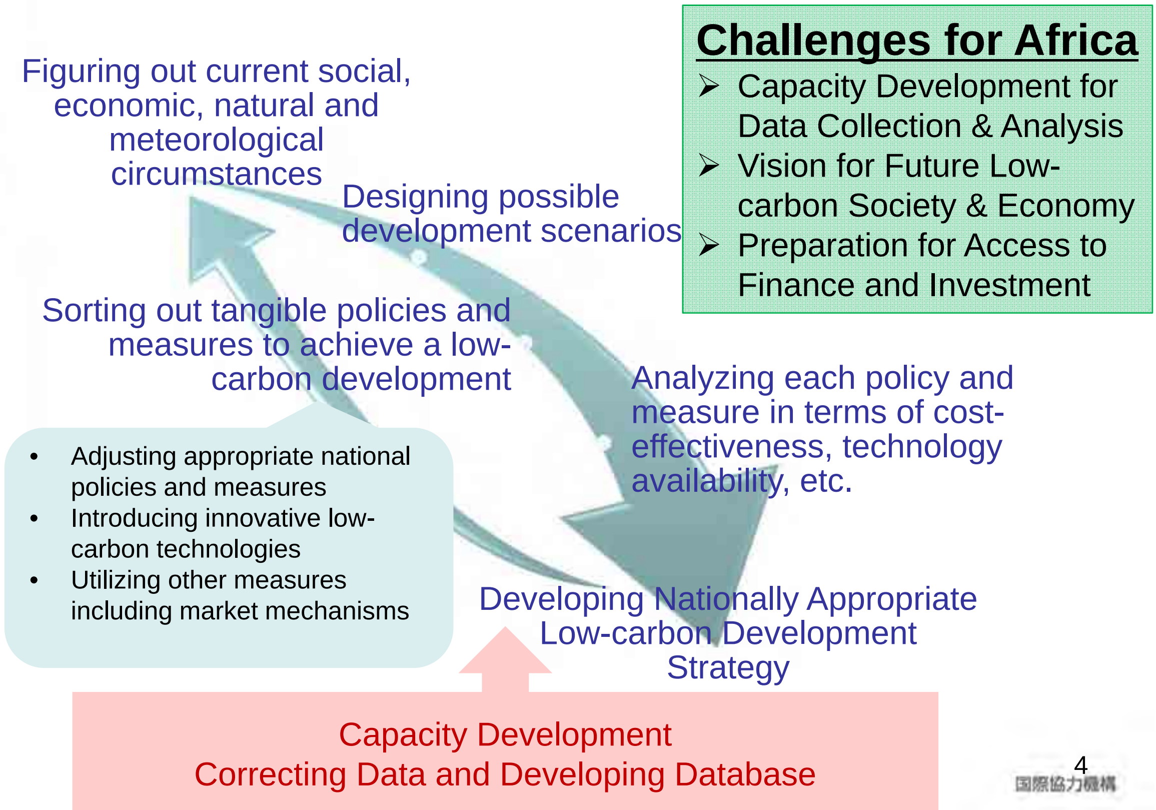
2. Toward a Low-carbon Development
(1) Assistance for Achieving a Low-carbon Development



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Low-carbon and Climate-resilient Development Framework
- Pioneering Examples from Indonesia and Vietnam -

Towards a Low-carbon and Climate-resilient Society

National Development Strategy, Budget Allocation & Finance Plans and Policy Coordination

Mitigation Actions
- NAMA* and MRV of Mitigation Effects
- Energy, Forestry, Transportation, etc.

Adaptation Actions
- Climate prediction & vulnerability assessment
- Disaster prevention, agriculture, fisheries, etc.

Development Policy Loan for Climate Change

Platform for Policy Coordination

Physical Infrastructure Development
- Renewable energy
- Energy efficiency
- Urban transport
- Flood management, etc.

Policy & Institutional Improvement
- Geothermal IPP investment regulations
- Energy efficiency labeling system, etc

Capacity Building
- Climate change projection model analysis
- Formulation of NAMA* in a MRV manner, etc.

Individual Policy, Program and Projects

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Malaysia-Japan Joint Research Project for Development of LSC Scenarios for Asian Regions (TA)

Science and Technology Research Partnership for Sustainable Development (SATREPS)

Science & Technology Research
- To Address global issues through science & technology innovation by Japan's world-leading technology & soft power

\+

International Cooperation
- Boosting self-reliant research & development capacity in developing countries through joint research by Official Development Assistance(ODA)

Research Members

Modeling Workshop

- **Develop methodology** of LCS Scenarios **suitable for Asian countries** in Malaysia as a showcase of rapid development regions in Asia
- **Incorporate research outputs into real planning** of regional/national development **to establish low carbon society** in Malaysia
- Diffuse project outcomes to other Asian countries through training in Malaysia **to enhance low carbon development in whole Asia**

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Outline of "Project of Capacity Development for Climate Change Strategies in Indonesia"

1. CURRENT STATUS
- Substantial GHG emissions, if including deforestation and peat land conversion
- Increase in GHG emissions due to economic development and population growth
- High vulnerability to climate change impacts, particularly among poor communities

2. THE EFFORTS BY THE GOVERNMENT OF INDONESIA
- National Action Plan on Climate Change; COP13 in Bali (2007)
- National Development Planning: Indonesia Responses to Climate Change ; Establishment of National Council on Climate Change (2008)
- Indonesia Climate Change Sectoral Roadmap ; Announcement of the commitment to 26% GHG emission reduction (2009)
- Association with the Copenhagen Accord (2010)

3. INDONESIA'S 26% GHG EMISSION REDUCTION
<7 Areas of Mitigation Actions>
①Sustainable Peat Land Management, ②Reduction in Rate of Deforestation and Land Degradation, ③Development of Carbon Sequestration, ④Promotion of Energy Efficiency, ⑤Development of Alternative and Renewable Energy Sources, ⑥Reduction in Solid and Liquid Waste, ⑦Shifting to Low-Emission Transportation Mode

PROJECT FRAMEWORK
Overall Goal: Promote mitigation and adaptation actions for climate change in Indonesia
Project Purpose: Capacity Development of the Government of Indonesia to formulate climate change policies
SUB-PROJECT1
①NAMA in a MRV manner
②Integration of adaption into development planning
③Background study for RPJMN 2015-2019
SUB-PROJECT2 Vulnerability Assessment
SUB-PROJECT3 National GHG Inventory

PROJECT OUTLINE
(1) Counterpart: National Development Planning Agency (BAPPENAS), The Agency for Meteorology Climatology and Geophysics (BMKG), Ministry of Environment (KLH) , etc.
(2) Area: Indonesia at the national level and pilot areas
(3) Duration: 5years from 2010
(4) Project Budget: about 1.1billion yen
(5) Inputs: ①experts (chief advisor, vulnerability assessment, national GHG inventory, project coordinator) & consulting teams, ②training (long/short term), ③local project cost, etc.

CHIEF ADVISOR (JICA Senior Advisor)

SUB-PROJECT1
Formulate NAMA in a MRV manner and Integrate adaption into development planning
■Counterpart: BAPPENAS
■**Sub-Project Outputs:**
①Capacity for formulating NAMA in a MRV manner
②Capacity for integrating adaptation into development planning
③ Background study for RPJMN 2015-2019 on low carbon development policy
- Pilot sectors for NAMA: sector/sub-sectors relating to Energy Efficiency and Waste
- Pilot Sites: to be determined

SUB-PROJECT2
Vulnerability Assessment
■Counterpart: BMKG
■**Sub-project Outputs:**
① Capacity for climate change projection and verification (assessment of exposure)
②Capacity for assessment of adaptive capacity
- Pilot Site: Bali
- Produce vulnerability assessment report, including vulnerability maps

SUB-PROJECT3
Prepare national GHG Inventories
■Counterpart: KLH
■ **Sub-project Outputs:**
① Capacity to periodically and systematically collect and compile data necessary for national GHG inventories
② Accuracy and reliability of GHG inventories for each sector
③institutional arrangement for preparing national GHG inventories
- Produce draft national GHG Inventory reports (2008 and 2010)

	SUB-PROJECT1	SUB-PROJECT2	SUB-PROJECT3
Stakeholders in Indonesia	・BAPPENAS ・KLH ・local governments, etc.	・BMKG ・KLH ・relevant line ministries ・local governments, etc.	・KLH ・relevant line ministries ・local governments , etc.
Other donors	・GTZ (NAMA/MRV) ・EU (MRV), etc.	・GTZ (vulnerability assessment), etc.	・UNDP (national communication), etc.
Inputs from Japan	・long-term expert (JICA Senior Advisor) & consultant team ・long- & short-term training, etc.	・long-term expert (Stockholm Environmental Institute) ・long-term training (Ibaraki Univ.), etc.	・long-term expert (National Institute of Environmental Studies GHG Inventory Office) & consultant team, etc.

1. Integral Approach
Linkage with the Climate Change Program Loan

2. Flexible Approach
Set flexible TOR for 5-year project duration to be able to respond to the changing landscape of negotiation process on post-2012 framework.

3. Actively Share the outputs and lessons learned with International community
e.g.) UNFCCC/COP, academic societies

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2. Toward a Low-carbon Development
(2) Vision of a Low-carbon Community introducing Renewable Energy

Solar

Basic Training for Introduction of Solar Power
- Introducing new technologies to administrative officials and engineers from developing countries through training in Japan

Geothermal

Kenya: Olkaria 1 Unit 4 and 5 Geothermal Power Project
- Expanding the existing Olkaria 1 geothermal power plant by installation of power generator units 4 and 5, 140MW in total in Rift Valley province of Kenya

Wind

Egypt: Gulf of El Zayt Wind Power Plant Project
- Constructing 220MW wind power plant contributing to achieve the Egyptian target to derive 12% of its total electricity generation from wind power by 2020

Challenges for Africa

Integrating various modes of assistance for effective introduction of renewable energy
- Preparation of roadmap & action plan to promote renewable energy at national level
- Establishing standards, institutions and policies related to renewable energy
- Capacity building
- Financing tangible renewable energy projects

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2. Toward a Low-carbon Development
(3) Vision of a Low-carbon Community with Energy Efficiency and Conservation

Case in Vietnam

Legal, institutional & policy issues

Capacity Building

Strengthening environmental finance

Implementation of EEC actions by firms

【ODA loan】Development Policy Loan for Climate Change（10 bil. JPY*）
■ Budget support for policy / institutional improvement (law and preferential policy measures for EEC, etc.)

【Technical Cooperation】EEC Master Plan
■ Preparation of Roadmap and Action Plan to Promote National Target Program for EEC, etc.

【Technical Cooperation】Capacity Building of Viet Nam Development Bank (VDB)
■ Strengthening environmental finance credit analysis

【ODA loan】Energy Efficiency and Renewable Energy Promoting Project（4.68 bil. JPY*）
■ Finance for energy-saving devices, etc. thru Viet Nam Development Bank, offers EEC consulting services for firms

Challenge for Africa
Identifying the bottleneck at various levels & applying the right mix of tools for assistance

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* Applied highly concessional term (Climate Change Japanese ODA loan)

2. Toward a Low-carbon Development
(4) Vision of a Low-carbon Community with Forest Conservation and REDD+

Achieving sustainable forest management by overcoming forest fires, illegal logging and inappropriate conversion of forest into farm land

Technical Cooperation: Support on Forest Resources Management through Leveraging Satellite Image Information

Removes the influence of clouds on satellite imagery and increases the frequency of the National Forest Inventory updates, through using data from PALSAR, on board the Japanese ALOS satellite and the US MODIS sensor

Expected outcomes include:
- Test estimation of carbon storage amount in forests (possible foundation for REDD+ MRV)
- Improved reliability of forest resource monitoring and assessment

Challenges for Africa
Integrating various schemes of assistance for forest conservation and REDD+
- Steady implementation of ground-based activities
- Applying regional approach, as needed
- Ensuring open and transparent approaches including securing multi-stakeholder's participation
- Encouraging private sector's active involvement

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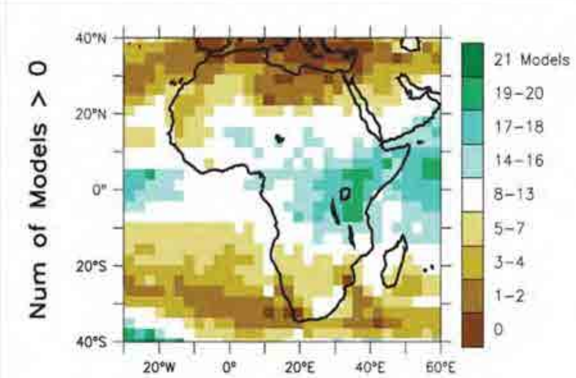
3. Toward Resilient Development
(1) Large Uncertainties in Climate Change

- Livelihood sources are highly dependent on rain-fed agriculture and natural resources in many African countries
- Whereas, there are large uncertainties in modeling future precipitation changes

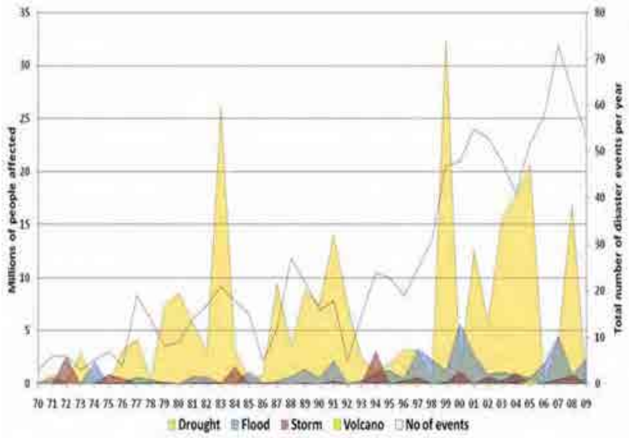


Number of Models out of 21 that project increases in annual mean precipitation (Source: IPCC, AR4)

- Increased Trends of Extreme Weather

"Future changes in precipitation extremes are very likely to be greater than changes in mean precipitation (IPCC, AR4)"

Ex) Recurrent Floods in the Sahel Region



Trends in Natural Disasters in Africa
(Source: Report on the status of Disaster Risk Reduction In Sub-Saharan Africa, 2010/ GFDRR)

3. Toward Resilient Development
(2) Vulnerability and Resilience

- Vulnerability is most commonly defined as 'Exposure + Sensitivity – Adaptive Capacity' (Adger, 2006)
- Vulnerability to climate change should be considered together with other environmental and social stresses (Smit and Wandel, 2006)

- Resilience refers to the 'ability to absorb shock' and 'the ability to adjust or to shape change'(Adger, 2006; Ensor and Berger, 2009)
- Resilience should not be seen as independent of vulnerability (Ensor and Berger, 2009)

- Observed climate change, present-day climate variability and future expectations of change are changing the course of development strategies (Adger et al, 2003)
- Adaptations are mainstreamed into other resource management, disaster preparedness and sustainable development programmes (Smit and Wandel, 2006)

3. Toward Resilient Development (3) In Practice

Reducing Vulnerabilities

- Measures to mitigate vulnerabilities: present-day environmental and social stresses

Close relationship with existent development programmes

- Water supply and management
- Agricultural diversification
- Livelihood diversification
- Other basic development needs such as MDGs

Enhancing Disaster Preparedness

- Need to adapt to multiple climate risks such as flood, drought, storm, etc.

Climate change will likely increase the trends of extreme weather events

- Structural measures

-Infrastructure and 'hard' engineering options

- Non-structural measures

-Early warning systems and other 'soft' adjustments such as land use planning

-Promotion of preventive measures by 'risk communication'

Examples -Structural and Non-Structural Measures against Floods

Structural measures

Non-structural measures






(UPPER)
Multi-purpose evacuation center
(LOWER)
Culvert

(UPPER)
Borehole / Well
(LOWER)
Evacuation center

(UPPER)
Disaster Education at school
(LOWER)
Participatory activity for hazard map

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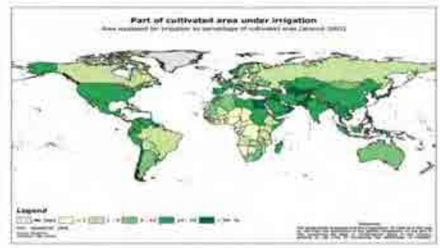
3. Toward Resilient Development
(4) Toward Resilient Agriculture

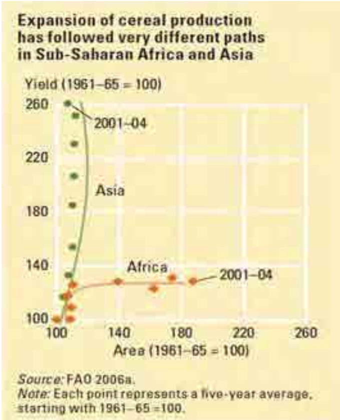
-In many African countries, economy and livelihood structures are highly dependent on rain-fed agriculture.

→ -Potentially very vulnerable to climate change and variability: food security could be threatened.



'Sub-Saharan Africa has a large untapped potential for irrigation' (WDR, 2008)

Only 4 percent of the total cultivated area is under irrigation, with a mere 4 million hectares added in the last 40 years, far less than in any other region



Asian Green Revolution is also called 'Seed-Fertilizer Revolution'

Development and diffusion of a series of fertilizer-responsive, short maturing, non-photoperiod sensitive, high-yielding modern varieties (MVs)

Challenges

- Expansion of irrigated fields
- Exploitation of wet low-lands (that does not require large-scale investment)
- Agricultural diversification for minimizing risks
- Development of value chain and marketing
- Realization of higher agricultural productivity

➢ Climate Finance Impact Tool (Climate-FIT)

JICA has prepared Climate Finance Impact Tool (JICA Climate-FIT), a reference document which contains the following components in order to facilitate consideration of policies and formulation of projects for assisting climate change related measures in developing countries.

1. Mitigation (25 sub-sectors)
Methodologies for MRV related to evaluation of GHG emission reduction

2. Adaptation (15 sub-sectors)
Concepts and guidelines for mainstreaming adaptation considerations into projects that contribute to reduction of vulnerability against climate change, and sustaining and increasing adaptive capacity and resilience

Japan International Cooperation Agency (JICA)
Climate Finance Impact Tool
for Mitigation and Adaptation (Summary)

JICA Climate-FIT (Summary)
Draft Ver. 1.0

June 2011

Office for Climate Change
JICA Global Environment Department

Final Report for Study on Mainstreaming Climate Change Considerations into JICA Operation (Summary) by NIPPON KOEI CO., LTD.

http://www.jica.go.jp/english/operations/climate_change/index.html

Opportunity - Adding Value to Investment（Mitigation）

Chapter 3 Basic concept and guidelines for quantitative evaluation of GHG emission reduction (sequestration) in mitigation

■ Basic Concept
① What is Quantitative Evaluation of GHG Emission Reduction (Sequestration)?
②Basic Concept
■ Composition of Estimation methodology Sheet and Calculation Sheet
① Aim and application
② Contents of Estimation Methodology Sheet
③ Composition of Calculation Sheet

Chapter 2 Selection of target sub-sectors and review of existing methodologies for mitigation

■ Selection of Target Sub-sectors
① Previous loan aid achieved
(Classify yen loan funded projects from 1995 to 2010)
② Loan provided by other donors
■ Methodologies of other certification bodies, etc.
① Reviewed methodologies
② Existing methodologies in each sub-sector

Chapter 4 Estimation methodologies and Calculation Sheet for mitigation project

Identification of mitigation projects

Composition of materials for each sub-sector

Estimation methodology Sheet
1. Outline of typical project
2. Applicability conditions
3. Estimation methodologies
4. Data required for estimation and monitoring
5. Other

Calculation Sheet
(1) Outline of typical project
(2) Applicability conditions

Target sub-sectors

① Forest and Natural Resources Conservation (1. Afforestation, 2. Forest conservation)
②Traffic and Transportation (3. Freight / Passenger Transportation Improvement , 4. MRT, 5. Monorail/LRT, 6. Bus)
③Energy Conservation (Industry)
(7. Energy Efficiency Improvement, 8. Electricity and heat supply, 9. Fuel switching)
④ Energy
(10. Energy plant with fuel switching, 11. Thermal power with electricity and heat supply, 12. Thermal power with fuel switching, 13. Thermal power with higher efficiency, 14. Power transmission with improved efficiency, 15. Power distribution with improved efficiency, 16. Rural electrification)
⑤ Renewable energy
(17. Hydro power, 18. Wind power, 19. Solar power/solar heat, 20. Geothermal power, 21. Biomass)
⑥Sewerage and Urban sanitation
(22. Landfill disposal of waste, 23. Intermediate treatment of waste, 24. Wastewater treatment, 25. Sewerage)

Opportunity - Adding Value to Investment（Adaptation）

Steps, Considerations and Actions for Adaptation Projects

	Evaluation Steps	Considerations and Actions
Step 1	1) Analysis of the Climate Trends from Past to Current and Risk Assessment	Identification of past and current conditions and changes with regard to climate parameters (weather, sea level, fire etc.) and impacts to each sector. Research shall be done by analyzing past data and interviewing stakeholders.
	2) Climate Risks and Changes	a) Identification of the weather condition after climate change. b) Identification of other socio-economic change variables
	3) Assessment of Sensitivity to Climate Change	a) Identification of past disasters b) Conditions of the facilities c) Sensitivity to the climate change
Step 2	4) Assessment of Adaptive Capacity to Climate Change	a) Adaptive Capacity to Climate Change b) Identification of other issues that can affect climate change
Step 3	5) Vulnerability Assessment	Identification of the vulnerability to climate change in the target area in consideration of factors in Step 1 and Step 2. Identification of variations of vulnerability within the target area (in case there are substantial differences)

Sub-sectors Examined in “JICA Climate-FIT (Climate Finance Impact Tool)”

1. Water Resource
2. Irrigation and Drainage
3. Farmland Management Enhancement
4. Forest Preservation / Afforestation
5. Ecosystem Integrity
6. Flood Control
7. Coastal Protection
8. Sediment-related Disaster Prevention
9. Disaster Prevention Information System
10. Rural / Urban Development
11. Bridge, Road and Railway
12. Port and Airport
13. Water Supply
14. Sewerage / Drainage
15. Medical / Health Care

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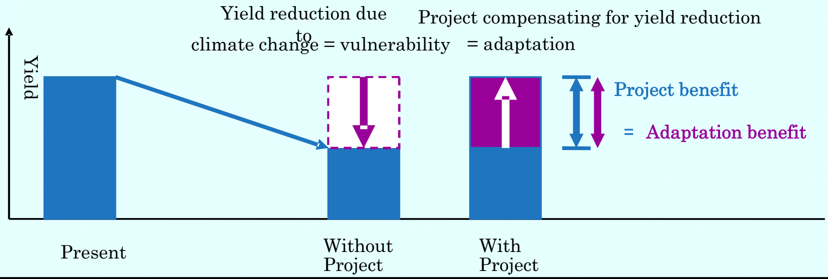
Purpose of Adaptation Finance

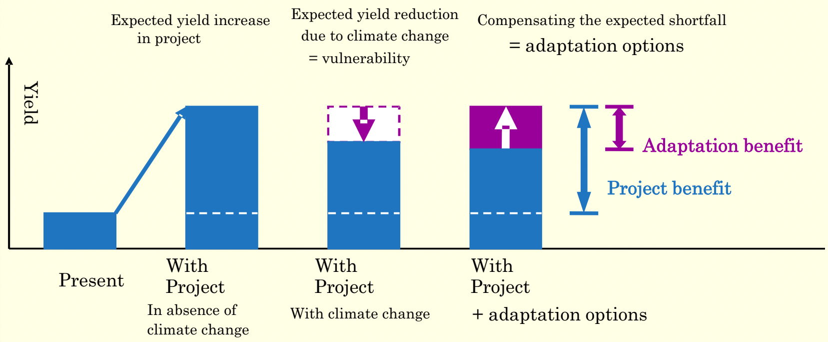
Adaptation Project

Projects formed to reduce the climate change vulnerability in the existing system such as projects to improve existing facility to cope with the increased vulnerability caused by the change of external forcing due to climate change.



Business-as-Usual Development with Adaptation Options

Projects which are not mainly aimed to reduce the vulnerability, but is designed to adapt to the impacts of the climate change in achieving its main objective, such as development and rehabilitation of infrastructure projects that are planned or designed with consideration to increasing external forcing stemming from climate change.



Adaptation Finance

Opportunities and challenges to promote investment that **minimize risks** and **maximize benefits** in the context of development and climate change

Japan International Cooperation Agency

Thank you for your attention.

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JICA Climate Finance Impact Tool (JICA Climate-FIT) Draft Ver. 1.0

<Outline of Mitigation Measures>

Web: http://www.jica.go.jp/english/operations/climate_change/mitigation.html

Office for Climate Change
JICA Global Environment Department
PPT created by: Japan Weather Association

2011/10/17 Ver.

国際協力機構

1. Outline of the Study

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1.1 Background and objective of the study

(1) Background

- "Cancun Agreement"
  (16th Conference of the Parties (COP16) of the United Nations Framework Convention on Climate Change (UNFCCC))
- Support for **mitigation**

  To conduct measurement, reporting and verification (MRV) for quantitative evaluations of greenhouse gas (GHG) emission reduction (sequestration)

- Support for adaptation

  To reduce vulnerability and improve/increase resistance and adaptability particularly in LDC, small island nations, Africa, and elsewhere

(2) Objective

- Future JICA climate change **mitigation projects**
  - Consideration of collaboration policy and compilation of estimation methodologies for quantitative evaluation to implement MRV for GHG emission reduction (sequestration) from inception stage of individual projects

*This study does not intend to provide methodologies for estimating emission reduction credits such as for CDM, therefore, it does not take into account additionality (proof that projects couldn't have been implemented without CDM)

Selection of target sub-sectors
Review of Mitigation Policy
(quantitative evaluation) concept

→ Creation of concept and guidelines for each sub-sector

1.2 Composition of the report

Chapter 1 Outline of the Study

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2. Selection of Target Sub-sectors

2.1 Determination of target sub-sectors

(1) Selection criteria for sub-sectors

・Previous loan aid achieved by JICA
・Potential for developing mitigation project

(2) Process of sub-sector selection

1. Cover sectors and sub-sectors for all yen loan achieved projects from 1995 to 2010

↓

2. Classify JICA funded yen loan projects into mitigation target sub-sectors and non-mitigation target sub-sectors

↓

3. Check against other donors' mitigation projects to confirm mitigation sub-sectors supported by other donors are covered

↓

4. Based on the outcome of above Step 2. & 3., consider high-potential sectors and sub-sectors for mitigation

↓

5. Determine target sub-sectors

2.1 Determination of target sub-sectors

(3) Determination of sector and sub-sectors based on previous JICA loan aid

Extraction of sub-sectors and projects funded by yen loan projects (1,139 projects) between 1995 and 2010

Covered by Mitigation Policy

Sector	Subsector (international yen loan field)	Applicable no.
3 Forestry and natural environment conservation	01 Afforestation	37
	02 Forest preservation/slope protection/soil conservation	15
	03 Mangrove preservation	0
	05 Conservation and study of ecosystem (biodiversity)	5
4 Disaster prevention	07 Forest disaster prevention	0
	08 Countermeasures for sediment disasters (same as 0302)	0
6 Traffic and transportation	04 Railroad	
	001 Freight (new lines, two-track lines)	21
	002 Passengers (new lines, two-track lines, four-track lines)	9
	003 MRT (city and suburban high-speed rail: underground railroad, elevated railroad)	46
	004 Monorail/LRT	2
	005 Railroad track repairs, switch to high standard, railroad bridge improvements	10
	006 Rehabilitation of railroad cars and facilities	8
9 Mining and manufacturing industry	01 Manufacturing	4
	02 Factories and plants	16
	03 Mining industry	3
11 Energy	01 Energy conservation	2
	02 Centralized heat supply system with fuel conversion	26
	03 Simultaneous heat distribution by thermal power generation	4
	04 Fuel conversion of thermal power generation	12
	05 Improved efficiency of thermal power generation	39
	06 Distribution of electricity	64
	07 Hydro power generation (excluding small hydro power and pumping water)	41
	08 Renewable energy	12
	09 Project promoting rural electrification	17
	10 Energy equipment (new establishment of natural gas pipelines)	2
13 Public utilities	02 Urban sanitation (waste treatment)	16
	03 Sewerage	52
	03 Drainage	35
	Total	498

Not covered by Mitigation Policy

Sector	Subsector (international yen loan field)	Applicable no.
1 Water resources	01 Suitable management of water resources	2
	02 Water resources development/water resources facility revision	14
	03 Effective use of water resources	2
	04 Improvement of water and sanitation	0
2 Agriculture and food	01 Irrigation and drainage	56
	02 Cultivation control, irrigation association enhancement	13
	03 Produce development and introduction	3
	04 Information system	0
	05 Animal husbandry	1
	06 Fishing industry	4
	07 Agricultural economy	1
	08 Continuous agriculture construction	2
	09 Maintenance/improvement of plantations	1
	10 Agricultural product manufacturing	1
3 Forestry and natural environment conservation	04 Lakeside/sea coast preservation and restoration	3
4 Disaster prevention	01 Coastal disaster prevention	3
	02 River disaster prevention (flood control)	35
	03 Disaster relief	1
	04 Information system	1
	05 Personnel training, environment management ability	4
	06 Urban disaster prevention	0
	09 Land use control	0
5 Urban community	01 Maintenance of rural regions	38
	02 Urban improvement (industrial parks)	2

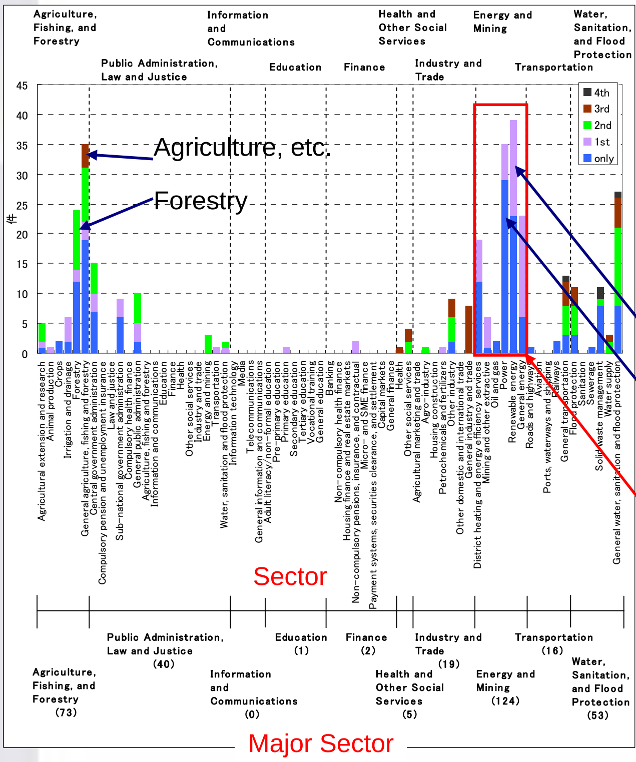
Sector	Subsector (international yen loan field)	Applicable no.
6 Transportation	01 Highways and bridges	164
	02 Airports	35
	03 Harbors	36
	05 Navy	7
	06 Other non-structural traffic management measures such as TDM, etc.	1
	07 Distribution facilities	1
	08 ICT	0
7 Medical care and health	01 Improvement of basic countermeasure abilities	0
	02 Countermeasures for high-risk areas	0
	03 Heat-related countermeasures	0
	04 Malaria countermeasures	0
	05 Water-borne infectious disease countermeasures	1
	06 Medical treatment	15
8 Construction	01 Construction	31
10 Administration	01 Financial affairs/financing	25
	02 Environmental issues	21
	03 Surveying/maps	1
	04 General administration	5
	05 Political system support	57
	06 Support for restoration/reconstruction	0
12 Human resources	01 Education	42
	02 Medical training	13
13 Public utilities	01 Sewerage	96
14 Commerce	01 Tourism	7
15 Communication/broadcasting	01 Telecommunications	17
	02 Broadcasting	11
99 Other	01 Reconstruction	1
	02 Poverty countermeasures	19
	Total	793

498 projects across 6 sectors (Forest and natural resources conservation, disaster prevention, transport, mining, energy, and public utilities) and 29 sub-sectors were classified into mitigation projects. On the other hand, 793 projects across 14 sectors and 52 sub-sectors were non-mitigation projects.

2.1 Determination of target sub-sectors

(4) Trends on mitigation projects supported by other donors

② The World Bank (193 mitigation projects classified by sectors)



Major Sector

Majorities are in energy sector (124 projects)

Sector

Mainly in power generation, renewable energy, agriculture, forestry, public utilities (sewerage, etc.)

Renewable energy

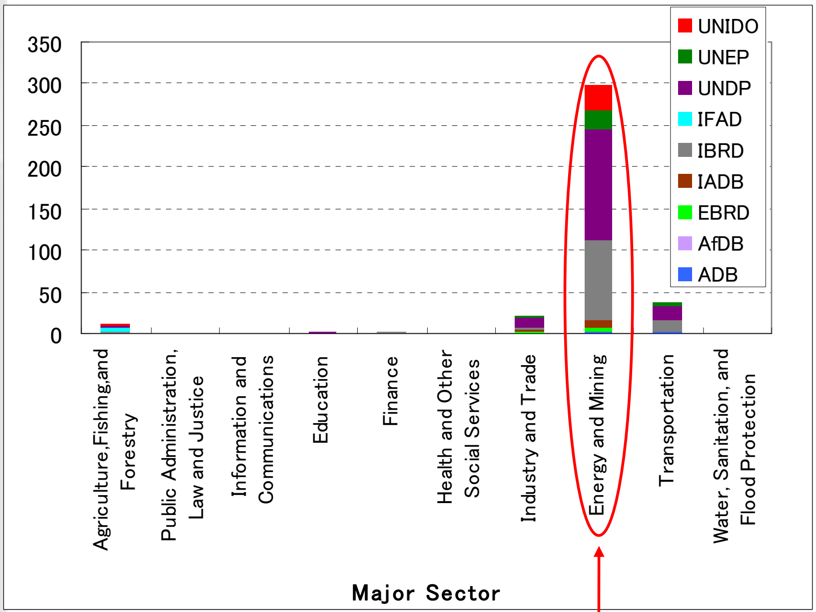
Power Generation

Energy

2.1 Determination of target sub-sectors

(4) Trends on mitigation projects supported by other donors

③ GEF (385 mitigation projects classified by donors and sectors)

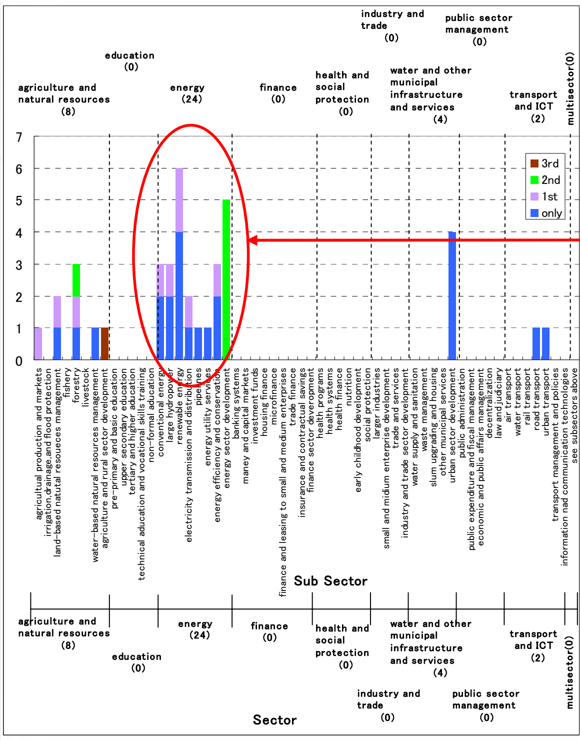


298 of 385 projects are energy related

2.1 Determination of target sub-sectors

(4) Trends on mitigation projects supported by other donors

④ ADB (38 loan funded projects classified by sectors)



Many energy-related projects

2.1 Determination of target sub-sectors

(5) Results on determination of target sub-sectors

The following 6 sectors and 25 sub-sectors were determined as target sectors

・Sub-sector determined (1)

Sector	Sub-sector	Examples of Mitigation Policy
Forest/natural resource conservation	1. Afforestation	Afforestation, reforestation
	2. Forest conservation	Forest conservation
Transportation	3. Passenger/Freight transportation improvement	Passenger (a new railway、a double track railway, or a quadruple track railway） Freight (a new railway, double track railway） Improvement of rails, High standardization
	4. MRT (Mass Rapid Transit)	City and suburb rapid railway (Subway, Elevated railway)
	5. Monorail/LRT	Monorail and Light Rail Transits
	6. Bus（BRT, Trunk bus）	BRT, Trunk bus
Energy conservation（Industry）	7. Energy efficiency improvement in industrial facilities (energy efficiency)	Introduction of high efficiency facilities and technology
	8. Electricity and heat supply in industrial facilities	Effective utilization of waste heat and waste gas
	9. Fuel switching in industry facilities	Fuel switching from coal or petroleum to natural gas

2.1 Determination of target sub-sectors

・Sub-sector determined (2)

Sector	Sub-sector	Examples of Mitigation Policy
Energy	10. Energy plant construction with fuel switching	Natural gas pipeline Natural gas supply system Intensive heat-supply facilities
	11. Thermal power with electricity and heat supply	Cogeneration (waste heat and waste gas use）
	12. Thermal power with fuel switching	Natural gas plants Natural gas pipeline Fuel switching from coal or petroleum to natural gas for existing thermal power plants
	13. Thermal power with high efficiency	Combined-cycle electric generation High efficient coal thermal power plants Thermal power plants improvement
	14. Power transmission with improved efficiency	Decreasing of electrical loss due to improved power transmission systems
	15. Power distribution with improved efficiency	Decreasing of electrical loss due to improved power distribution systems
	16. Rural electrification	Rural electrification project by renewable energy use
Renewable Energy	17. Hydro power	Small hydro power, river-runoff hydro power Reservoir hydro power (except for pumped and storage hydro power)
	18. Wind power	Wind power plants
	19. Photovoltaic power/Solar heat	Solar power plants
	20. Geothermal power	Geothermal plants
	21. Biomass	Power generation and heat supply using biomass
Sewerage and Urban sanitation	22. Landfill disposal of waste	Landfill LFG power generation
	23. Intermediate treatment of waste	Waste power plants, waste composition
	24. Wastewater treatment	Methane emission reduction by improving wastewater treatment
	25. Sewerage	Biomass generation and composting sewage sludge

2.2 Methodologies of other certification organizations, etc.

Existing methodologies and tools are reviewed in order to clarify the basic concept and guidelines to be provided under this survey.

(1)Reviewed methodologies

This survey mainly reviews CDM methodologies. Other methodologies, including domestic and international Voluntary Emissions Trading methodologies, GHG emission reduction calculation manual or tool used by international organization for assistance to developing countries, and VER certification organization methodologies are also considered.

・Target of existing GHG estimation methodologies

Survey Targets	
CDM Methodology	Approved methodologies, Approved consolidated methodologies, Small-scale CDM methodology, Afforestation/reforestation CDM Methodology, Approved consolidated afforestation/reforestation CDM methodology, Small-scale approved consolidated afforestation/reforestation CDM methodology
Domestic Voluntary Emissions Trading methodologies	J-VER（offset-credit) system (Ministry of the Environment, Japan）
	Domestic Credit System (Domestic emission certification system)（ Ministry of Economy, Trade and Industry, Ministry of the Environment, Ministry of Agriculture, Forestry and Fisheries, Japan）
	J-MRV (Japan Finance Corporation, Japan Bank For International Cooperation）
Manual or tool to estimate GHG emission reduction by international organization (Developing country support)	WB, IFC, OECD, ADB, UNEP, GEF, GHG protocol, USAID, CIDA, GTZ, KFW, PROPARCO
Methodology of VER Certification agency	Gold Standard、VER+、CCB Standards, Green-c, VOS, CCX, CCAR, Plan Vivo, Social Carbon, NCOS

2.2 Methodologies of other certification organizations, etc.

（2）Existing methodologies for targeted sub-sectors

The existing methodologies and tools are classified into each of the mitigation sub-sectors and served as basic data for discussion of this survey. Some of the applied methodologies in past projects are as follows.

①Forest and natural resources conservation sector

Some of the methodologies of CDM and J-VER are applied in the forestry sector. Application of CDM to afforestation projects is limited. AR-AM0003 has the most applied numbers, with only 4 approved projects. On the other hand, there is progress in application of Japan's J-VER methodologies to domestic forest management projects. There are two methodologies on increase of CO2 sequestration through forest management activities, with 51 applications for one of the methodologies (Thinning Promotion R001).

・Applied number of methodologies for each sub-sectors

Sub-Sector	CDM	VCS	Domestic Credit System	J-MRV	J-VER
Afforestation	12	-	-	-	-
Forest conservation	-	Unknown	-	-	60

Note：Application number is indicated in the approved real ones. In ( ) indicate the number of cases pending projects.（as of March 31, 2011）
'0': there are methodologies but no applied cases. '-':there are no methodologies.

2.2 Methodologies of other certification organizations, etc.

（2）Existing methodologies for targeted sub-sectors

②Traffic and transportation sector

Some methodologies are currently available for CDM and J-VER in traffic and transportation sector. However, only CDM methodologies have been applied to actual project activities. There are only 6 projects including five modal shift projects and one bio-diesel production projects because of the geographically large project boundary and difficulties in estimating/verification/monitoring of GHG emission reductions effect.

・Applied number of methodologies for each sub-sectors

Sub-Sector	CDM	VCS	Domestic Credit System	J-MRV	J-VER
Freight/Passenger Transportation Improvement	2	-	-	-	-
MRT（Mass Rapid Transit）	0	-	-	-	-
Monorail, LRT	1	-	-	-	-
Bus (BRT, Trunk bus)	2(1)	-	-	-	-

Note：Application number is indicated in the approved real ones. In ( ) indicate the number of cases pending projects.（as of March 31, 2011）
'0': there are methodologies but no applied cases. '-':there are no methodologies.
there are methodologies in the sub-sectors other than above sub-sectors about J-VER

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2.2 Methodologies of other certification organizations, etc.

（2）Existing methodologies for targeted sub-sectors

③Energy conservation (Industry) sector

Energy conservation (Industry) sector has methodologies and actual application examples in the CDM,J-VER, Domestic Credit System and J-MRV. Domestic Credit System 001 is ranked highest at 248 applications in the sub-sector of energy efficiency improvement for industrial facilities. Also, the small-scale approved methodologies, AMS-II.D, ranked highest at 42 among other methodologies for the CDM. The CDM-approved consolidated methodology, ACM0012, ranked highest at 22 in cogeneration (supply of electricity and heat) for industrial facilities. Small-scale CDM methodology AMS-III.B and consolidated methodology ACM0003, both with 13 applications each, rank the highest among the methodologies in the sub-sector of fossil fuel switching measure for industrial facilities.

・Applied number of methodologies for each sub-sectors

Sub-Sector	CDM	VCS	Domestic Credit System	J-MRV	J-VER
Energy Efficiency Improvement	66	-	493	Unknown	5
Electricity and heat supply	46 (2)	-	8	Unknown	2
Fuel switching	77（2）	-	1	-	13

Note：Application number is indicated in the approved real ones. In ( ) indicate the number of cases pending projects.（as of March 31, 2011）
'0': there are methodologies but no applied cases. '-':there are no methodologies.

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2.2 Methodologies of other certification organizations, etc.

(2) Existing methodologies for targeted sub-sectors

④Energy sector

The energy sector has methodologies and actual application examples in the CDM and VCS. Projects under CDM-approved methodology AM0029 ranked highest at 31 in the sub-sector of plant supplying energy maintenance with fuel switching, targeting projects that supply natural gas originated electricity to a grid. Projects under CDM-approved consolidated methodology ACM0012 ranked second at 22 in the sub-sector of fossil fuel fired power plants for supplying electricity. Projects under CDM small-scale methodology MS-III.B ranked third at 13 in the sub-sector of fossil fuel-fired power plants for fuel switching.10 projects have applied CDM small-scale methodology AMS-II.B in the sub-sector of fossil fuel-fired power plants for efficiency improvement, targeting projects that replace plants such as boilers in fossil fuel-fired power plants.

・Applied number of methodologies for each sub-sectors

Sub-Sector	CDM	J-MRV
Energy plant with fuel switching	36(1)	-
Thermal power with electricity and heat supply	23(1)	-
Thermal power with Fuel switching	14(1)	-
Thermal power with Higher efficiency	17	Unknown

Sub-Sector	CDM	J-MRV
Power transmission With improved efficiency	0	-
Power distribution With improved efficiency	0	-
Rural electrification	0	-

Note: Application number is indicated in the approved real ones. In ( ) indicate the number of cases pending projects. (as of March 31, 2011)
'0': there are methodologies but no applied cases. '-':there are no methodologies.

2.2 Methodologies of other certification organizations, etc.

(2) Existing methodologies for targeted sub-sectors

⑤Renewable energy sector

The renewable energy sector has some methodologies available with the CDM, J-VER, and Domestic Credit System. However, only the CDM and Domestic Credit System exhibit actual application examples. Most CDM methodologies fall into two sub-sectors. One group is categorized into hydro, wind, photovoltaic and geothermal. The other is biomass. Projects under approved consolidated methodology ACM0002 ranked highest at 900, while projects under small-scale approved methodology AMS-I.C ranked second at 846 in the sub-sector group of hydro, wind, photovoltaic and geothermal. These are all projects for grid-connected electricity generation from renewable sources. The above 2 methodologies account for about half of the current CDM approved projects. Bio-diesel production and use for transportation applications are referred separately in the fuel switching methodologies. Approved consolidated methodology for electricity generation with biomass residues under ACM0006 is here regarded as the highest ranking methodology with 93 application cases.

・ Applied number of methodologies for each sub-sectors

Sub-Sector	CDM	VCS	Domestic Credit System	J-MRV	J-VER
Hydro,Wind, Photovoltaic power /solar heat, Geothermal power	1,864(54)	-	21	Unknown	-
Biomass	93(1)	-	-	-	-

Note: Application number is indicated in the approved real ones. In ( ) indicate the number of cases pending projects. (as of March 31, 2011)
'0': there are methodologies but no applied cases. '-':there are no methodologies.

2.2 Methodologies of other certification organizations, etc.

（2）Existing methodologies for targeted sub-sectors

⑥Sewerage and urban sanitation sector

Sewerage and urban sanitation sector have methodologies, but only the CDM has actual application examples. In the sub-sector of waste management, projects under approved consolidated methodology ACM0001 ranked highest at 129. These include the methodologies for landfill gas capture projects. In the 2 sub-sectors of treatment of wastewater and sewerage, 93 projects have applied small-scale approved methodology, targeting projects for methane recovery in wastewater treatment.

・Applied number of methodologies for each sub-sectors

Sub-Sector	CDM	VCS	Domestic Credit System	J-MRV	J-VER
Landfill disposal of waste	187	-	-	-	-
Intermediate treatment of waste	38	-	-	-	-
Wastewater treatment	101（5）	-	-	-	-
Sewerage	103（5）	-	-	-	-

Note：Application number is indicated in the approved real ones. In ( ) indicate the number of cases pending projects.（as of March 31, 2011）
'0': there are methodologies but no applied cases. '-':there are no methodologies.

3. Basic Concept on Quantitative Evaluation of GHG Emission Reduction (Sequestration)

3.1 Quantitative evaluation of GHG emission reduction (sequestration) in mitigation

(1) Mitigation against global warming

・Measure to prevent global warming and stabilize the concentration of greenhouse gas in the atmosphere by reducing (sequestrating) GHG emission, which cause global warming

・Time-consuming process and challenges, however, it is a countermeasures toward fundamental solution.

Examples:
- Efficient use of energy resources
- Energy efficiency measures
- Carbon capture and storage (CCS), and increase in absorption sources

(2) Quantification of GHG in mitigation

Quantitative estimation of the effect of GHG emission reduction as a result of implementation of countermeasures (project)

3.2 Basic concept on GHG emission estimation

(1) Transportation, energy, renewable energy, sewerage and urban sanitation sectors

・GHG emission reduction (ERy) is calculated by the difference between emission without project (Baseline emissions, BEy) and emission with implementation of the project (Project emissions, PEy) .

$$ER_y = BE_y - PE_y$$

ERy : GHG emission reduction results
BEy : Emissions without project (Baseline emissions)
PEy : Emissions with implementation of project (Project emissions)

・Baseline emissions

- GHG emission by continuation of current situation without project
- Activity level in the baseline is estimated based on the same amount of electricity generation or production output when the project has been implemented.

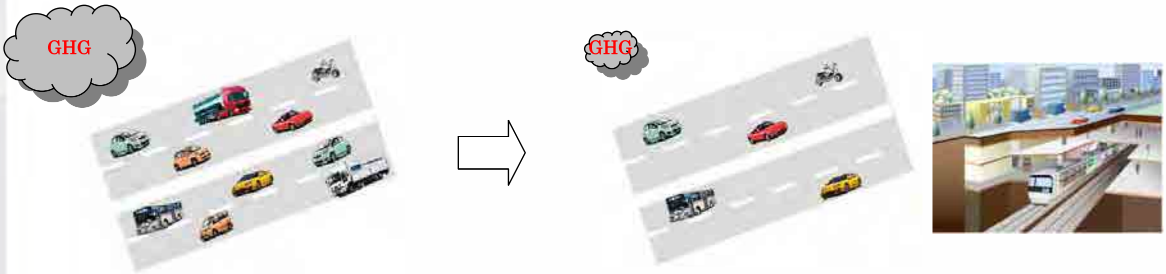
・Project emissions

- GHG emission by implementation of the project
- Project emissions are basically smaller than baseline emissions
- For renewable energy, GHG emission from project implementation are regarded zero

3.2 Basic concept on GHG emission estimation

・Example of MRT project baseline emissions and project emissions

BE$_y$：Baseline emissions (without implementing project)　***PE$_y$***：Project emissions (with implementation of project)



・In case of <u>development finance projects</u>

└→ Support multiple small to medium sized sub-projects through intermediary financial institutions

・ Taking into account data availability and workload, etc., estimation of GHG emission should adopt simplified method such as the methodologies presented in this study.

3.2 Basic concept on GHG emission estimation

(2) Forestry and natural resources conservation sector

Trees grow by sequestrating carbon dioxide from the atmosphere and fixing carbon through photosynthesis
＝Afforested land is a sink of carbon dioxide (or carbon)

Net anthropogenic GHG removal by sinks: $ER_{AR,y}$ by afforestation is calculated by deducting the increment (or decrement) of the amount of carbon stocks when afforestation is not carried out (baseline sequestration: $\Delta C_{BSL,y}$) and GHG emission produced when implementing afforestation projects (project emissions: $GHG_{PRJ,y}$) from the increment (or decrement due to thinning, harvest or lumbering, etc.) of carbon stocks on afforested land after project implementation over a fixed period (project sequestration: $\Delta C_{PRJ,y}$).

$$ER_{AR,y} = \Delta C_{PRJ,y} - \Delta C_{BSL,y} - GHG_{PRJ,y}$$

$ER_{AR,y}$: Net anthropogenic GHG removal by sinks over y (years) of afforestation (t-CO_2/y)
$\Delta C_{PRJ,y}$: Annual GHG removal by sinks over y (years) of afforestation (t-CO_2/y) (Project sequestration)
$\Delta C_{BSL,y}$: Annual GHG removal by sinks over y (years) of no afforestation (t-CO_2/y) (Baseline sequestration)
$GHG_{PRJ,y}$: GHG emissions over y (years) of afforestation (t-CO_2/y) (Project emissions)

4. Formulation Process of Mitigation Project and GHG Emission Reduction Estimation Methodologies by Sub-Sector

4.1 Formulation Process of Mitigation Project

1. Inception of the study

Confirmation of the projects' correspondence to each sub-sector identified in the study

Projects not classified as mitigation measure

Projects' targeted field is not relevant to sub-sector for mitigation

No GHG emission reduction (sequestration) can be achieved by the project

"Estimation methodology Sheet" by sub-sector →

"Calculation Sheet" by sub-sector in excel →

2. Calculation of mitigation effects

Calculate GHG reduction effects of the projects by each sub-sector

3. Classification of the projects

Projects that can be classified as mitigation measure

Projects to reduce GHG directly

Projects directly reduce GHG such as through efficient use of energy through energy efficiency

Projects to absorb CO_2

Projects to increase in CO_2 sink through afforestation, etc. CO_2 absorption and fixation

4. Preparatory study for future collaboration, etc.

・Concrete content of mitigation measures
・Level of effectiveness of GHG emission reduction (sequestration)

4.2 Estimation Methodology for Each Sub-sector (Outline)

(1) Forestry and Natural Resources Conservation Sector

1. Afforestation
2. Forest conservation

1. Afforestation

(1) Outline of typical project

Enlarge CO_2 sequestration source by carrying out afforestation on land that has not been afforested, such as degraded lands, grasslands, agricultural land, etc.

(2) Applicability conditions

The land to be afforested must not fall under the country's definition of forest.
After afforestation, forest work such as periodic thinning, etc. is to be carried out and forests are to be continuously managed.

(3) Estimation methodology

Trees grow by sequestrating carbon dioxide from the atmosphere through photosynthesis. Therefore, calculations are to be made by considering the afforested land as a sink of carbon dioxide (or carbon). Net anthropogenic GHG removal by sinks is calculated by deducting the increment (or decrement) of the amount of carbon dioxide stock when afforestation is not carried out (baseline sequestration) and GHG emissions produced when implementing afforestation projects (project emissions) from the increment (or decrement due to periodic thinning, harvest or lumbering, etc.) of carbon dioxide stock on afforested land after project implementation over a fixed period (project sequestration).

$$ER_{AR,y} = \Delta C_{PRJ,y} - \Delta C_{BSL,y} - GHG_{PRJ,y}$$

$ER_{AR,y}$: Net anthropogenic GHG removal by sinks over year y of afforestation (t-CO_2/y)
$\Delta C_{PRJ,y}$: Annual GHG removal by sinks over year y of afforestoation (t-CO_2/y) (project sequestration)
$\Delta C_{BSL,y}$: Annual GHG removal by sinks over year y of no afforestoation (t-CO_2/y) (baseline sequestration)
$GHG_{PRJ,y}$: GHG emissions over year y of afforestoation (t-CO_2/y) (project emissions)

1. Afforestation

(3) Estimation methodology

① Estimation of project sequestration

The annual project sequestration is estimated by the difference of carbon dioxide stock on afforested land at y (year) and previous year (y-1 year). The amount of carbon dioxide stored is estimated by multiplying the biomass volume of (dry weight) of afforested trees by the afforestation area and carbon/CO_2 conversion factor.

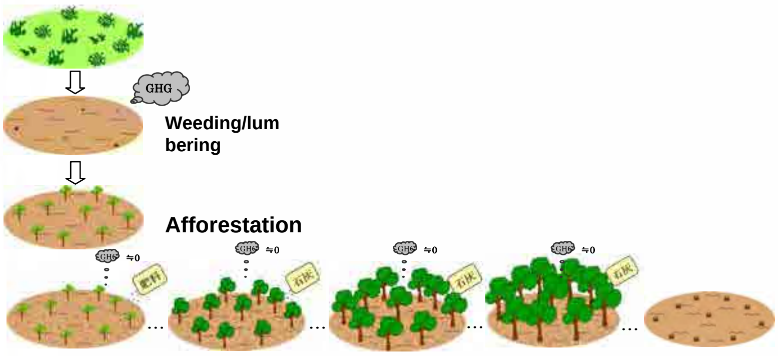
② Estimation of baseline sequestration

If it is supposed that there is no afforestation, the same vegetation conditions continue from year to year, hence the baseline sequestration will be zero.
The baseline removal by sinks will be estimated by the difference of carbon dioxide stock of the original vegetation on land to be afforested at y (year) and previous year (y-1 year). The amount of carbon dioxide stock is estimated by multiplying the biomass volume (dry weight) of grass, etc. by the area and carbon/CO_2 conversion factor.

1. Afforestation

(3) Estimation methodology

③ Estimation of project emissions



Project emissions are estimated as sum of ① nitrous oxide (N_2O) by fertilization and ② GHG emissions due to weeding of naturally growing grass and crops as part of preparation of the land for afforestation.

1. Afforestation

(4) Other

① Project boundary

The scope of GHG estimation will cover the land to be afforested in the project.

② Leakage

When shifting humans and agricultural activities (farming/stock-farming) due to project implementation, there is a risk of the loss (leakage) of the carbon stock due to deforestation outside the boundary. However, while this estimation formula subjects grasslands and agricultural land to afforestation, it does not cover projects where large numbers of farmers and related agricultural activities are shifted outside of the boundary, so leakage is regarded as being zero. Still, if there is a risk of leakage from the effects of moving humans and agricultural activities (farming/stock-farming), leakage will be calculated by taking into account the farming area and number of livestock, etc. moved outside the boundary.

③ Monitoring

In loan-funded projects, normally only one post-audit is conducted after completion of the project. There is no need to monitor baseline sequestration in afforestation projects. As for other items (project sequestration and project emissions), monitoring will be carried out once the arrival of the afforestation project results can be confirmed, and estimations will be made after the project has been implemented. In addition to the difficulty of ascertaining these post-audit implementation periods in afforestation projects, further difficulty may be caused by the enlargement of the area. Satellite imaging is useful in the resolution of these problems.

2. Forest conservation

(1) Outline of typical project

Reduction of GHG emissions (REDD) by avoiding deforestation due to uncontrolled logging of natural woods, etc. in developing countries.

(2) Applicability conditions

Forests must be managed continuously.

(3) Estimation methodology

Trees grow by sequestrating carbon dioxide from the atmosphere and fixing carbon through photosynthesis, so forests can be considered as sinks of carbon dioxide (or carbon).
Reduction of net anthropogenic GHG emissions by the project is calculated by the increment of the decreased amount of stored carbon dioxide when measures are not taken for a fixed period (baseline emissions) and the decreased amount of stored carbon dioxide after the project has been implemented (project emissions).

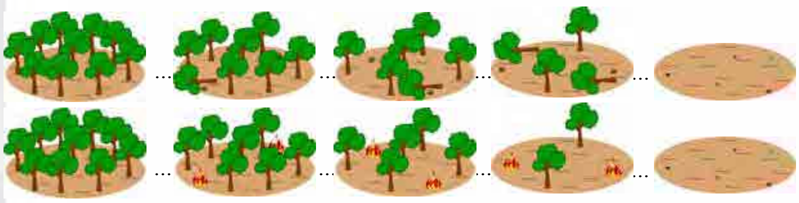
$$ER_{REDD,y} = \Delta C_{BSL,y} - \Delta C_{PRJ,y}$$

$ER_{REDD\,y}$: Net anthropogenic GHG reductions by REDD over y (years) (t-CO_2/y)
$\Delta CBSL,y$: Annual GHG emissions over y (years) without REDD (t-CO_2/y) (Baseline emissions)
$\Delta CPRJ,y$: Annual GHG emissions over y (years) with REDD (t-CO_2/y) (Project emissions)

2. Forest conservation

(3) Estimation methodology

① Estimation of baseline emissions



This is estimated as the difference between carbon dioxide sinks in forest at y (year) and previous year (y-1 year) supposing that no REDD project is implemented. The amount of carbon dioxide stock is estimated by multiplying the biomass volume (dry weight) of trees by the area (taking into account deforestation) and carbon/CO_2 conversion factor.

② Estimation of project emissions

Project emissions after implementation of the REDD project will be estimated by the difference of carbon dioxide stock in forest at y (year) and previous year (y-1 year). The amount of carbon dioxide stored is estimated by multiplying the biomass volume (dry weight) of trees by the forest area and carbon/CO_2 conversion factor.

2. Forest conservation

(4) Other

① Project boundary

The scope of GHG estimation will cover the REDD region within the project site.

② Leakage

When shifting humans and agricultural activities (farming/stock-farming) due to project implementation, there is a risk of the loss (leakage) of the carbon stock due to deforestation outside the boundary. However, while this estimation formula subjects grasslands and agricultural land to afforestation, it does not cover projects where large numbers of farmers and related agricultural activities are not shifted outside of the boundary, so leakage is regarded as being zero. Still, if there is a risk of leakage from the effects of moving humans and agricultural activities (farming/stock-farming), leakage will be calculated by taking into account the farming area and number of livestock, etc. moved outside the boundary.

③ Monitoring

In loan-funded projects, normally only one post-audit is conducted after completion of the project. There is no need to monitor baseline sequestration in afforestation projects. As for other items (project sequestration and project emissions), monitoring will be carried out once the arrival of the afforestation project results can be confirmed, and estimations will be made after the project has been implemented. In addition to the difficulty of ascertaining these post-audit implementation periods in afforestation projects, further difficulty may be caused by the enlargement of the area. Satellite imaging is useful in the resolution of these problems.

(2) Traffic and Transportation Sector

3. Freight / Passenger Transportation Improvement
 - Railway Passengers
 - Railway Freight
4. MRT (Mass Rapid Transit)
5. Monorail/LRT
6. Bus (BRT/Trunk Bus)

3.1 Freight / Passenger Transportation Improvement (Railway Passengers)

(1) Outline of typical project

Introduction of new lines, double line, and quadruple line in passenger railroad to control green house gas (GHG) emission by promoting modal shift or electrification of existing transport facilities.

(2) Applicability conditions

After project implementation, there will be a railroad infrastructure with mass passenger transportation. Baseline transportation facilities are road traffic such as buses, private vehicles, taxis, bikes, etc. Railroad electrification projects will also cover railroad (non-electrification) baseline transportation systems. Passenger trains will be powered by electricity or internal-combustion engines.

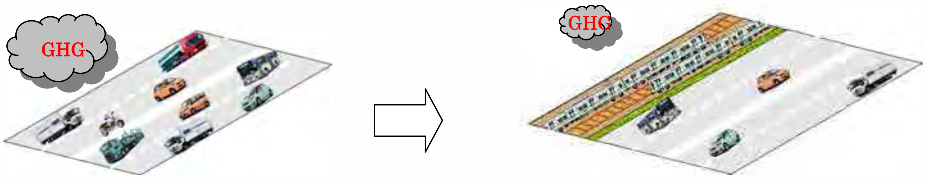
3.1 Freight / Passenger Transportation Improvement (Railway Passengers)

(3) Estimation methodology

GHG emission reduction by the introduction of new lines, double line, and quadruple line are estimated by the difference between GHG emission through continuation of existing transport facilities (buses, private vehicles, taxis, bikes) and GHG emission when there has been a modal shift (project) to passenger railroad. Alternatively, this will be estimated by the difference of GHG emission in railroad without electrification (baseline) and railroad with electrification (project).

BE_y : Baseline emissions

PE_y : Project emissions



Emissions when existing transport facilities continue, without introduction of passenger railroad

Emissions when passenger railroad is introduced

$$ER_y = BE_y - PE_y$$

ERy: GHG emission reduction by project implementation over year y (years) (t-CO_2/y)
BEy: GHG emission by continuation of existing transport facilities over year y (years) (t-CO_2/y)
PEy: GHG emission by a modal shift to passenger railroad (years) (t-CO_2/y)

3.1 Freight / Passenger Transportation Improvement (Railway Passengers)

(3) Estimation methodology

① Estimation of baseline emissions

(a) Road transport facilities

Assuming the same number of passengers in existing transportation facilities will be taken over by the railroad after project implementation, baseline emissions is calculated by multiplying the number of passengers in each type of car by CO_2 emissions per passenger prior to project implementation.

(b) Railroad without electrification (diesel/internal-combustion engine trains)

Estimated by multiplying the annual total fuel consumption of existing passenger trains (diesel/internal-combustion engine) by CO_2 emission factor of fuel consumed.

② Estimation of project emissions

(a) Electric-powered (electric train or electric locomotives)

Estimated by multiplying the amount of annual total fuel consumption (planned figure) of passenger trains (diesel/internal-combustion engine) after project implementation, by CO_2 emission factor of electricity consumed.

(b) Internal-combustion engines (diesel/internal combustion engine trains)

Estimated by multiplying the amount of annual total fuel consumption (planned figure) of passenger trains (diesel/internal-combustion engine) after project implementation, by CO_2 emission factor of fuel consumed.

3.1 Freight / Passenger Transportation Improvement (Railway Passengers)

(4) Other

① Project boundary

The scope of GHG estimation will cover the area of passenger railroad services.

② Leakage

When considering Life Cycle Assessments (LCA) of passenger railroad, leakage may include GHG emission from energy consumption when producing/transporting raw materials for construction/manufacturing of railroad-related facilities, railroad cars, etc. However, these GHG emission are not to take into account.

3.2 Freight / Passenger Transportation Improvement (Railway Freight)

(1) Outline of typical project

Introduction of new lines, double line, and quadruple line in (freight) railroad to control green house gas (GHG) by promoting modal shift or electrification of existing transport facilities.

(2) Applicability Conditions

After project implementation, there will be a railroad infrastructure with mass freight transportation. Baseline transportation facilities are road traffic (trucks and). Railroad electrification projects will also cover railroad (non-electrification) baseline transportation systems. Freight trains will be powered by electricity or internal-combustion engines.

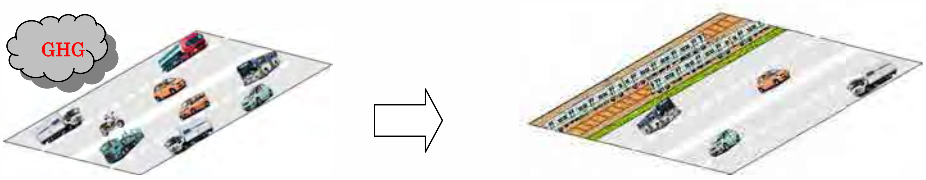
3.2 Freight / Passenger Transportation Improvement (Railway Freight)

(3) Estimation methodology

GHG emission reduction by the introduction of new lines, double line, and quadruple line are estimated by the difference between GHG emission through continuation of existing transport facilities (trucks and trailers) and GHG emission when there has been a modal shift (project) to freight railroad. Alternatively, this will be estimated by the difference of GHG emission in railroad without electrification (baseline) and railroad with electrification (project).

BE_y : Baseline emissions

PE_y : Project emissions



Emissions when existing transport facilities continue, without introduction of freight railroad

Emissions when freight railroad is introduced

$$ER_y = BE_y - PE_y$$

ERy: GHG emission reduction by project implementation over year y (years) (t-CO_2/y)
BEy: GHG emission by continuation of existing transport facilities over year y (years) (t-CO_2/y)
PEy: GHG emission by a modal shift to freight railroad (years) (t-CO_2/y)

3.2 Freight / Passenger Transportation Improvement (Railway Freight)

(3) Estimation methodology

① Estimation of baseline emissions

(a) Road transport facilities

Assuming the same amount of freight in existing transportation facilities will be taken over by the railroad after project implementation, baseline emissions is calculated by multiplying the amount of freight in each type of car by CO_2 emissions per freight (ton) prior to project implementation.

(b) Railroad without electrification (diesel/internal-combustion engine trains)

Estimated by multiplying the annual total fuel consumption of existing freight trains (diesel/internal-combustion engine) by CO_2 emission factor of fuel consumed.

② Estimation of project emissions

(a) Electric-powered (railroad with electricity or electric locomotives)

Estimated by multiplying the amount of annual total fuel consumption (planned figure) of freight trains (diesel/internal-combustion engine) after project implementation, by CO_2 emission factor of electricity consumed.

(b) Internal-combustion engines (diesel/internal combustion engine trains)

Estimated by multiplying the amount of annual total fuel consumption (planned figure) of passenger freight (diesel/internal-combustion engine) after project implementation, by CO_2 emission factor of fuel consumed.

3.2 Freight / Passenger Transportation Improvement (Railway Freight)

(4) Other

① Project boundary

The scope of GHG estimation will cover the area of freight railroad services.

② Leakage

When considering Life Cycle Assessments (LCA) of freight railroad, leakage may include GHG emission from energy consumption when producing/transporting raw materials for construction/manufacturing of railroad-related facilities, railroad cars, etc. However, these GHG emission are not to take into account.

4. MRT (Mass Rapid Transit)

(1) Outline of typical project

Introduction of Mass Rapid Transit systems (MRT) to control green house gas (GHG) emission by promoting a modal shift.

(2) Applicability conditions

After project implementation, there will be a high-speed railroad (subway/elevated railroad) infrastructure linking cities and suburbs, and a system implementing rapid passenger transit. Baseline transportation facilities are road traffic such as buses, private, taxis, bikes, etc. High-speed railroad will be powered by electricity.

4. MRT (Mass Rapid Transit)

(3) Estimation methodology

GHG emission reductions by the introduction of MRT are estimated by the difference between GHG emissions when existing transportation facilities (buses, private vehicles, taxis, bikes) continue (baseline) and GHG emissions when there has been a modal shift (project) to MRT.

BE_y : Baseline emissions

Emissions when existing transportation facilities are continued without introduction of MRT

PE_y : Project emissions

Emissions when MRT is introduced

$$ER_y = BE_y - PE_y$$

ERy: GHG emission reduction by project implementation over year y (years) (t-CO_2/y)
BEy: GHG emission by continuation of existing transport facilities over year y (years) (t-CO_2/y)
PEy: GHG emission by a modal shift to MRT (years) (t-CO_2/y)

4. MRT (Mass Rapid Transit)

(3) Estimation methodology

① Estimation of baseline emissions

Assuming the same number of passengers in existing transportation facilities will be taken over by MRT after project implementation, baseline emissions is calculated by multiplying the number of passenger in each type of car by CO_2 emissions per passenger prior to project implementation.

② Estimation of project emissions

Estimated by multiplying the amount of annual total fuel consumption (planned figure) of MRT trains after project implementation, by CO_2 emission factor of electricity consumed.

(4) Other

① Project boundary

The scope of GHG estimation will cover the area MRT services.

② Leakage

When considering Life Cycle Assessments (LCA) of MRT, leakage may include GHG emission from energy consumption when procuring/transporting raw materials for construction/manufacturing of railroad-related facilities, railroad cars, etc. or during the construction and manufacturing. However, these GHG emission are not to take into account.

5. Monorail/LRT

(1) Outline of typical project

Introduction of monorail (a light/medium weight transportation system) or LRT (Light Rail Transit) to control green house gas (GHG) emission by promoting a modal shift.

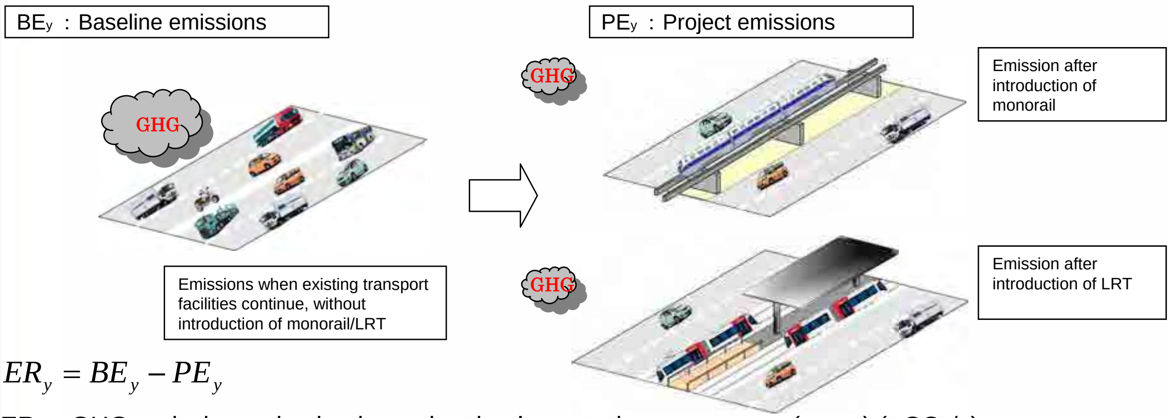
(2) Applicability conditions

After project implementation, there will be a rail transit infrastructure linking cities and suburbs, and a system implementing effective transport of passengers. Baseline transportation facilities are road traffic such as buses, private vehicles, taxis, bikes, etc. Monorail/LRT will be powered by electricity.

5. Monorail/LRT

(3) Estimation methodology

GHG emission reduction by the introduction of monorail/MRT are estimated by the difference between GHG emission through continuation of existing transport facilities (buses, private vehicles, taxis, and bikes) and GHG emission when there has been a modal shift (project) to Monorail/LRT.



$$ER_y = BE_y - PE_y$$

ERy: GHG emission reduction by project implementation over year y (years) (t-CO_2/y)
BEy: GHG emission by continuation of existing transport facilities over year y (years) (t-CO_2/y)
PEy: GHG emission by a modal shift to Monorail/LRT (years) (t-CO_2/y)

5. Monorail/LRT

(3) Estimation methodology

① Estimation of baseline emissions

Assuming the same number of passengers in existing transportation facilities will be taken over by Monorail/LRT after project implementation, baseline emissions is calculated by multiplying the number of passengers in each type of car by CO_2 emissions per passenger prior to project implementation.

② Estimation of project emissions

Estimated by multiplying the amount of annual total fuel consumption (planned figure) of Monorail/LRT after project implementation, by CO_2 emission factor of electricity consumed.

(4) Other

① Project boundary

The scope of GHG estimation will cover the area of Monorail/LRT services.

② Leakage

When considering Life Cycle Assessments (LCA) of Monorail/LRT, leakage may include GHG emission from energy consumption when producing/transporting raw materials for railroad-related facilities, railroad cars, etc. or during the construction and manufacturing. However, these GHG emission are not to take into account.

6. BRT/Trunk Bus

(1) Outline of typical project

Introduction of BRT (a bus rapid transit system) or Trunk Bus to control green house gas (GHG) emission by promoting a modal shift.

(2) Applicability conditions

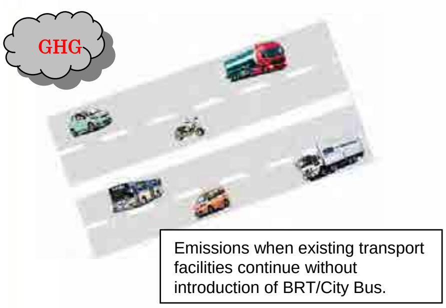
After project implementation, there will bus lanes that are separated from existing transport facilities, and a system implementing effective transport of passengers. Baseline transportation facilities are road traffic such as buses, private vehicles, taxis, bikes, etc. BRT/Trunk Bus will be powered by internal-combustion engines (not electricity).

6. BRT/Trunk Bus

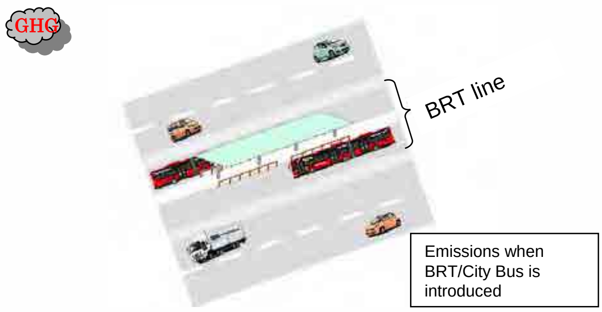
(3) Estimation methodology

GHG emission reduction by the introduction of BRT/Trunk Bus are estimated by the difference between GHG emission through continuation of existing transport facilities (buses, private vehicles, taxis, and bikes) and GHG emission when there has been a modal shift (project) to BRT/Trunk Bus. Alternatively, this will be estimated by the difference of GHG emission in railroad without electrification (baseline) and BRT/Trunk Bus (project).

BE_y : Baseline emissions



PE_y : Project emissions



$$ER_y = BE_y - PE_y$$

ERy: GHG emission reduction by project implementation over year y (years) (t-CO_2/y)
BEy: GHG emission by continuation of existing transport facilities over year y (years) (t-CO_2/y)
PEy: GHG emission by a modal shift to BRT/City Bus (years) (t-CO_2/y)

6. BRT/Trunk Bus

(3) Estimation methodology

① Estimation of baseline emissions

Assuming the same number of passengers in existing transportation facilities will be taken over by BRT/Trunk Bus after project implementation, baseline emissions is calculated by multiplying the number of passengers in each type of car by CO_2 emissions per passenger prior to project implementation.

② Estimation of project emissions

Estimated by multiplying the amount of annual total fuel consumption (planned figure) of BRT/Trunk Bus) after project implementation, by CO_2 emission factor of electricity consumed.

(4) Other

① Project boundary

The scope of GHG estimation will cover the area of BRT/Trunk Bus services.

② Leakage

When considering Life Cycle Assessments (LCA) of BRT/Trunk Bus, leakage may include GHG emission from energy consumption when producing/transporting raw materials for railroad-related facilities, railroad cars, etc. or during the construction and manufacturing. However, these GHG emission are not to take into account.

(3) Energy Conservation (Industry) Sector

7. Energy Efficiency Improvement
8. Cogeneration (Electricity and heat supply)
9. Fuel switching

7. Energy Efficiency Improvement

(1) Outline of typical project

Energy efficiency through improvement of motors in industrial facilities, etc. Green house gas (GHG) emissions will be controlled by reduced fuel consumption.

(2) Applicability conditions

For newly built facilities, implementation of the project in which new industrial facilities use higher efficiency equipment than that of the existing facilities.
For existing facilities, as a general rule, there must be repairing or improving/updating of the equipment used in the facilities which consume the same type of fuel as was previously used.

(3) Estimation methodology

GHG emission reductions due to energy efficiency improvement in industrial facilities are estimated by taking the difference of emissions after efficiency improvement (project) from emissions when efficiency of facilities is low (baseline). Emissions are estimated by multiplying the amount of electricity consumed (for facilities using electricity) or the amount of fuel consumed (for facilities using fuel), by the respective CO_2 emission factor.

$$ER_y = BE_y - PE_y$$

ERy : GHG emission reductions by project implementation over y (years)
BEy : GHG emissions over y (years) with low efficient facilities (t-CO_2/y) (Baseline emissions)
PEy : GHG emissions over y (years) with efficiency improved facilities (t-CO_2/y) (Project emissions)

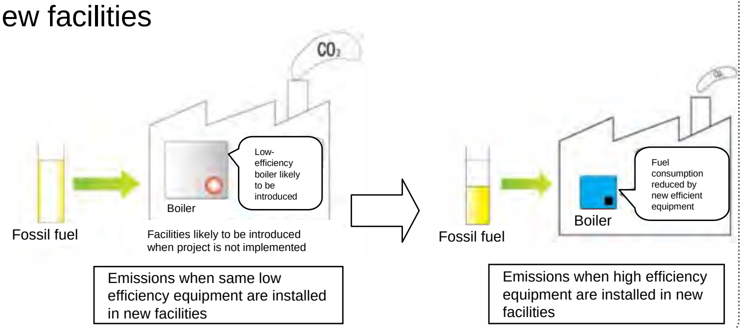
7. Energy Efficiency Improvement

(3) Estimation methodology

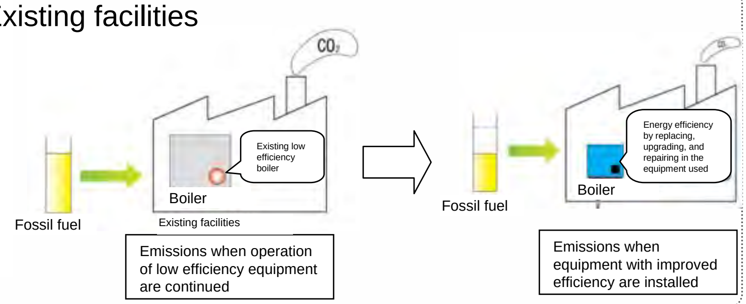
BE_y : Baseline emissions

PE_y : Project emissions

New facilities



Existing facilities



7. Energy Efficiency Improvement

(3) Estimation methodology

① Estimation of baseline emissions

Estimated by multiplying the amount of fuel/electricity used when equipment is not repaired/improved/updated, by the respective emission factor.
For newly built facilities the amount of fuel/electricity shall be based on the amount necessary for existing equipment/facilities to achieve the same production scale (output, etc.) as new facilities.

② Estimation of project emissions

Estimated by multiplying the amount of electricity and fuel used by facilities after project implementation in which their equipment has been repaired/improved/updated, by the respective emission factor.

(4) Other

① Project boundary

The scope of GHG estimation covers the relevant power generation facilities inside the project site.

② Leakage

Possible leakage in the energy efficiency improvement of industrial facilities may include CO_2 emissions from equipment manufacturing and equipment transportation/disposal, etc. However, these CO_2 emissions will not be taken into account.

8. Cogeneration (Electricity and heat supply)

(1) Outline of typical project

Collection and utilization of waste energy (waste heat, waste gas and waste pressure) generated in industrial facilities such as steel plants and cement factories, etc. Green house gas (GHG) emissions will be directly controlled by reduced consumption of electricity and fuel.

(2) Applicability conditions

Implementation of the project that aims to reduce GHG emissions through introduction of new equipment or repair/improvement of existing equipment to collect and utilize waste energy in the factories, etc.
The project must use the waste energy to generate electricity and/or heat.

8. Cogeneration (Electricity and heat supply)

(3) Estimation methodology

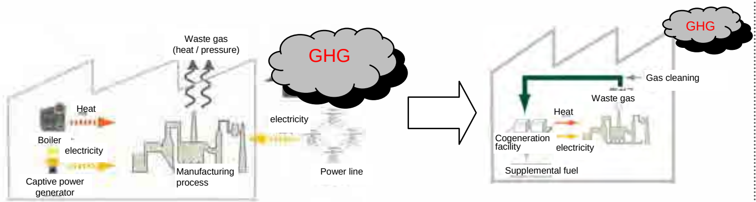
GHG reductions due to collection/utilization of waste energy generated in industrial facilities such as factories, etc. are estimated by taking the difference of power and heat obtained when project is not implemented (baseline) from emissions after project implementation (project). Emissions will be estimated in terms of the amount of power generation and heat utilized by collection/utilization of waste energy.

$$ER_y = BE_y - PE_y$$

ER_y : GHG emission reductions by project implementation over y (years)
BE_y : GHG emissions over y (years) without collection and utilization of waste energy (t-CO_2/y) (Baseline emissions)
PE_y : GHG emissions over y (years) with collection and utilization of waste energy (t-CO_2/y) (Project emissions)

BE_y : Baseline emissions

PE_y : Project emissions



Emissions when waste energy is released without utilzed. Energy required is sourced from grid and captive power generator, and boiler.

Emissions when waste energy is collected and utilized for power generation or heat supply

8. Cogeneration (Electricity and heat supply)

(3) Estimation methodology

① Estimation of baseline emissions

Estimated by electricity, etc. consumed to gain electricity and heat after project implementation. Baseline emissions are estimated by multiplying the power generation (MWh/y) and heat quantity (TJ/y) from collection and utilization of waste energy after project implementation, by the respective CO_2 emission factors. The electricity emission factor for grid power and captive power generator are determined separately.

② Estimation of project emissions

Estimated by multiplying the amount of electricity and supplemental fuel used by facilities after project implementation, by the respective CO_2 emission factor.

(4) Other

① Project boundary

The scope of GHG estimation covers the relevant power generation facilities inside the project site.

② Leakage

Possible leakage of GHG emission reductions in the collection/use of waste energy in industrial facilities may include CO_2 emissions from manufacturing and transportation, etc. for building/updating facilities for collection/utilization of waste energy. However, these CO_2 emissions will not be taken into account.

9. Fuel switching

(1) Outline of typical project

Conversion of the fuel used by newly built and existing industrial facilities from fuel with larger CO_2 emission factor (heavy oil, etc.) to fuel with smaller emission potentials (natural gas, etc.). As a result, green house gas (GHG) emissions will be controlled.

(2) Applicability conditions

The implementation of the project must convert to fuel that has a smaller CO_2 emission factor than traditional fuel for both in newly built facilities and existing facilities.

(3) Estimation methodology

GHG emission reductions due to fuel switching in industrial facilities are estimated by taking the difference of emissions when high CO_2 emission factor fuel is used (baseline) from emissions after fuel switching (project). Emissions will be estimated by multiplying the amount of fuel required to achieve the same amount of power generation after project implementation, by the CO_2 emission factor.

$$ER_y = BE_y - PE_y$$

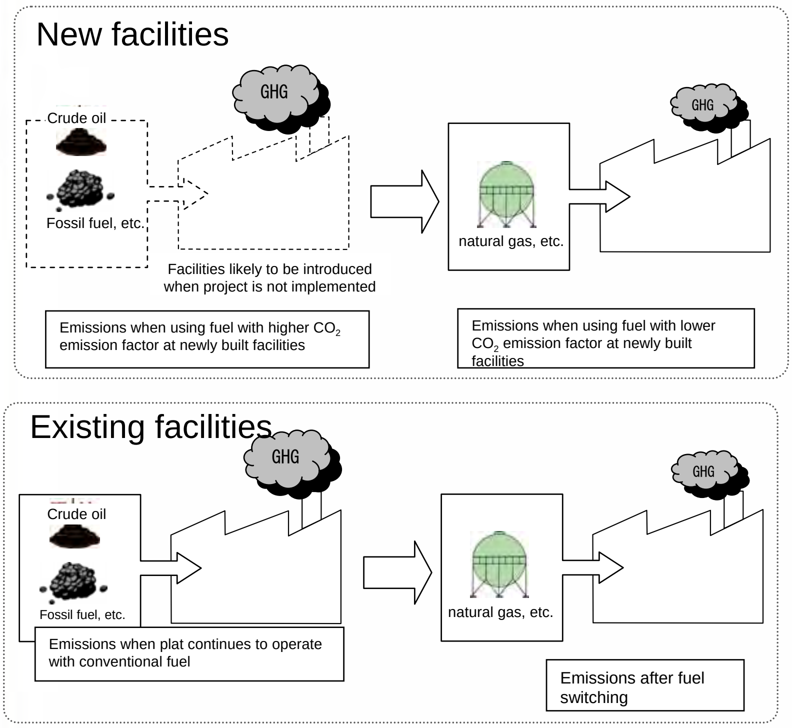
ER_y : GHG emission reductions by project implementation over y (years)
BE_y : GHG emissions over y (years) without fuel switching (t-CO_2/y) (Baseline emissions)
PE_y : GHG emissions over y (years) with fuel switching (t-CO_2/y) (Project emissions)

9. Fuel switching

(3) Estimation methodology

BE_y : Baseline emissions

PE_y : Project emissions



9. Fuel switching

(3) Estimation methodology

① Estimation of baseline emissions

Estimated by multiplying the amount of fuel used when fuel switching is not carried out, by the respective emission factor.
For newly built facilities, estimations take the amount of fuel required to achieve the same scale of production (output, etc.) after project implementation by the same fuel as was previously used.

② Estimation of project emissions

Estimated by multiplying the amount of fuel used by facilities after project implementation in which improvements have been made by fuel switching, by the respective emission factor.

(4) Other

① Project boundary

The scope of GHG estimation covers the relevant industrial facilities (factories, etc.) inside the project site.

② Leakage

Possible leakage in fuel switching in industrial facilities may include CO_2 emissions from product manufacturing and equipment transportation, etc. when updating equipment. However, these CO_2 emissions will not be taken into account.
CH_4 leakage emissions for fuel production after project implementation (including fuel transport/delivery of natural gas) will be estimated by referring to Table C-5 and C-6 in Annex. If these reach approximately 10-20% of project emissions it will be necessary to deduct from GHG reductions.

(4) Energy Sector

10. Energy Plant Construction with Fuel Switching
11. Thermal Power with Electricity and Heat Supply
12. Thermal Power with Fuel Switching
13. Thermal Power with Higher Efficiency
14. Power Transmission with Improved Efficiency
15. Power Distribution with Improved Efficiency
16. Rural electrification

10. Energy Plant Construction with Fuel Switching

(1) Outline of typical project

Conversion of the fuel used by newly built and existing concentrated heat supply facilities from fuel with larger CO_2 emission factor (heavy oil, etc.) to fuel with smaller emission potentials (natural gas, etc.). As a result, green house gas (GHG) emissions will be controlled.

(2) Applicability Conditions

The implementation of the project must convert to fuel that has a smaller CO_2 emission factor than traditional fuel for both in newly built facilities and existing facilities.

(3) Estimation methodology

GHG emission reductions due to fuel switching in industrial facilities are estimated by taking the difference of emissions when high CO_2 emission factor fuel is used (baseline) from emissions after fuel switching (project). Emissions will be estimated by multiplying the amount of fuel required to achieve the same amount of power generation after project implementation, by the CO_2 emission factor.

$$ER_y = BE_y - PE_y$$

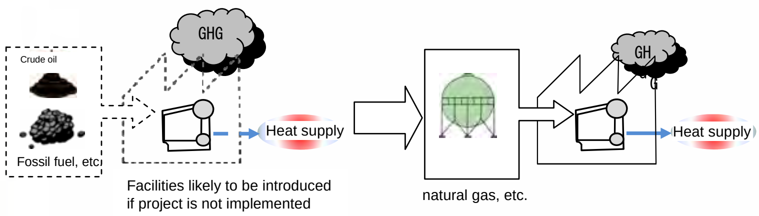
ER_y : GHG emission reductions by project implementation over y (years)
BE_y : GHG emissions over y (years) without fuel switching (t-CO_2/y) (Baseline emissions)
PE_y : GHG emissions over y (years) with fuel switching (t-CO_2/y) (Project emissions)

10. Energy Plant Construction with Fuel Switching

(3) Estimation methodology

BE_y : Baseline emissions | PE_y : Project emissions

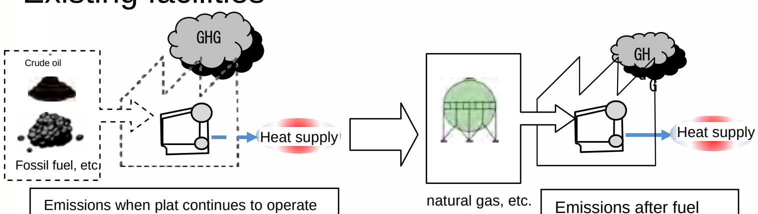
New facilities



Emissions when using fuel with higher CO_2 emission factor at newly built facilities

Emissions when using fuel with lower CO_2 emission factor at newly built facilities

Existing facilities



Emissions when plat continues to operate with conventional fuel

Emissions after fuel switching

10. Energy Plant Construction with Fuel Switching

(3) Estimation methodology

① Estimation of baseline emissions

Estimated by multiplying the amount of fuel used when fuel switching is not carried out, by the respective emission factor.
For newly built facilities, estimations take the amount of fuel required to achieve the same scale of production (output, etc.) after project implementation by the same fuel as was previously used.

② Estimation of project emissions

Estimated by multiplying the amount of fuel used by facilities after project implementation in which improvements have been made by fuel switching, by the respective emission factor.

(4) Other

① Project boundary

The scope of GHG estimation covers the relevant industrial facilities (factories, etc.) inside the project site.

② Leakage

Possible leakage in fuel switching in industrial facilities may include CO_2 emissions from product manufacturing and equipment transportation, etc. when updating equipment. However, these CO_2 emissions will not be taken into account.
CH_4 leakage emissions from fuel production (including fuel transport/delivery of natural gas) after project implementation will be estimated by referring to Table C-5 and C-6 in Annex. If these reach approximately 10-20% of project emissions it will be necessary to deduct from GHG reductions.

11. Thermal Power with Electricity and Heat Supply

(1) Outline of typical project

Collection and utilization of waste energy (waste heat, waste gas) generated in thermal power plants (newly built combined cycle power plant, etc.). Green house gas (GHG) emissions will be directly reduced by less consumption of electricity and fuel.

(2) Applicability conditions

Implementation of the project that aims to reduce GHG emissions through introduction of new equipment or repairing/improving of existing equipment to collect and utilize waste energy in thermal power plants.
The project must use the waste energy to generate electricity and/or heat.

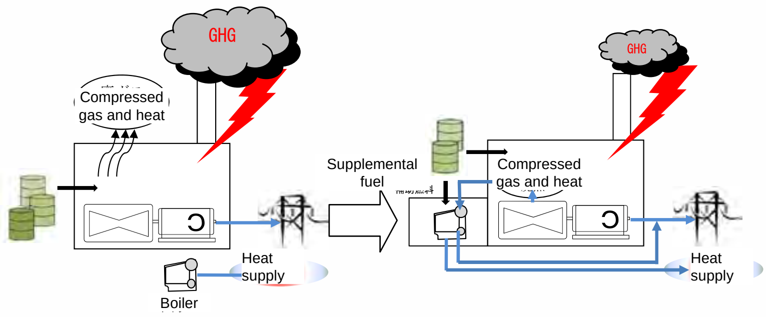
11. Thermal Power with Electricity and Heat Supply

(3) Estimation methodology

GHG emission reductions due to collection/utilization of waste energy generated in thermal power plants are estimated by taking the difference of power and heat obtained when project is not implemented (baseline) from emissions after project implementation (project). Emissions will be estimated in terms of the amount of power generation and heat utilized by collection/utilization of waste energy.

$$ER_y = BE_y - PE_y$$

ER_y : GHG emission reductions by project implementation over y (years)
BE_y : GHG emissions over y (years) without collection and utilization of waste energy (t-CO_2/y) (baseline emissions)
PE_y : GHG emissions over y (years) with collection and utilization of waste energy (t-CO_2/y) (project emissions)



Emissions when waste energy is not utilized and released. Energy required is sourced from grid and captive power generator, and boiler.

Emissions when waste energy is collected and utilized for power generation or heat supply

11. Thermal Power with Electricity and Heat Supply

(3) Estimation methodology

① Estimation of baseline emissions

Estimated by fuel, etc. consumed to gain electricity and heat after project implementation. Baseline emissions are estimated by multiplying the power generation (MWh/y) and heat quantity (TJ/y) from collection and utilization of waste energy after project implementation, by the respective CO_2 emission factors.

② Estimation of project emissions

Estimated by multiplying the amount of electricity and supplemental fuel used by facilities after project implementation, by the respective CO_2 emission factor.

(4) Other

① Project boundary

The scope of GHG estimation covers the relevant power generation facilities inside the project site.

② Leakage

Possible leakage of GHG emission reductions in the collection/use of waste energy in industrial facilities may include CO_2 emissions from manufacturing and transportation, etc. for building/updating facilities for collection/utilization of waste energy. However, these CO_2 emissions will not be taken into account.

12. Thermal Power with Fuel Switching

(1) Outline of typical project

Conversion of the fuel used by newly built and existing thermal power plants from fuel with larger CO_2 emission factor (heavy oil, etc.) to fuel with smaller emission potentials (natural gas, etc.) . As a result, green house gas (GHG) emission will be controlled.

(2) Applicability Conditions

The implementation of the project must convert to fuel that has a smaller CO_2 emission factor than traditional fuel for both in newly built facilities and existing facilities.

(3) Estimation methodology

GHG emission reductions due to fuel switching in thermal power plants are estimated by taking the difference of emissions when high CO_2 emission factor fuel is used (baseline) from emissions after fuel switching (project). Emissions will be estimated by multiplying the amount of fuel required to achieve the same amount of power generation after project implementation, by the CO_2 emission factor.

$$ER_y = BE_y - PE_y$$

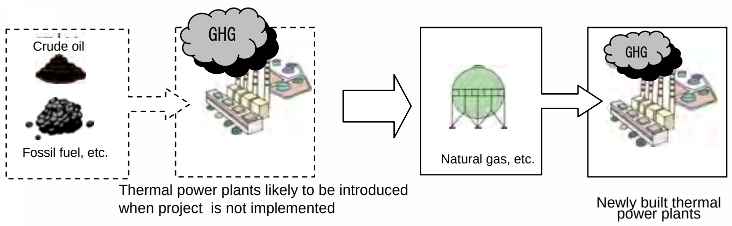
ER_y : GHG emission reductions by project implementation over y (years)
BE_y : GHG emissions over y (years) without fuel switching (t-CO_2/y) (Baseline emissions)
PE_y : GHG emissions over y (years) with fuel switching (t-CO_2/y) (Project emissions)

12. Thermal Power with Fuel Switching

(3) Estimation methodology

BE_y : Baseline emissions | PE_y : Project emissions

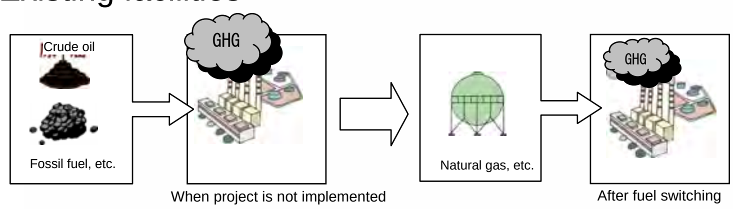
New facilities



Emissions when using fuel with higher CO_2 emission factor at newly built facilities

Emissions when using fuel with lower CO_2 emission factor at newly built facilities

Existing facilities



Emissions when plat continues to operate with conventional fuel

Emissions after fuel switching

12. Thermal Power with Fuel Switching

(3) Estimation methodology

① Estimation of baseline emissions

Estimated by multiplying the amount of fuel used when fuel switching is not carried out, by the respective emission factor.
For newly built power plants, estimations take the amount of fuel required to achieve the same scale of production (output, etc.) after project implementation by the same fuel as was previously used.

② Estimation of project emissions

Estimated by multiplying the amount of fuel used by power plants after project implementation in which improvements have been made by fuel switching, by the respective emission factor.

(4) Other

① Project boundary

The scope of GHG estimation covers the relevant power plants inside the project site.

② Leakage

Possible leakage in fuel switching in thermal power plants may include CO_2 emissions from product manufacturing and equipment transportation, etc. when updating equipment. However, these CO_2 emissions will not be taken into account.
CH_4 leakage emissions for fuel production after project implementation (including fuel transport/delivery of natural gas) will be estimated by referring to Table C-5 and C-6 in Annex. If these reach approximately 10-20% of project emissions it will be necessary to deduct from GHG reductions.

13. Thermal Power with Higher Efficiency

(1) Outline of typical project

Introduction of newly built thermal power plants or upgrading of existing thermal power plants (conversion to combined cycle power generation, upgrading/improvement to high efficiency thermal power plants, etc.). Green house gas (GHG) emissions will be controlled by reduced fuel consumption of thermal power plants.

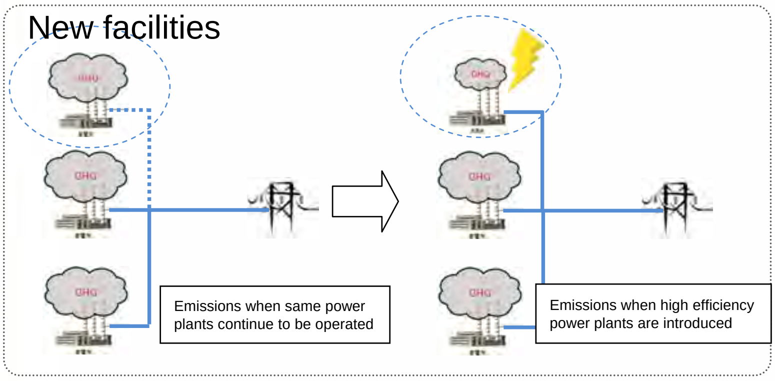
(2) Applicability conditions

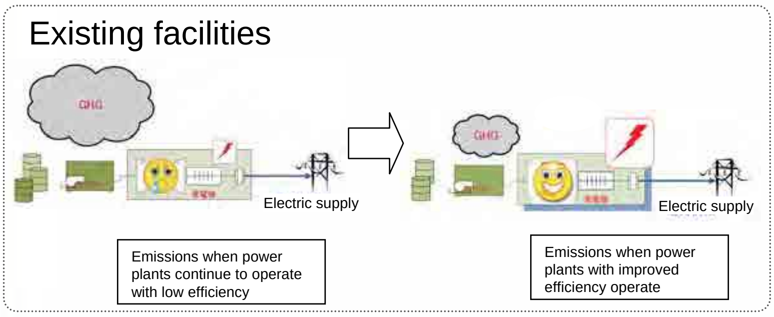
For newly built facilities, implementation of the project will introduce new thermal power generators using technology that has higher efficiency than the power generation technology in existing plants.
For existing facilities, as a general rule, the equipment of thermal plants using the same fuel will be updated or repaired/improved. Both newly built facilities and existing facilities will i) be thermal power plants connected to power grids, and ii) will not be cogeneration facilities.

13. Thermal Power with Higher Efficiency

(3) Estimation methodology

BEy : Baseline emissions PEy : Project emissions





13. Thermal Power with Higher Efficiency

(3) Estimation methodology

GHG emission reductions due to higher efficiency thermal power generation is estimated by taking the difference of emissions when power generation efficiency is low (baseline) from emissions after efficiency improvement (project).

Emissions will be estimated by multiplying the power generation by the emission factor. The emission factor before and after project implementation will be taken from the power generation efficiency before and after project implementation, and this will be compared with the emissions generated when obtaining the same amount of power generation (after project implementation). For existing facilities, baseline emissions will be estimated using the actual emission factor values from power plants before improvement.

$$ER_y = BE_y - PE_y$$

ER_y : GHG emission reductions by project implementation over y (years)
BE_y : GHG emissions over y (years) with low efficient power generators (t-CO2/y) (Baseline emissions)
PE_y : GHG emissions over y (years) with efficiency improvement of power generator (t-CO2/y) (Project emissions)

① Estimation of baseline emissions

Emissions produced to obtain the amount of power generation after project implementation are estimated by using the CO_2 emission factor from power generation efficiency before improvement when power generators are not be repaired, improved or updated.

② Estimation of project emissions

Emissions produced in power generation after project implementation are estimated by taking the CO_2 emission factor from power generation efficiency after improvement when power generators have been repaired, improved or updated.

13. Thermal Power with Higher Efficiency

(4) Other

① Project boundary

The scope of GHG estimation covers the relevant power generation facilities inside the project site.

② Leakage

Possible leakage in efficiency improvement of thermal power plants may include CO_2 emissions from product manufacturing and equipment transportation/disposal, etc. when updating equipment. However, these CO_2 emissions will not be taken into account.

14. Power Transmission with Improved Efficiency

(1) Outline of typical project

Reduction of power transmission loss and maintenance of high voltage substations, etc. to control GHG emissions from power transmission loss at new and existing transmission lines/substations.

(2) Applicability conditions

Reduction of fuel consumption and power transmission loss by updating power lines for less electricity loss, and repairing/improving high voltage substations.

(3) Estimation methodology

GHG emission reductions due to efficiency improvement of transmission lines/substations will be estimated by taking the difference of emissions when there is a high amount of electricity loss from electric supply (baseline) from emissions after efficiency improvement (project).
Emissions will be estimated by multiplying the amount of electricity loss from electric supply, by the emission factor. Estimation will be made by multiplying the respective amounts of electricity loss before and after project implementation, by the CO_2 emission factor.

$$ER_y = BE_y - PE_y$$

ER_y : GHG emission reductions by project implementation over y (years)
BE_y : GHG emissions over y (years) without efficiency improvement of transmission line/substations (t-CO2/y) (Baseline emissions)
PE_y : GHG emissions over y (years) with efficiency improvement of transmission lines/substations (t-CO2/y) (Project emissions)

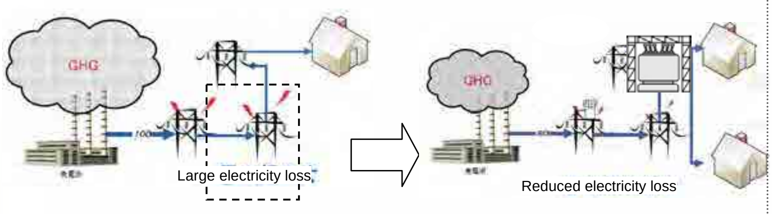
14. Power Transmission with Improved Efficiency

(3) Estimation methodology

BEy : Baseline emissions

PEy : Project emissions

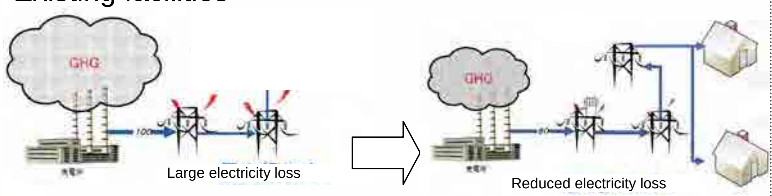
New facilities



Emissions when conventional types of transmission lines/substations are retained

Emissions when efficient transmission lines/substations are installed in newly built power grids

Existing facilities



Emissions when there is large electricity loss from electric supply

Emissions when efficiency of transmission lines/substations are improved

14. Power Transmission with Improved Efficiency

(3) Estimation methodology

① Estimation of baseline emissions

Estimated by taking the amount of electricity loss when transmission lines/substations are not improved and multiplying the electricity loss when supplying the same electric energy after project implementation, by the respective CO_2 emission factor.

② Estimation of project emissions

Estimated by multiplying the electricity loss in transmission lines/substations after project implementation in which efficiency has been improved, by the respective CO_2 emission factor.

(4) Other

① Project boundary

The scope of GHG estimation covers the relevant transmission networks inside the project site.

② Leakage

Possible leakage in efficiency improvement transmission networks may include CO_2 emissions from product manufacturing and transportation of materials, etc. when updating equipment. However, these CO_2 emissions will not be taken into account.

15. Power Distribution with Improved Efficiency

(1) Outline of typical project

Efficiency improvement of power distribution equipment and reduction of electricity distribution loss, etc. to control GHG emissions from power distribution loss at new and existing power distribution equipment.

(2) Applicability Conditions

Reduction of fuel consumption and power distribution in comparison to conventional power distribution equipment by updating to service power lines and reduce electricity loss, and servicing/repairing/improving power distribution facilities.

(3) Estimation methodology

GHG emission reductions due to efficiency improvement of power distribution equipment will be estimated by taking the difference of emissions when there is a high amount of electricity loss from power distribution baseline) and emissions after efficiency improvement (project).
Emissions will be estimated by multiplying the amount of electricity loss from power distribution by the emission factor. An estimation will be made by multiplying the respective amounts of electricity loss before and after project implementation, by the CO_2 emission factor.

$$ER_y = BE_y - PE_y$$

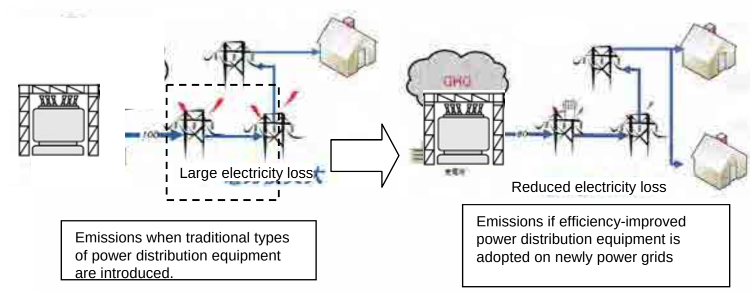
ERy : GHG emission reductions by project implementation over y (years)
BEy : GHG emissions over y (years) without efficiency improvement of power distribution facilities (t-CO_2/y) (Baseline emissions)
PEy : GHG emissions over y (years) with efficiency improvement of distribution facilities (t-CO_2/y) (Project emissions)

15. Power Distribution with Improved Efficiency

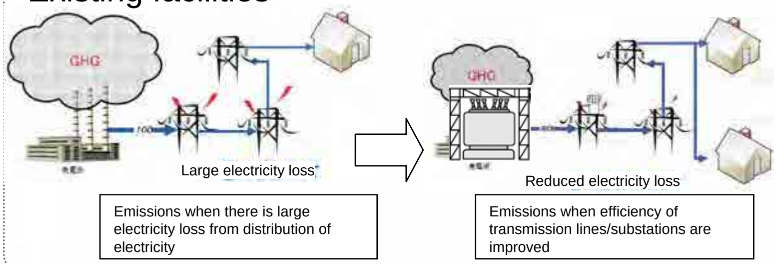
(3) Estimation methodology

BEy : Baseline emissions　　PEy : Project emissions

New facilities



Existing facilities



15. Power Distribution with Improved Efficiency

(3) Estimation methodology

① Estimation of baseline emissions

Estimated by taking the amount of electricity loss when power distribution facilities are not improved and multiplying the electricity loss when supplying the same electric energy after project implementation, by the respective CO_2 emission factor.

② Estimation of project emissions

Estimated by multiplying the electricity loss in power distribution facilities after project implementation in which efficiency has been improved, by the respective CO_2 emission factor.

(4) Other

① Project boundary

The scope of GHG estimation covers the relevant power distribution networks inside the project site.

② Leakage

Possible leakage in efficiency improvement distribution networks may include CO_2 emissions from product manufacture and transportation of materials, etc. when updating equipment. However, these CO_2 emissions will not be taken into account.

16. Rural electrification

(1) Outline of typical project

Production of renewable energy that by implementing a project that applies renewable energy in areas that are not connected to electricity grids and which use diesel power generation/kerosene for lighting. GHG emissions will be controlled by renewable energy which does not produce GHG during power generation.

(2) Applicability Conditions

Electrification of the regions not connected to electricity grids. The project uses renewable energy for electric supply in standalone form (not connected to the grids or mini-grid.

(3) Estimation methodology

GHG reductions due to rural electrification using renewable energy will be estimated by taking the difference of GHG emissions of the traditional energy amount (baseline) to be replaced with renewable energy and the results after renewable energy connection (project).

$$ER_y = BE_y - PE_y$$

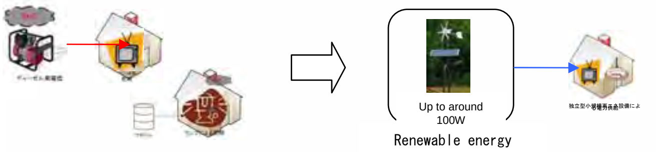
ER_y : GHG emission reductions by project implementation over y (years)
BE_y : GHG emissions over y (years) by continuation of power supply such as by diesel (t-CO_2/y) (Baseline emissions)
PE_y : GHG emissions over y (years) by rural electrification with renewable energy (t-CO_2/y) (Project emissions)

16. Rural electrification

(3) Estimation methodology

BEy : Baseline emissions | PEy : Project emissions

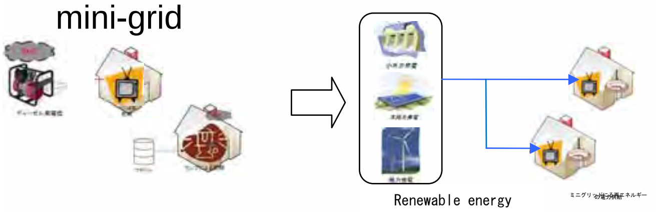
Standalone



Emissions if existing power supply is retained

Emissions if power supply comes direct from independent renewable energy facilities

mini-grid



Emissions if traditional power supply continues

Emissions with mini-grid supply using renewable energy

16. Rural electrification

(3) Estimation methodology

① Estimation of baseline emissions

If renewable energy facilities are not built, existing power distribution will continue. GHG emissions are estimated from the fuel control amount, since traditional fuel consumption will be controlled by switching to renewable energy. In non-electrified regions, the control fuels will be diesel oil and kerosene if, as assumed, power distribution is not carried out and diesel power generation and kerosene lighting are used.

② Estimation of project emissions

GHG emissions in power generation by renewable power after project implementation are considered ZERO.

(4) Other

① Project boundary

The scope of GHG estimation covers supply areas and the relevant power generation facilities inside the project site.

② Leakage

Possible leakage in renewable energy may include CO_2 emissions from product manufacturing and transportation of materials, etc. relating to construction of renewable energy facilities. However, these CO_2 emissions will not be taken into account.

(5) Renewable Energy Sector

17.Hydro power
18. Wind power
19. Solar power/Solar heat
- Solar power
- Solar heat

20. Geothermal power
21. Biomass

17. Hydro power

(1) Outline of typical project

Contribute directly to GHG emissions reduction though building hydro power generation facilities by utilizing natural hydro resources to produce renewable energy that does not produce green house gas (GHG).

(2) Applicability conditions

The project will cover newly built or rehabilitated hydro power generation facilities.
Power generated can be supplied by connecting to existing power grids or can be supplied independently without connecting to power grids.

(3) Estimation methodology

GHG reductions due to hydro power generation will be estimated by taking the difference of GHG emissions of the energy generation by conventional power plant to be replaced by hydro power (baseline) and the results after operation of hydro power plants (project). Hydro power generation facilities may be connected to power grids, standalone, or mini-grid.

$$ER_y = BE_y - PE_y$$

ER_y : GHG emission reductions by project implementation over y (years)
BE_y : GHG emissions over y (years) by conventional power plant (t-CO_2/y) (Baseline emissions)
PE_y : GHG emissions over y (years) after operation of hydro power plants (t-CO_2/y) (Project emissions)

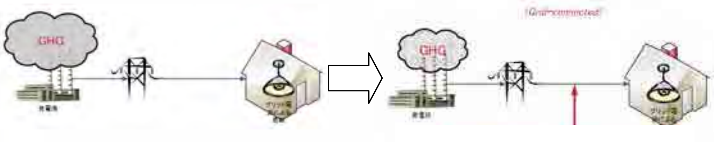
17. Hydro power

(3) Estimation methodology

Grid connected (newly built facilities)

BEy : Baseline emissions

PEy : Project emissions



Emissions when conventional power supply continues without construction of hydro power plants

Emissions when power supply from hydro power plants is added to power grids

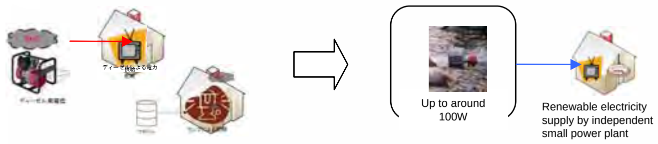
17. Hydro power

(3) Estimation methodology

Standalone

BEy : Baseline emissions

PEy : Project emissions



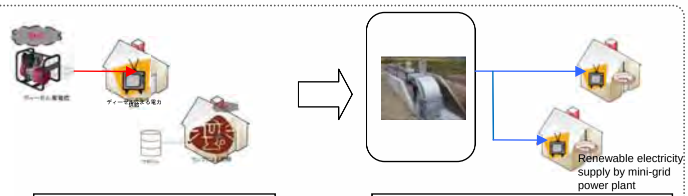
Emissions when existing power supply continues

Emissions with direct power supply from independent micro hydro power equipment, etc.

mini-grid

BEy : Baseline emissions

PEy : Project emissions



Emissions when existing power supply continues

Emissions with mini-grid power supply from hydro power generator

17. Hydro power

(3) Estimation methodology

① Estimation of baseline emissions

Grid connected

If hydro power generation facilities are not built, conventional power supply will continue. GHG emissions are estimated from fuel amount controlled, since power supply from existing conventional facilities will be controlled by switching to hydro power generation.

Also, for existing hydro power generation facilities that have become less efficient due to aging, etc. power generation efficiency will increase through rehabilitation. GHG emissions will be estimated from the fuel control amount, since the power supply from existing conventional facilities will be controlled by improvement of hydro power plant rehabilitate.

Standalone/mini-grid

Standalone/mini-grid covers non-electrified regions. If hydro power generation facilities are not built, conventional power supply will continue. GHG emissions are estimated from the fuel amount controlled, since the fuel consumption of existing conventional power facilities will be controlled by switching to renewable energy through hydro power generation. In non-electrified regions, the fuels controlled will be diesel oil and kerosene which would have been used by diesel power generation and kerosene lighting.

17. Hydro power

(3) Estimation methodology

② Estimation of project emissions

GHG emissions in power generation by hydro power generation after project implementation are considered ZERO.

For hydro power generation facilities with reservoirs, methane may be emitted from the reservoirs. This will be accounted as baseline emissions, however will be negligible if comprising less than 1% of the baseline emissions.

(4) Other

① Project boundary

The scope of GHG estimation covers the relevant power generation facilities inside the project site.

② Leakage

Possible leakage in hydro power plants may include CO_2 emissions from product manufacturing and transportation of materials, etc. relating to construction of hydro power generation facilities. However, these CO_2 emissions will not be taken into account.

Consumption of fuels (extraction, processing, transportation, etc.) are also not to be taken into account.

18. Wind power

(1) Outline of typical project

Contribute directly to GHG emissions reduction through building wind power generation facilities by utilizing natural wind resources to produce renewable energy that does not produce green house gas (GHG).

(2) Applicability conditions

The project will cover newly built or rehabilitated wind power generation facilities.
Power generated can be supplied by connecting to existing power grids or can be supplied independently without connecting to power grids.

(3) Estimation methodology

GHG reductions due to wind power generation will be estimated by taking the difference of GHG emissions of the energy generation by conventional power plant to be replaced by wind power (baseline) and the results after operation of wind power plants (project). Wind power generation facilities may be connected to power grids or standalone.

$$ER_y = BE_y - PE_y$$

ER_y : GHG emission reductions by project implementation over y (years)
BE_y : GHG emissions over y (years) by conventional power plant ($t\text{-}CO_2/y$) (Baseline emissions)
PE_y : GHG emissions over y (years) after operation of wind power plants ($t\text{-}CO_2/y$) (Project emissions)

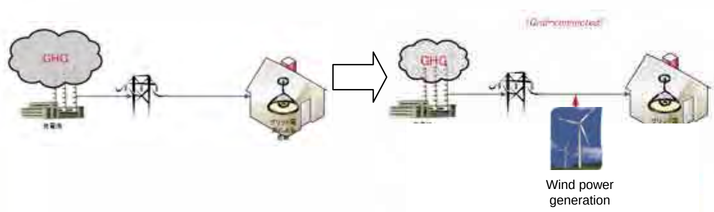
18. Wind power

(3) Estimation methodology

Grid connected (newly built facilities)

BE_y : Baseline emissions

PE_y : Project emissions



Emissions when conventional power supply continues without construction of wind power plants

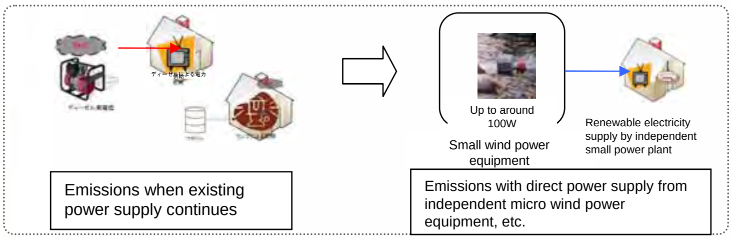
Emissions when power supply from wind power plants is added to power grids

18. Wind power

(3) Estimation methodology

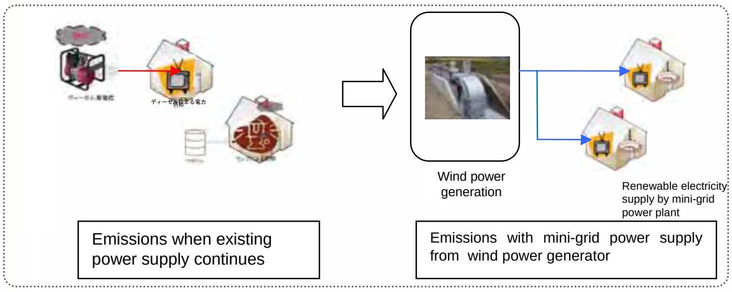
Standalone

BEy : Baseline emissions | PEy : Project emissions



Mini-grid

BEy : Baseline emissions | PEy : Project emissions



18. Wind power

(3) Estimation methodology

① Estimation of baseline emissions

If wind power generation facilities are not built, conventional power supply will continue. GHG emissions are estimated from fuel amount controlled, since power supply from existing conventional facilities will be controlled by switching to wind power generation.
Also, for existing wind power generation facilities that have become less efficient due to aging, etc. power generation efficiency will increase through rehabilitation. GHG emissions will be estimated from the fuel control amount, since the power supply from existing conventional facilities will be controlled by improvement of wind power plant rehabilitate.

② Estimation of project emissions

GHG emissions in power generation by wind power generation after project implementation are considered ZERO.

(4) Other

① Project boundary

The scope of GHG estimation covers the relevant power generation facilities inside the project site.

② Leakage

Possible leakage in wind power plants may include CO_2 emissions from product manufacturing and transportation of materials, etc. relating to construction of wind power generation facilities. However, these CO_2 emissions will not be taken into account.
Consumption of fuels (extraction, processing, transportation, etc.) are also not to be taken into account.

19-1. Solar power

(1) Outline of typical project

Contribute directly to GHG emissions reduction through building solar power generation facilities by utilizing natural solar resources to produce renewable energy that does not produce green house gas (GHG).

(2) Applicability conditions

The project will cover newly built or rehabilitated solar power generation facilities.
Power generated can be supplied by connecting to existing power grids or can be supplied independently without connecting to power grids.

(3) Estimation methodology

GHG reductions due to solar power generation will be estimated by taking the difference of GHG emissions of the energy generation by conventional power plant to be replaced by solar power (baseline) and the results after operation of solar power plants (project). Solar power generation facilities may be connected to power grids or standalone.

$$ER_y = BE_y - PE_y$$

ER_y : GHG emission reductions by project implementation over y (years)
BE_y : GHG emissions over y (years) by conventional power plant (t-CO_2/y) (Baseline emissions)
PE_y : GHG emissions over y (years) after operation of solar power plants (t-CO_2/y) (Project emissions)

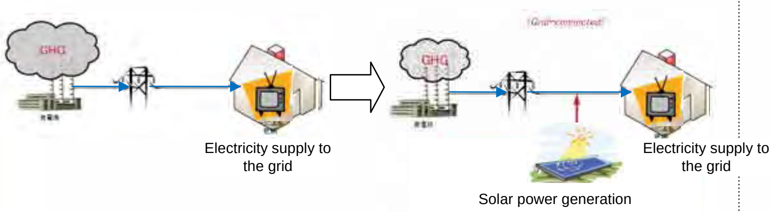
19-1. Solar power

(3) Estimation methodology

Grid connected (newly built facilities)

BE_y : Baseline emissions

PE_y : Project emissions



Emissions when conventional power supply continues without construction of solar power plants

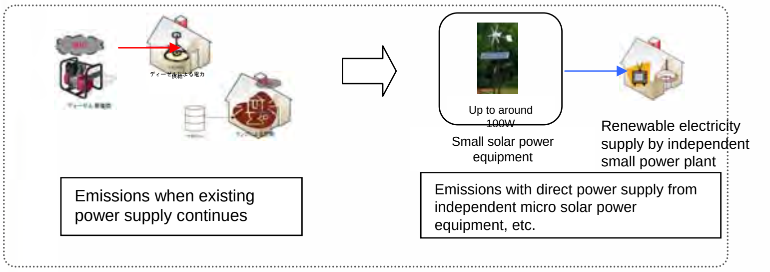
Emissions when power supply from solar power plants is added to power grids

19-1. Solar power

(3) Estimation methodology

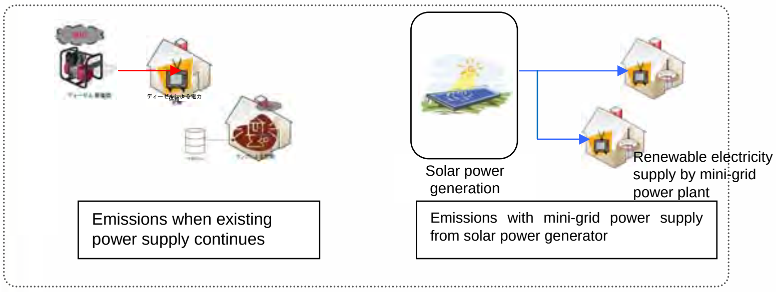
Standalone

BEy : Baseline emissions | PEy : Project emissions



Mini-grid

BEy : Baseline emissions | PEy : Project emissions



19-1. Solar power

(3) Estimation methodology

① Estimation of baseline emissions

If solar power generation facilities are not built, conventional power supply will continue. GHG emissions are estimated from fuel amount controlled, since power supply from existing conventional facilities will be controlled by switching to solar power generation.
Also, for existing solar power generation facilities that have become less efficient due to aging, etc. power generation efficiency will increase through rehabilitation. GHG emissions will be estimated from the fuel control amount, since the power supply from existing conventional facilities will be controlled by improvement of solar power plant rehabilitate.

② Estimation of project emissions

GHG emissions in power generation by solar power generation after project implementation are considered ZERO.

(4) Other

① Project boundary

The scope of GHG estimation covers the relevant power generation facilities inside the project site.

② Leakage

Possible leakage in solar power plants may include CO_2 emissions from product manufacturing and transportation of materials, etc. relating to construction of solar power generation facilities. However, these CO_2 emissions will not be taken into account.
Consumption of fuels (extraction, processing, transportation, etc.) are also not to be taken into account.

19-2. Solar heat

(1) Outline of typical project

Contribute directly to GHG emissions reduction through building solar heat utilization facilities (Concentrating solar power generation, solar water heater, etc.) by utilizing natural solar heat resources to produce renewable energy that does not produce green house gas (GHG).

(2) Applicability conditions

The project will cover generation of solar heat power or supply of hot water.
Power generated can be supplied by connecting to existing power grids.
Hot water supply can be done by standalone solar water heater.

(3) Estimation methodology

GHG reductions due to solar heat utilization will be estimated by taking the difference of GHG emissions of the energy generation by conventional power plant to be replaced by solar heat utilization (baseline) and the results after operation of solar heat utilization facilities (project).

$$ER_y = BE_y - PE_y$$

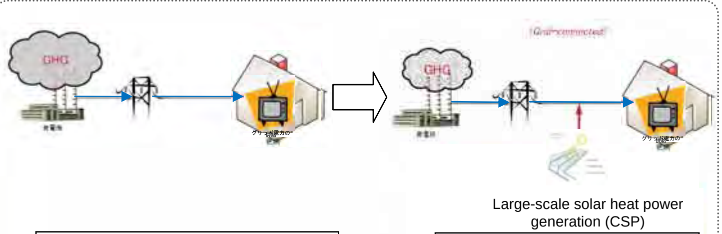
ER_y : GHG emission reductions by project implementation over y (years)
BE_y : GHG emissions over y (years) by conventional power plant (t-CO_2/y) (Baseline emissions)
PE_y : GHG emissions over y (years) after operation of solar heat utilization facilities (t-CO_2/y) (Project emissions)

19-2. Solar heat

(3) Estimation methodology

Grid connected (newly built facilities)

BE_y : Baseline emissions | PE_y : Project emissions

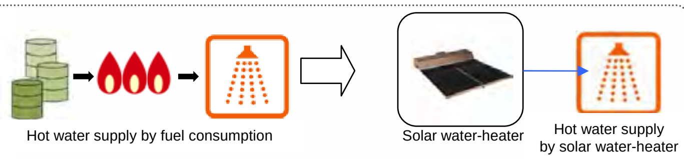


Emissions when conventional power supply continues without construction of solar heat power plants

Emissions when power supply from solar heat power plants is added to power grids

Standalone

BE_y : Baseline emissions | PE_y : Project emissions



Emissions when existing hot water production from fossil fuel continues

Emissions with hot water supply by solar water heater

19-2. Solar heat

(3) Estimation methodology

① Estimation of baseline emissions

Grid connected

If solar heat power generation facilities are not built, conventional power supply will continue. GHG emissions are estimated from fuel amount controlled, since power supply from existing conventional facilities will be controlled by switching to solar heat power generation.

Standalone (hot water supply)

If standalone solar water heater, etc. are not introduced, hot water supply by conventional electricity from grid will continue. GHG emissions are estimated from the electricity amount controlled, since the electricity consumption of in existing hot water supply facilities will be controlled by switching to hot water produced by standalone solar water heater.

② Estimation of project emissions

GHG emissions in power generation by solar heat power generation and solar water heater after project implementation are considered ZERO.

19-2. Solar heat

(4) Other

① Project boundary

The scope of GHG estimation covers the relevant power generation facilities and solar water heaters inside the project site.

② Leakage

Possible leakage in solar heat power generation and solar water heaters may include CO_2 emissions from product manufacturing and transportation of materials, etc. relating to construction/installation of solar heat power generation facilities and solar water heaters. However, these CO_2 emissions will not be taken into account.

Consumption of fuels (extraction, processing, transportation, etc.) are also not to be taken into account.

20. Geothermal power

(1) Outline of typical project

Contribute directly to GHG emissions reduction through building geothermal power generation facilities by utilizing natural geothermal resources to produce renewable energy that does not produce green house gas (GHG).

(2) Applicability conditions

The project will cover newly built or rehabilitated geothermal power generation facilities.
Generated power can be supplied by connecting to existing power grids.

(3) Estimation methodology

GHG reductions due to wind power generation will be estimated by taking the difference of GHG emissions of the energy generation by conventional power plant to be replaced by geothermal power (baseline) and the results after operation of geothermal power plants (project).

$$ER_y = BE_y - PE_y$$

ER_y : GHG emission reductions by project implementation over y (years)
BE_y : GHG emissions over y (years) by conventional power plant (t-CO_2/y) (Baseline emissions)
PE_y : GHG emissions over y (years) after operation of geothermal power plants (t-CO_2/y) (Project emissions)

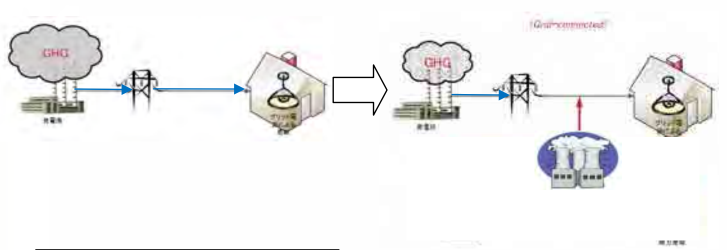
20. Geothermal power

(3) Estimation methodology

Grid connected (newly built facility)

BE_y : Baseline emissions

PE_y : Project emissions



Emissions when conventional power supply continues without construction of geothermal power plants

Emissions when power supply from geothermal power plants is added to power grids

20. Geothermal power

(3) Estimation methodology

① Estimation of baseline emissions

If geothermal power generation facilities are not built, conventional power supply will continue. Emissions are estimated from fuel amount controlled, since power supply from existing conventional facilities will be controlled by switching to geothermal power generation.

② Estimation of project emissions

GHG emissions in power generation by geothermal power generation after project implementation are calculated by adding GHG emissions due to steam release and CO_2 emission due to on site fossil fuel consumption.

(4) Other

① Project boundary

The scope of GHG estimation covers the relevant power generation facilities inside the project site.

② Leakage

Possible leakage in geothermal power plants may include CO_2 emissions from product manufacturing and transportation of materials, etc. relating to construction of geothermal power generation facilities. However, these CO_2 emissions will not be taken into account.

21. Biomass

(1) Outline of typical project

By generating electricity or supplying heat using biomass residue, control the amount of electricity and fossil fuel consumption used in the power plants and factories, etc. directly reduce GHG emissions.

(2) Applicability conditions

The biomass used in the project should be by-products, residues, or wastes from agriculture and forestry activities. It should not include domestic wastes or other type of wastes.
The project will cover newly build facilities or fuel switch and rehabilitation in existing facilities.
The biomass should be sourced within the project boundary.
The biomass should be stored in aerobic condition to minimize methane release and to prevent the risk of fire and explosion.

21. Biomass

(3) Estimation methodology

GHG reductions due to biomass power generation or heat supply will be estimated by taking the difference of GHG emissions when obtaining power generation and heat quantity after project implementation without using biomass residue (baseline) and the emissions after using biomass residue (project).

The emissions will be estimated by multiplying the amount of fuel required to achieve the same amount of power generation after project implementation by the CO_2 emission factor.

$$ER_y = BE_y - PE_y$$

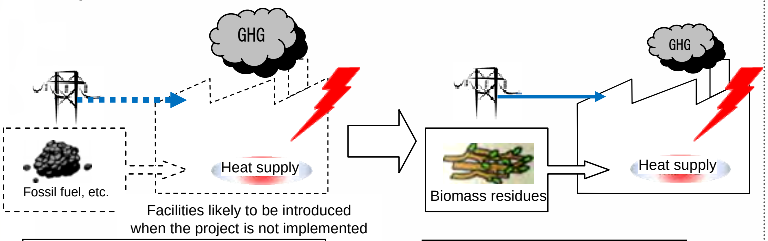
ER_y : GHG emission reductions by project implementation over y (years)
BE_y : GHG emissions over y (years) without biomass residue utilization (t-CO_2/y) (Baseline emissions)
PE_y : GHG emissions over y (years) with biomass residue utilization (t-CO_2/y) (Project emissions)

21. Biomass

(3) Estimation methodology

BE_y : Baseline emissions　　PE_y : Project emissions

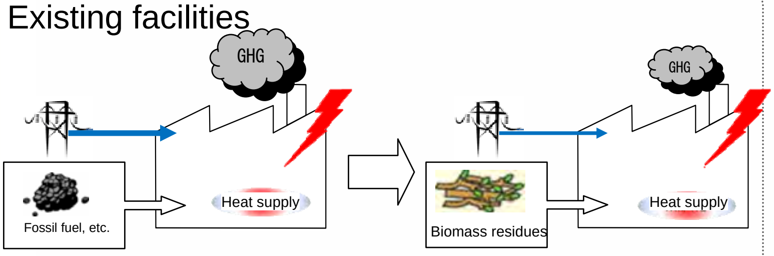
Newly built facilities



Emissions when conventional fuel are continued to be used in the new facilities

Emissions when biomass residues are used as a fuel in the new facilities

Existing facilities



Emissions when conventional fuel are used to generate electricity and supply heat in existing facilities.

Emissions when biomass residues are used as a fuel in existing facilities.

21. Biomass

(3) Estimation methodology

① Estimation of baseline emissions

GHG emissions are estimated by electricity, etc. consumed to gain power and heat after project implementation when biomass residue are not used. Baseline emissions are estimated by multiplying the amount of fuel required to gain the power (MWh/y) and heat (TJ/y) from the same use of biomass residue after project implementation, by the respective CO_2 emission factors.

② Estimation of project emissions

Estimated by multiplying the amount of fuel used in transportation for use of excess biomass and the amount of electricity and supplemental fuel used by facilities using this excess after project implementation, by the respective CO_2 emission factor.

21. Biomass

(4) Other

① Project boundary

The scope of GHG estimation covers areas and locations where biomass residue are generated and the relevant power generation facilities inside the project site.

② Leakage

Possible leakage in utilization of biomass residue in the power plants and factories, etc. may include CO_2 emissions from product manufacture and transportation of materials, etc. relating to construction of facilities for utilization of biomass residues. However, these CO_2 emissions will not be taken into account.
If newly grown crops in the plantation are used as biomass fuel rather than biomass residues, GHG emissions due to plantations (fertilisation, transportation, etc.) will be calculated as leakage and these must be deducted from GHG reductions.

(6) Sewerage and Urban Sanitation Sector

22. Landfill disposal of waste
23. Intermediate treatment of waste
24. Wastewater treatment
25. Sewage

22. Landfill disposal of waste

(1) Outline of typical project

To reduce green house gas (GHG) emissions by collecting and utilizing (power generation and heat supply) landfill gas (LFG) produced from closed or in-use landfill waste disposal site.

(2) Applicability conditions

The project will be LFG collection in anaerobic or semiaerobic landfill sites, etc. The captured LFG will be utilized to generate electricity/thermal energy. Or the CH4 in LFG will be destroyed by flaring. The project will be implemented in closed or in-use landfill waste disposal site.

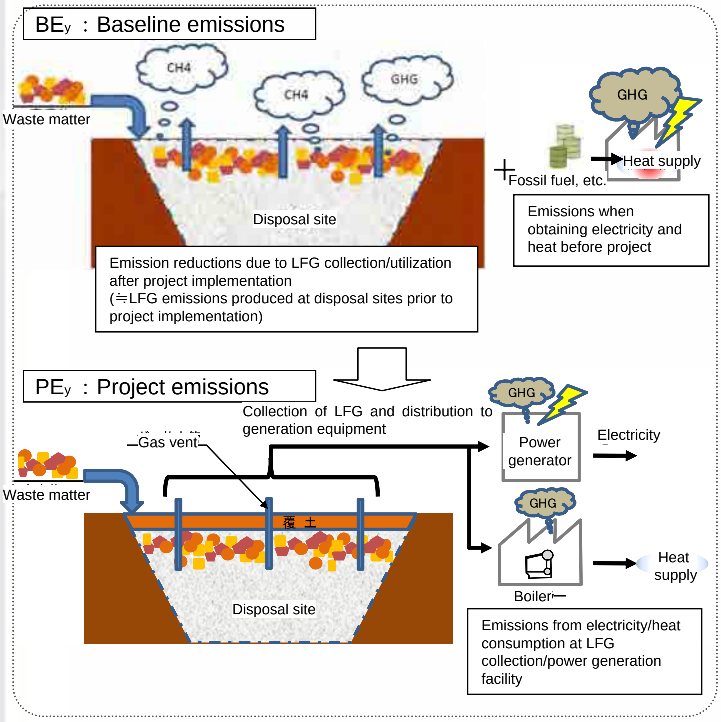
(3) Estimation methodology

GHG emission reductions due to collection/utilization of LFG are estimated by taking the difference of emissions when methane from LFG is released into the atmosphere (baseline) and emissions after collection/utilization of LFG (project). Utilization in this context is for electricity generation. GHG emissions due to LFG will also be taken into account.

$$ER_y = BE_y - PE_y$$

ERy : GHG emission reductions by project implementation over y (years)
BEy : GHG emissions over y (years) without LFG collection and utilization (t-CO_2/y) (Baseline emissions)
PEy : GHG emissions over y (years) with LFG collection and utilization (t-CO_2/y) (Project emissions)

22. Landfill disposal of waste



22. Landfill disposal of waste

(3) Estimation methodology

① Estimation of baseline emissions

Baseline emissions are taken as the total amount of methane emissions in LFG emanating from the atmosphere when not collected, and GHG emissions in power generation obtained after project implementation and heat supply energy produced by traditional methods.

② Estimation of project emissions

GHG emissions are estimated by the consumption of electricity and fuel in LFG collection/power generation facilities, etc. after project implementation.

(4) Other

① Project boundary

The scope of GHG estimation covers inside the project activity site where landfill gas is collected/destroyed/utilized.

② Leakage

When considering Life Cycle Assessments (LCA) of waste management, leakage may include GHG emission from energy consumption when producing/transporting raw materials for construction/manufacturing of power generation facilities, etc. However, these GHG emission are not to take into account.

23. Intermediate treatment of waste

(1) Outline of typical project

When organic waste matter is disposed of by sanitary landfill it decays and produces methane. This project will reduce GHG emissions by intermediate treatment such as methane power generation, incineration, composting, etc. without disposing newly generated waste matter to landfill site.

(2) Applicability Conditions

This project will cover newly produced waste matter (organic matter contained in newly produced domestic, commercial and municipal waste) to be disposed by sanitary landfill that will be treated by one or more of the methods such as composting, gasification, anaerobic digestion, RDF treatment without incineration, thermal treatment, and incineration.

(3) Estimation methodology

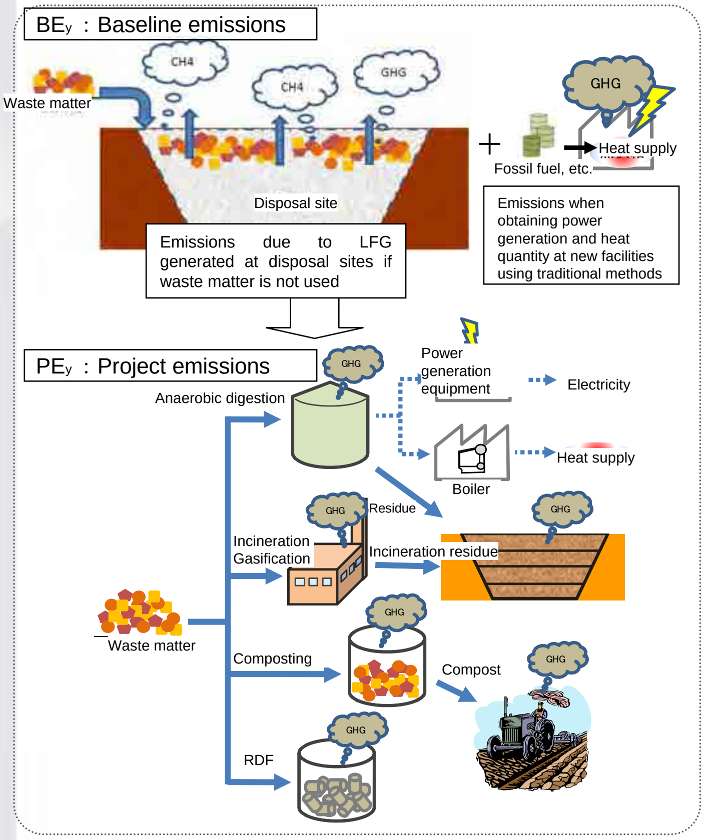
GHG emission reductions due to intermediate treatment of waste (composting, anaerobic digestion, RDF treatment without incineration, thermal treatment, and incineration) are estimated by taking the difference of emissions when methane from LFG is released into the atmosphere (baseline) and emissions after treatment of waste (project)/

$$ER_y = BE_y - PE_y$$

ER_y : GHG emission reductions by project implementation over y (years)
BE_y : GHG emissions over y (years) without intermediate treatment of waste (t-CO_2/y) (Baseline emissions)
PE_y : GHG emissions over y (years) with intermediate treatment of waste (t-CO_2/y) (Project emissions)

23. Intermediate treatment of waste

(3) Estimation methodology



23. Intermediate treatment of waste

(3) Estimation methodology

① Estimation of baseline emissions

Baseline emissions are estimated by the total amount of GHG emissions due to methane generated from disposing of new waste matter in the landfill, and GHG emissions (when there is power generation/heat supply after project implementation) from power generation and heat supply obtained by using the method in the baseline.

② Estimation of project emissions

GHG emissions are estimated by the consumption of electricity and fuel in waste treatment facilities, etc. after project implementation.

(4) Other

① Project boundary

The scope of GHG estimation covers inside the project activity sites where waste matter is processed with intermediate treatment and is disposed of by sanitary landfill.

② Leakage

Possible leakage in waste treatment may include emissions from increased traffic, incineration residue and end-users of renewable biomass. However, these CO_2 emissions will not be taken into account.

Emissions from anaerobic digestion, gasification, burning of RDF/renewable biomass, and final disposal of compost residue will be estimated by referring to Table D-10 in Annex and deducted from GHG reductions.

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24. Wastewater treatment

(1) Outline of typical project

By improving domestic and industrial wastewater treatment, enhance sanitation environment, control CH_4 generated by wastewater and reduce GHG emissions. Also, it aims to reduce GHG emissions by collecting/utilizing or destroying CH_4 produced in new/existing wastewater treatment facilities.

(2) Applicability conditions

This project will cover wastewater and sludge treatment systems that prior to project implementation are in aerobic or anaerobic condition, or are not treated at all. After project implementation, wastewater and sludge treatment systems will be in aerobic or anaerobic circumstances.

(3) Estimation methodology

GHG emission reductions due to wastewater treatment are estimated by taking the difference of emissions when wastewater treatment is not improved (baseline) and emissions after improvement of wastewater treatment (project).

$$ER_y = BE_y - PE_y$$

ER_y : GHG emission reductions by project implementation over y (years)
BE_y : GHG emissions over y (years) without wastewater treatment (t-CO_2/y) (Baseline emissions)
PE_y : GHG emissions over y (years) with wastewater treatment (t-CO_2/y) (Project emissions)

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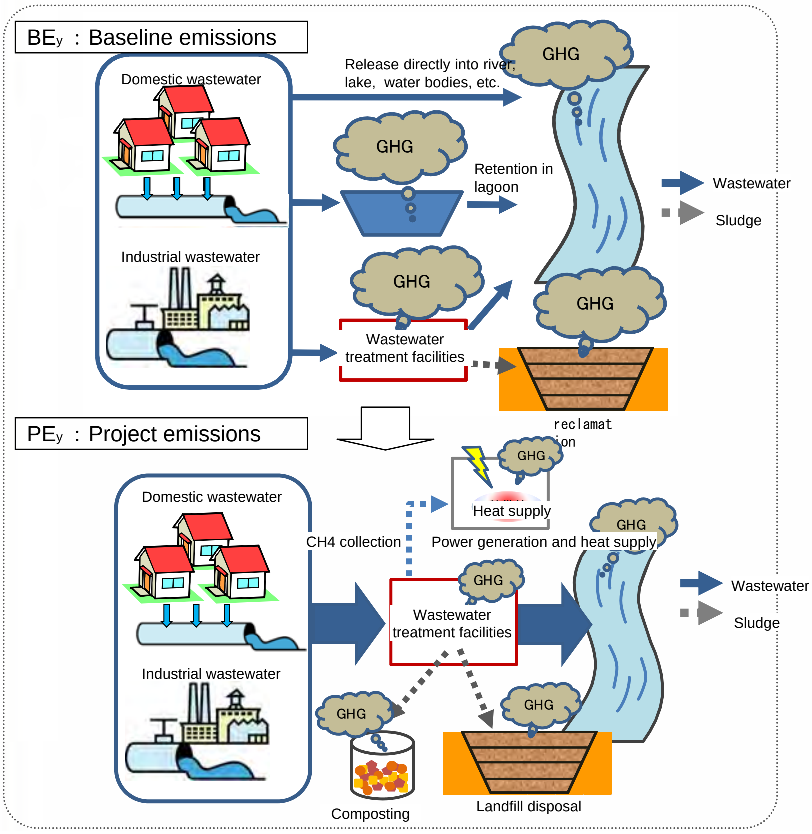
24. Wastewater treatment

(3) Estimation methodology



24. Wastewater treatment

(3) Estimation methodology

① Estimation of baseline emissions

Baseline emissions will be estimated by the total amount of the following emissions:
- GHG emissions by the consumption of electricity and fossil fuel before project implementation
- GHG emissions by wastewater treatment before project implementation
- GHG emissions by sludge treatment before project implementation
- GHG emissions by releasing of treated wastewater into rivers, lakes and oceans before project implementation
- GHG emissions by power generation and heat supply after project implementation obtained by using the method in the baseline.

② Estimation of project emissions

Project emissions will be estimated by the total amount of the following emissions:
- GHG emissions by the consumption of electricity and fossil fuel after project implementation
- GHG emissions by wastewater treatment after project implementation
- GHG emissions by sludge treatment after project implementation
- GHG emissions by releasing of treated wastewater into rivers, lakes and oceans after project implementation
- GHG emissions by decay of sludge after project implementation

24. Wastewater treatment

(4) Other

① Project boundary

The scope of GHG estimation covers inside the project activity sites where wastewater and sludge treatment take place.

② Leakage

Possible leakage in project implementation may include GHG emissions when transferring equipment from outside project boundary or moving existing equipment to other locations. However, these will not be taken into account as leakage.

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25. Sewerage

(1) Outline of typical project

To control CH4 produced by the decay of sewage sludge and reduce green house gas (GHG) emissions by biogas power generation and composting.

(2) Applicability conditions

Prior to project implementation, sewage sludge is decaying under anaerobic condition and generating CH_4. After project implementation, sewage sludge will be composted and utilized in aerobic condition. It is assumed that there will be no transfer of equipment from outside the project boundary in the implementation of the project.

(3) Estimation methodology

GHG emission reductions due to biogas power generation/composting of sewage sludge are estimated by taking the difference of emissions when biogas power generation/composting of sewage sludge is not carried out (baseline) and emissions after implementation (project).

$$ER_y = BE_y - PE_y$$

ER_y : GHG emission reductions by project implementation over y (years)
BE_y : GHG emissions over y (years) without treatment of sludge for biogas power generation/composting (t-CO_2/y) (Baseline emissions)
PE_y : GHG emissions over y (years) with treatment of sludge for biogas power generation/composting (t-CO_2/y) (Project emissions)

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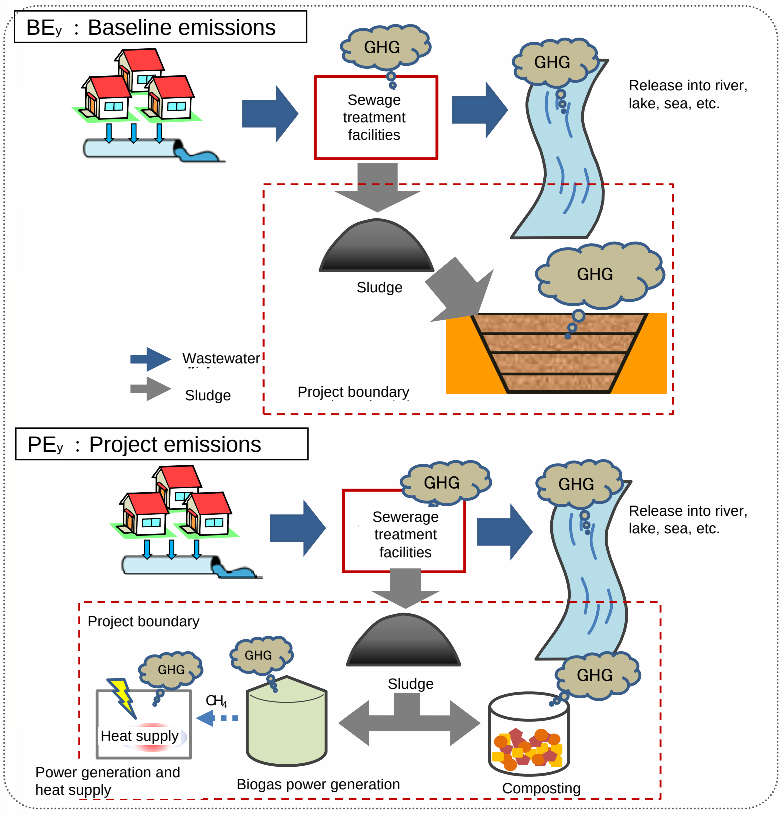
25. Sewerage

(3) Estimation methodology



25. Sewerage

(3) Estimation methodology

① Estimation of baseline emissions

Baseline emissions will be estimated by the total amount of the following emissions:
・GHG emissions by decay of sludge before project implementation
・CO_2 emissions proportionate to power generation and heat supply by CH4 collection/utilization after project implementation

② Estimation of project emissions

Project emissions will be estimated by total amount of the following emissions:
・GHG emissions by the consumption of electricity and fossil fuel after project implementation
・GHG emissions by composting of sludge after project implementation

(4) Other

① Project boundary

The scope of GHG estimation covers inside the project activity site where sludge is treated.

② Leakage

Possible leakage in project implementation may include GHG emissions when transferring equipment from outside project boundary or moving existing equipment to other locations. However, these will not be taken into account as leakage.

JICA Climate Finance Impact Tool (JICA Climate-FIT) Draft Ver. 1.0

<Outline of Adaptation Measures>

Web: http://www.jica.go.jp/english/operations/climate_change/adaptation.html

Office for Climate Change
JICA Global Environment Department
This PTT was prepared by: Japan Weather Association

2011/10/24 Ver.

1. Outline of the Study

1.1 Background and objective of the study

(1) Background

・ "Cancun Agreement"

(16th Conference of the Parties (COP16) of the United Nations Framework Convention on Climate Change (UNFCCC))

・ Support for mitigation

To conduct measurement, reporting and verification (MRV) for quantitative evaluations of greenhouse gas (GHG) emission reduction (sequestration)

・ Support for adaptation

To reduce vulnerability, maintain or increase adaptive capacity and resilience particularly in least developed countries (LDC), the Alliance of Small Island States (AOSIS), and Africa

(2) Objective

・Future JICA climate change adaptation projects

・Consideration of collaboration policy and compilation of estimation methodologies for quantitative evaluation to implement MRV for GHG emission reduction (sequestration) from inception stage of individual projects

-Establishing concepts of adaptation measures
-Selection of target sub-sectors

→ Establish concepts by sub-sector and develop guidelines

1.2 Composition of the report

Chapter 1 Outline of the Study
Chapter 2 Review of the Existing Resources

Chapter 3 Basic concept of adaptation measures
- The basic concept
- Vulnerability assessment
- Adaptation Project and BAU project with Adaptation Options
- Maladaptation
- Evaluation and monitoring adaptation effect
- Required data

Chapter 4 Selection of target sub-sectors
- Sub-sectors on general adaptation projects
- Previous loan aid achieved (Classify yen loan funded projects from 1995 to 2010)
- Integration of sub-sectors with classification of yen loan funded projects
- Loan provided by other donors
- Selection of target sub-sectors

Chapter 5 Basic Concept and Guidelines for Adaptation Measures

Identification of adaptation project

Composition of materials for each sub-sector

1) Basic concept of adaptation
2) Guidelines for "Adaptation project"
3) Guidelines for "Regular development project with Adaptation Options"

Projection of future climate

Target sub-sectors

①Water Resources (1. Water resources)
②Agriculture and Food (2. Irrigation and drainage, 3. Farmland management enhancement)
③Forestry/Natural Environment Conservation (4. Forest preservation/ afforestation, 5. Ecosystem Integrity)
④Disaster Management (6. Flood control, 7. Coastal protection, 8. Sediment-related disaster prevention, 9. Disaster prevention information system)
⑤Urban/ Regional Development (10. Rural/urban development)
⑥Transportation (11. Bridge, road and railway, 12. Port and airport)
⑦Sanitary Improvement (13. Water supply, 14. Sewerage/ urban drainage, 15. Medical/ health care)

2. Concept of Adaptation Measures

2.1 Definition of terms

The terms "adaptation", "vulnerability", etc. have various definitions.
The definitions applied in this study are as follows:

(1) Adaptation measures

Given that the adaptation projects covered in this study is subject to OECD adaptation marker, the definition of OECD is adopted.

Agency	Reference	Definition
OECD	Addendum on the Climate Change Adaptation Marker	Intends to reduce the vulnerability of human or natural systems to the impacts of climate change and climate-related risks, by maintaining or increasing adaptive capacity and resilience.

(2) Vulnerability

The term "vulnerability" is determined by several components comprising of climate change as an external force, and the sensitivity and adaptive capacity of systems. This study adopts the UNDP definition that is formulated based on the OECD definition.

Agency	Reference	Definition
UNDP	Mapping Climate Change Vulnerability and Impact Scenarios	"Vulnerability"= "exposure to climate hazards and perturbations" x "sensitivity" – "adaptive capacity"

2.1 Definition of terms

(3) Adaptive capacity

Adaptive capacity is basically defined as the ability to reduce negative impacts by climate change. This study adopts the definition of OECD which includes the ability to take advantage of opportunities.

Agency	Reference	Definition
OECD	Integrating Climate Change Adaptation into Development Co-operation – Policy Guidance	**Adaptive capacity is a system's ability to adjust to climate change to moderate potential damage, to take advantage of opportunities or to cope with consequences.**

(4) Maladaptation

The definition of Maladaptation by OECD is adopted.

Agency	Reference	Definition
OECD	Integrating Climate Change Adaptation into Development Co-operation – Policy Guidance	**Business-as-usual developments which, by overlooking climate change impacts, inadvertently increase exposure and vulnerability to climate change. Actions undertaken to adapt to climate impacts that do not succeed in reducing vulnerability but increase it instead.**

2.2 Vulnerability assessment

・**Purpose of adaptation = To reduce vulnerability** to climate change
・**Planning adaptation =** Necessary to identify and **evaluate vulnerability**
・To **evaluate vulnerability,** the following steps were established in reference to the UNDP guidebook (2010).

Steps and summary of vulnerability assessment in target sectors (Adaptation Project)

Step 1 Identification of the Hazards and Sensitivity to Climate Change	**1) Assess past and present climate trends and risks**
	2) Assess future exposure to climate hazards and changes **a) Study future weather conditions after climate change** **b) Study other factors related to socioeconomic changes**
	3) Assess sensitivity to future climate change **a) Study past damage situation** **b) Study the counter measures taken** **c) Assess sensitivity to future climate change**
Step 2 Determine Adaptive Capacity to Climate Change	**4) Assess adaptive capacity, etc. to climate change** **a) Identify of adaptive capacity to climate change** **b) Identify factors exacerbating climate change impacts**
Step3 Assessment of Vulnerability	**5) Assess vulnerability** **Assessment of vulnerability to climate change in the target region in consideration of factors of Steps 1 and 2. Identification of differences in vulnerability within the target region, in case there are substantial differences.**

2.3 Adaptation project and regular development project

(1) Difference between Adaptation project and regular development project with adaptation option

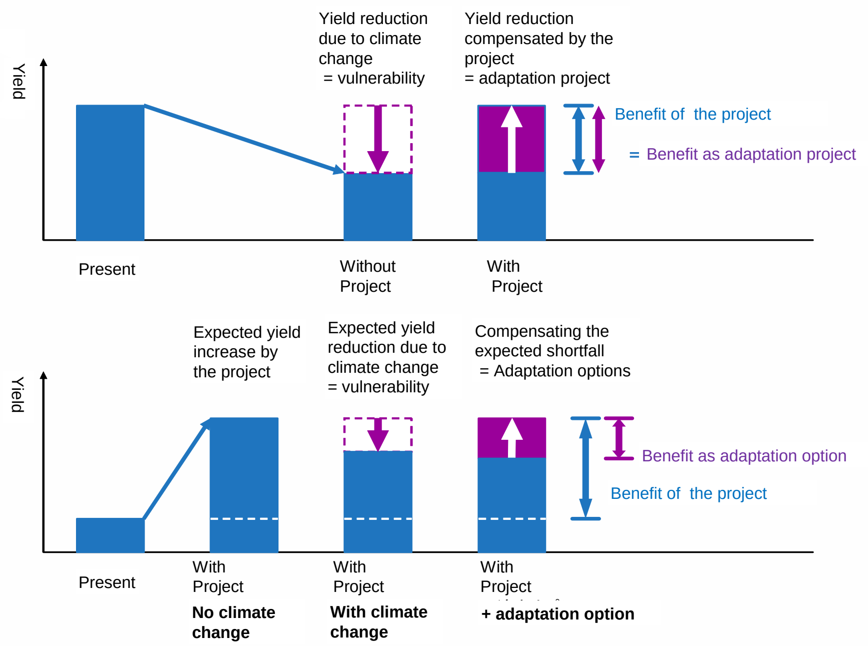
Guidelines for adaptation measures was developed based on classification by "Adaptation project" and "Regular development project with Adaptation options." However, it is not realistic to draw a clear line between the two types, and there may be variations between them.

- Adaptation project
  The main objectives of the projects is adaptation.
- Regular development project with adaptation options
  Projects designed to adapt to the impacts of the climate change in achieving their main objectives

	Adaptation project	Regular development project with adaptation options
Definition	Projects formulated to reduce vulnerability in climate change in the existing system. E.g., projects to improve existing facility to adapt to the increased vulnerability caused by the change of external forces due to climate change.	Projects not mainly aiming to reduce the vulnerability, but is designed to adapt to the impacts of climate change in achieving their main objectives. E.g., infrastructure development/ rehabilitation projects that are planned or designed in consideration of increased external forces stemming from climate change.
Example of projects	- Drainage of a glacial lake with the risk of collapse by global warming - Expansion of existing irrigation systems to address the crop damage caused by increased frequency and intensity of drought. - Disaster prevention project to strengthen resilience against potential hazards that might occur in association with inundation of roads due to increased flood risk by climate change.	- Mangrove afforestation project in consideration of the sea level rise to protect coastal areas and ecosystems. - Flood control project primarily aimed to contribute to economic development in consideration of external forces caused by increased frequency of extreme events and rainfall. - Road construction project which takes into account potential flood damage caused by climate change to design the route and related facilities.

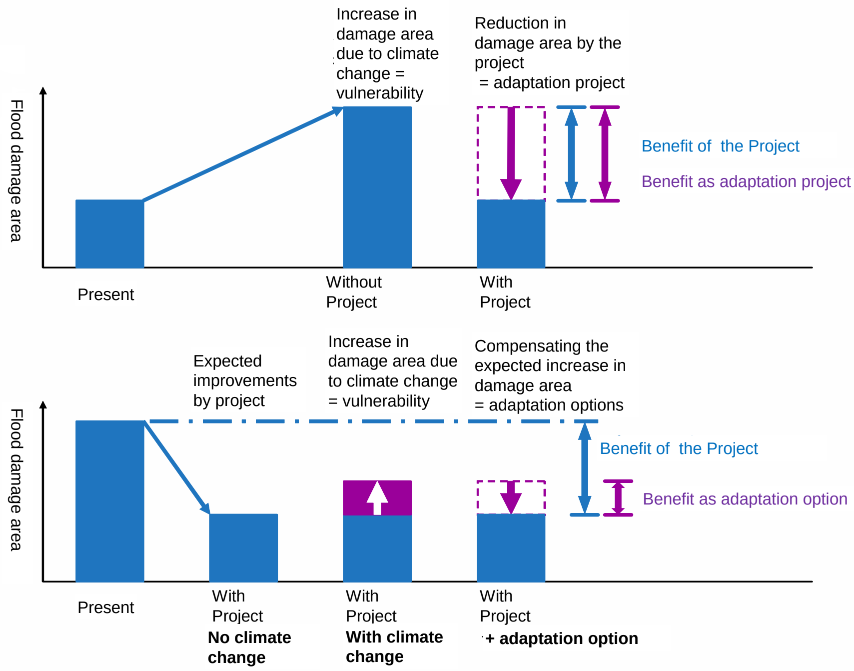
2.3 Adaptation project and regular development project

(2) Example of differences between "Adaptation project" (above) and "Regular development project with adaptation options" (below) (Irrigation)



2.3 Adaptation project and regular development project

(3) Example of differences between "Adaptation project" (above) and "Regular development project with adaptation options" (below) (Flood control)



2.3 Adaptation project and regular development project

(4) Difference in framework of assessment

While "Adaptation project" evaluates vulnerability as specific as possible, "Regular development project with adaptation options" conducts the minimum level of such evaluation and only examines risks and changes related to climate change, namely, the change of external forces.

・Vulnerability assessment in "Adaptation project"

STEP 1: Hazards and Sensitivity to Climate Change

1) Assess past and present climate trends and risks

2) Assess future exposure to climate hazards and changes

3) Assess sensitivity to future climate change

STEP 2: Determine Adaptive Capacity to Climate Change

4) Assess adaptive capacity, etc. to climate change

STEP 3 Assessment of Vulnerability

5) Assess vulnerability

・Vulnerability assessment in "Regular development project with adaptation options"

Identify hazards and changes to climate change

2.4 Evaluation and monitoring of adaptation measures

Guidelines by sub-sector have been developed by summarizing basic concepts and vulnerability assessment methods, as well as assessment items in implementation of projects and evaluation indicators used in monitoring and reviewing.

(1) Project evaluation methods and items

・Adaptation measures that bring benefits to the system under the present climate conditions.

It is possible to evaluate based on cost-benefit analysis (economic evaluation)

- Adaptation measures specialized in adapting to climate change
- When the effects of Adaptation Project differ from the benefits of regular development project

It is necessary to identify assessment items and indicators (quantitative/qualitative assessment) to evaluate changes in the system’s sensitivity and adaptive capacity.

(2) Monitoring / review indicators

・Use the same items and indicators shown in (1) above, if they are applicable
・If the same items and indicators in（1）above are not applicable,

“Alternative indicators” are needed to evaluate changes in sensitivity and adaptive capacity.
“Alternative indicators” should be examined for each suggested project.

3. Selection of Target Sub-sectors

3.1 Selection of target sub-sectors

(1) Selection criteria for sub-sectors

- Previous loan aid achieved by JICA (Including former JBIC)
- Potential for developing adaptation project

(2) Process of sub-sector selection

1. Develop sectors/small classifications based on examples of typical adaptation measures

↓

2. Classify JICA funded yen loan projects into sectors/sub-sectors

↓

3. Determine target sub-sectors by integrating small classifications that are similar or related.

↓

4. Check against other donors' adaptation projects to confirm adaptation sub-sectors supported by other donors are covered.

↓

5. Determine target sub-sectors

3.1 Selection of target sub-sectors

① Development of sectors/small classifications based on examples of typical adaptation measures

In order to categorize sub-sectors covering all adaptation measures, examples of adaptation measures are extracted from the following documents a) to d). Sectors/small classifications have been determined to include all adaptation measures extracted.

a. JICA's Assistance for Adaptation to Climate Change, 2007
b. IPCC AR4 WG II Technical Summary
c. Reports by Ministry of the Environment Japan, Global Warming and Adaptation, 2009
d. Principle on Climate Change Adaptation, Ministry of the Environment Japan, 2010.11

②Determination of sectors/small classifications based on the previous loan aid achieved by JICA

A total of 1,139 JICA loan projects from 1995 to 2010 were categorized into small classifications. New categories were created for those projects which did not fall into existing classifications. In addition, adaptation measures not described in any of the above a) to d) were allocated to one of the small classifications.

3.1 Selection of target sub-sectors

③Integration of small classifications into target sub-sectors

Sub-sectors identified through ① and ② that are similar or related were integrated into the following eight sectors and 20 sub-sectors.

Sector	Sub-sector
Water resources	Water resources management
	Water resources development
	Water resources utilization
Agriculture and Food	Irrigation and drainage
	Enhancement of agricultural management (cultivation management, breed, irrigation association)
	Livestock and fisheries
Forestry/ natural environment conservation	Forest preservation, afforestation (planting grass seeds)
	Ecosystem integrity
Disaster management	Flood control
	Coastal protection
	Sediment-related disaster prevention
	Information system

Sector	Sub-sector
Urban-regional development	Rural community improvement
	Urban community improvement
Transportation	Transportation infrastructure
Sanitary Improvement	Water supply
	Sewerage and drainage
	Medical / health care
Others	Village development, local community enhancement
	Development of human resources

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3.2 Selection of target sub-sectors

④Analyses of other donors' trends (part 1)

GEF focuses on water resources, agriculture, government administration and human resources sectors.

Sector	Suggested sub-sector: Sub-sector	World Bank: Sub-sector	#	GEF: Sub-sector	#	ADB: sub-sector	#
Water resources	Water resources management			Water resources management	8	Water resources management	3
	Water resources development			Water resources development	1	Water resources development	1
	Water resources utilization						
Agriculture and food	Irrigation and drainage	Irrigation and drainage	5				
	Farmland management enhancement (cultivation management, breed variety, irrigation association)			Farming management support	10	Farming management support	2
				Sustainable agriculture	2		
		R & D	12				
	Livestock and fishery	Livestock	3	Livestock	3		
		Agricultural administration	3				
		Agricultural processing	7	Large in umber, but these may include mitigation measures		Other	1
Forestry / natural environment conservation	Forest preservation / afforestation (planting grass seeds)	Forest	47	Forest preservation / afforestation planting	1		
				Forest disaster prevention	1	Coastal conservation	3
	Ecosystem integrity			Human resources development and environmental management ability	24	Development of human resources, environmental management ability	3
Disaster prevention	Flood control	Flood control	6	Flood control	1		
	Coastal protection			Coastal protection	2		
	Landslide disaster prevention						
	Information system			Information system	4	Information system	1
						Land use management	1

Disaster prevention and government sectors tend to be stressed in ADB projects. Many non-structural measures , including educational activities and capacity building related to climate change are promoted.

Non-structural measures

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3.2 Selection of target sub-sectors

④Analyses of other donors' trends (part 2)

Sector	Proposed sub-sector	World Bank		GEF		ADB	
	sub-sector	Sub-sector	#	Sub-sector	#	Sub-sector	#
Urban /regional development	Rural development	Housing	1				
	Urban development						
Transportation	Transport infrastructure	Transportation by ship, port	4			Ports and harbors	1
		Railway	4				
		Road	6				
		General transportation	15				
		Transportation administration	5				
Sanitary improvement	Water supply	Water supply	3				
	Sewerage and drainage	Sewerage	2				
	Medical / health care improvement	Sanitation	1	Medical education		Medical education	
Other	Village development and enhancement of local communities						
	Human resources development	Primary education	1	Education	10		
		Vocational training	1				
Government				Environmental issues	13	Environmental issues	1
				General administration	1		
Energy				Renewable energy	1		
Finance		Finance	2				
Overall water management (water resources, sewage, flood control)		Overall water management	14				
		Government administration	1				

GEF focuses on water resources, agriculture, government administration and human resources sectors.

Disaster prevention and government sectors tend to be stressed in ADB projects. Many non-structural measures , including educational activities and capacity building related to climate change are promoted.

Large in umber, but these may include mitigation measures

Non-structural measures

3.2 Selection of target sub-sectors

(3) Result of the selection of target sub-sectors

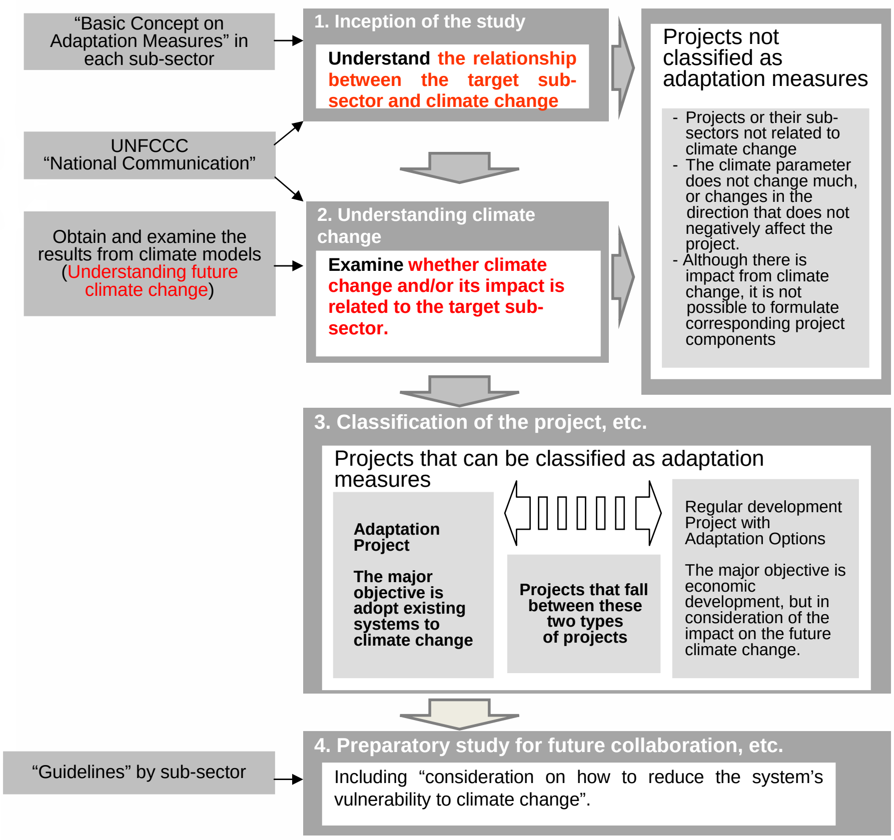
Based on the above consideration, potential adaptation measures were further assessed and the following 15 sub-sectors were selected as sub-sectors.

Sub-sector
1. Water resources
2. Irrigation and drainage
3. Farmland management enhancement (cultivation management, breed variety, irrigation association)
4. Forest preservation/ afforestation
5. Ecosystem integrity (wetlands, etc.)
6. Flood control
7. Coastal protection
8. Sediment-related Disaster Prevention

Sub-sector
9. Disaster prevention information system
10. Rural / urban development
11. Bridge, road and railway
12. Port and airport
13. Water supply
14. Sewerage / Urban Drainage
15. Medical / health care

4. Basic Concept and Guidelines for Adaptation Measures

4.1 Formulation process for potential Adaptation project



4.2 Concept of adaptation measures by sub-sector (overview)

0. Understanding future climate change (Common to all sectors)

0. Understanding future climate change

(1) Basic concept

<Future climate as basis for consideration of adaptation measures>

・Use the projection results of assessment models adopted in each country's policies for climate change measures.
・If no assessment model is established, prediction results from IPCC Fourth Assessment Report (IPCC AR4) shall be used.

Projection results are summarized in IPCC AR4; however, it is preferable that the outputs are understood in further detail for application in projects. In this section, **the approach to investigate adaptation measures for the assumed or particular project area is discussed in reference to outputs of the global climate model (GCM). This section also identifies methods to examines the necessity of adaptation measures in the potential projects and areas where they will be conducted**. As the IPCC Fifth Assessment Report will be issued in September 2014, the latest outputs should also be referred to and be used when it is available.

(2) Overview of climate change projection

▼The following four factors need to be defined to project future climate change:
1) Scenarios
2) Projection model
3) Projection terms
4) Projection elements

Climate change projection employed in the **IPCC** AR4 is based on respective scenarios in which **multiple models are used** for projecting future climate. It is also important to understand variance in outputs inherent to **climatic elements** and **grid sizes** selected for the **projection year**.

0. Understanding future climate change

(2) Overview of climate change projection

① Scenarios

<Major Scenarios used in IPCC Fourth Assessment Report>

Category	Scenario	Major assumption
SRES Scenario	SRESA1B	A world of very rapid economic growth, world population, after reaching the peak in the middle of this century, turns downward. Rapid introduction of new and more efficient technology. Major underlying themes are economic and cultural convergence and capacity building, with a substantial reduction in regional differences in per capita income.
	SRESB1	A world with the same global population as in the A1 storyline but with rapid changes in economic structures toward a service and information economy, with reductions in materials intensity, and the introduction of clean and resource-efficient technologies.
	SRESA2	A very heterogeneous world. The major challenges include preservation of self-reliance and local identities. Fertility patterns across regions slowly converge and the global population continuously grows. Economic development is primarily regional-oriented, and per capita economic growth and technological changes are more fragmented and slower compared to other scenarios.
Non-SRES Scenario	1PTO2X (1% to double)	Experiments run with greenhouse gasses increasing from pre-industrial levels at a rate of 1% per year until the concentration has doubled and held constant thereafter.
	1PTO4X (1% to quadruple)	Experiments run with greenhouse gasses increasing from pre-industrial levels at a rate of 1% per year until the concentration has quadrupled and held constant thereafter.
	20C3M	Experiments run with greenhouse gasses increasing as observed through the 20th century.
	COMMIT	An idealized scenario in which the atmospheric burdens of greenhouse gasses are held fixed at AD2000 levels.
	PICTL	Experiments run with constant pre-industrial levels of greenhouse gasses.

※SRES Scenario＝Special Report on Emissions Scenarios (IPCC, 2000)
A1B: Economic growth oriented and globalization. Emphasis on balanced energy mix.
A2: Emphasis on economic growth in regional-oriented society.
B1: Globalization with sustainable, environmentally-balanced society with smaller regional gaps.

0. Understanding future climate change

(2) Overview of climate change projection

② Projection model

GCM （Global Climate Model）

- Various climatic elements are computed in the grid size of 0.3-4 degrees horizontally, and 16-56 layers vertically. GCM is further subdivided into AGCM for atmospheric circulation and OGCM for oceanic circulation. AOGCM, the combination of the two GCM types, is used since oceanic circulation has larger impacts on climate change.
- Since different climatic elements are used in various models, it is crucial to ensure that climatic elements required in the assumed or particular project are projected. Also, in case of using the outputs by project level, it should be noted that GCM outputs represent values of the grids that cover wider regions rather than values for specific areas.
- Because the output of GCM represents each region, it is important to **use a model applicable to the target country or region**. Since the projection also differs by model and depending on scenarios to be used, it is desirable to **use ensemble mean** when using the IPCC evaluation model.

RCM （Regional Climate Model）

- RCM is a model used to express climatic elements through computation in finer grids.
- Computation requires a high-end computer as well as enormous computation costs. It is recommended to use the existing RCM computation results if they are regionally available.
- As RCM outputs inherit uncertainties held in GCM as computational assumption, **errors systematically caused by topography should be considered in view of GCM-inherent uncertainties.**

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0. Understanding future climate change

(2) Overview of the climate change projection

③ Projection term

When the projection term is set in the assumed or particular project, appropriate climatic values should be set in consideration of the project amortization period or the service life of major structures and/ or systems to be built in the project. Generally, the mean value in 30 years is employed as the climatic value. However, 20 years is sometimes employed. It is appropriate to consider the projection term to set the climatic value in the range of 20-30 years.

<For a projection in a long-term perspective>
The projection accuracy of a climate model tends to be lower as the time goes since the initiation of the projection. Thus, when the projection requires a long-term perspective, it will be necessary to set up the climatic value **for a longer time span (e.g., 100 years) to formulate adaptation measures in consideration of the uncertainties of the climate model.**

<For a projection in a foreseeable term>
Gaps between a projection and the actual data are comparatively small in a global warming scenario during the term for 20-30 years. Thus the climatic value after 20-30 years should be set so that the detailed adaptation measures against potential impacts within a foreseeable can be considered, while envisaging long-term impacts.

④ Projection elements

A projection obtained from a climate model has many parameters, including those required for computation. Items typically required for project implementation are as follows:

・Specific humidity ・Precipitation ・Pressure at sea level ・Downwelling shortwave
・Temperature ・Temperature daily max ・Temperature daily min ・Eastward wind
・Northward wind

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0.Understanding future climate change

(3) Major tools and their characteristics

Climate model outputs hold extensive data. Various tools are provided to extract data on future climate change for the target region, scenario or term to easily view these outputs.

	Overview	Functions related to climate projection	Other functions
IPCC DDC Data Visualization Tool	This web-based display system, provided by Data Distribution Center of IPCC, enables to extract data from all GCM model outputs.	The following climatic elements can be displayed: ･Specific humidity ･Precipitation ･Pressure at sea level ･Downwelling shortwave ･Temperature ･Temperature daily max ･Temperature daily min ･Eastward wind ･ Northward wind	
ci:grasp（The Climate Impacts: Global and Regional Adaptation Support Platform）	A web-based information display system for climate change projection developed by German Federal Ministry for Environment (BMU), Potsdam Institute for Climate Impact Research (PIK) and GTZ. This system features a user-friendly display of problems caused by climate change and the adaptation process to overcome such problems.	･Simulation results can be displayed on the map ･Enables to graphically display the changes in the specific location for different terms	･The climate elements and effects, as well as search results on adaptation project data can be overlaid on the map. ･The location to implement the adaptation project can be displayed on the map.
The WB Climate Change Portal	This portal site visualizing climate-related information using WEB-GIS, allows to display the location for implementing the climate change project, climate data, impact maps and socio-economic data (population).	Among GCMs used in the IPCC AR4, information summarizing 14 GCM outputs is provided, allowing to use such climate data as future climate, historical climate, weather observatory stations and climate data.	Allows to visualize agricultural impact data, malaria distribution, natural disasters, climate change projects, locations, budgets and other details of projects, f impact map and socio-economic data.
Climate Wizard	This web-based system easily displays climate change status. It is particularly effective to display ensemble information for the 23 GCMs.	Various GCM output data on the map display system can be easily displayed, enlarged or moved on the web.Data can be visually shown on the map or GCM computation results can be displayed by clicking the location.	
SERVIR Viz!	The climate mapping tool is provided by the USAID, NASA, etc. Dataset of Meso-America and Africa are availabl0e as of May 2011.	Data are provided in an approximately 50 km grid size and temperature, and precipitation data for the reference period (1961-1990) are available. The model is based on AIBSRES scenario.	

0.Understanding future climate change

(4) Sectors and relevant elements

The projection models provide outputs as various climatic elements such as temperature and precipitation. For formulating adaptation measures in a specific sub-sector, it is necessary to extract key climatic elements which are highly relevant to the sub-sector, as shown in the table below.

	Specific humidity	Precipitation	Pressure at sea level	Downwelling shortwave	Temperature	Temperature daily max	Temperature daily min	Wind velocity	Sea level rise
1. Water resources	xx	xx	-	xx	xx	xx	xx	xx	xx
2. Irrigation and drainage	xx	xx	-	xx	xx	xx	xx	xx	xx
3. Farmland management enhancement (cultivation management, breed variety, irrigation association)	x	xx	-	x	xx	x	x	x	-
4. Forest preservation / afforestation	x	xx	-	x	xx	x	x	-	xx
5. Ecosystem integrity (wetlands, etc.)	x	xx	-	x	xx	x	x	-	xx
6. Flood control	-	xx	-	-	-	-	-	-	xx
7. Coastal protection	-	xx	-	-	-	-	-	xx	xx
8. Sediment-related disaster prevention	-	xx	-	-	-	-	-	-	x
9. Disaster prevention information system	-	-	-	-	-	-	-	-	-
10. Rural / urban development	x	xx	-	x	xx	x	x	xx	xx
11. Bridge, road and railway	-	xx	-	-	x	-	-	xx	xx
12. Port and airport	-	xx	xx	-	xx	xx	x	xx	xx
13. Water supply	xx	xx	-	xx	xx	xx	xx	xx	xx
14. Sewerage / urban drainage	x	xx	-	x	x	x	x	-	xx
15. Medical / health care	-	x	-	-	x	x	x	-	x

Legend
xx :closely related, need to consider as a reference
x : related or related but not possibly be reflected in planning
- :not related

1. Water Resources

1. Water resources

（1）Concept of adaptation project in the water resources sub-sector

Basic concept

Maintain and improve the supply and demand of water against climate change impacts, such as the reduction or imbalance of water availability and the increase in water demand through appropriate development, management, and utilization of water resources.

Vulnerability

< Major climate change impacts>

- Reduction in precipitation, change of precipitation pattern, increase/ intensification/ prolongation of drought
  ⇒The reduction in surface stream water and groundwater will cause **shortage of water supply and water salinization.**
- Increase / intensification of precipitation, increase/ intensification of extreme climate phenomenon
  ⇒**Decrease in the active capacity of dam reservoirs** due to the increase in soil deposited in the reservoir. **Damage to water resources facility** by flood.
- Temperature rise
  ⇒**Change in the amount of meltwater and the time of the year when meltwater is available**
- Sea level rise
  ⇒**Salinization of surface water** due to the intrusion of saline water, **damage to seawater desalination plants** constructed in the coast

Adaptation measures

- Development, expansion and enhancement of surface water facilities
- Development, expansion and enhancement of groundwater resource facilities
- Development, expansion and enhancement of water conveyance facilities
- Development, expansion and enhancement of water treatment facilities
- Development of water management, water use coordination

Maladaptation

▽Maladaptation in Adaptation measures

・Additional water intake would bring about more serious influence to the other water use or area

▽Maladaptation common in non-Adaptation measures

・The change in future river runoff, and the water levels of rivers and groundwater would exceed the design capacity and affect the safety of facilities.

1. Water resources

(2) Guidelines for Adaptation Project

＜**Steps in vulnerability assessment**＞ (Common to all adaptation projects)
①Assess past and present climate trends and risks
②Assess future exposure to climate hazards and perturbations
③Assess Sensitivity to future climate change
④Assess adaptive capacity to climate change
⇒ vulnerability assessment

Necessity of adaptation measures

Climate change will bring **imbalance between water supply and demand** for existing water resources facilities due to the increase in water demand caused by temperature rise, etc. **It may also damage these facilities** due to intensification of flood caused by changes in precipitation and its pattern.

Vulnerability assessment

①Collect past meteorological and hydrological records
②Estimate future precipitation and its pattern
③Understand past drought, flood damage and countermeasures.
④Evaluate flexibility on the water supplier and user side.
⇒Assess vulnerability to climate change in the target area based on the above ① to ④.

Adaptation measures

To increase the active capacity of reservoirs through structural measures such as heightening of dams, excavation of reservoirs, etc. to increase water resources by reducing water leakage, developing water resources and conveying water, and to reallocate and utilize water resources by improving management of dams or introduction of integrated water resources management

Items to assess in project implementation

- Sensitivity to future climate change
- Flexibility on the water supplier side
- Flexibility on the water user side
- Flexibility in coordinating water supply and demand
- Disaster resilience capability of regulatory agencies
- Existence and capability of R&D labs.

Alternative items to assess in monitoring and review

- Improvement of the target return period by expansion of facilities
- Improvement of target return period in the target area by development of new facility
- Improvement of the target return period in the target area by improvement of water management
- Changes in the number of beneficiaries
- Changes in the awareness of stakeholders

Effect of adaptation measures

The impacts of climate change will be reduced.

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1. Water resources

(3) Guidelines for Regular Development Project with Adaptation Options

Necessity of adaptation options

Needs to develop or extend water resources since future water demand in association with economic growth will exceed the existing water supply from water resources. Anticipated climate change impacts include **the reduction in water availability** due to rainfall change, **increase in water demand** due to temperature rise, **intensification of the flood scale**, etc.

Vulnerability assessment

Assess risks and perturbation in association with climate change (precipitation patters, availability of water, etc.)

Adaptation measures

Implement appropriate measures in the project with consideration of the climate change impacts.

Items to assess in project implementation

- Sensitivity to future climate change

Alternative items to assess in monitoring and review

- Improvement of the target return period by expansion of facilities
- Improvement of target return period in the target area by development of new facility
- Improvement of the target return period in the target area by improvement of water management
- Changes in the number of beneficiaries
- Changes in the awareness of stakeholders

Effect of adaptation options

The expected water supply will be maintained even in the event of climate change

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2. Irrigation and Drainage

2. Irrigation and Drainage

(1) Concept of Adaptation projects in the irrigation and drainage sub-sector

Basic concept

Secure and improve agricultural productivity against climate change impacts through the enhancement of water supply and drainage capacity.

Vulnerability

<Major climate change impacts>

Reduction in precipitation, change of precipitation pattern

⇒ **Crop damage and the decrease in irrigation water** due to water shortage

■ Increase / intensification of precipitation and extreme climate phenomenon.

⇒**Flood damage on crops and structures, including reservoirs, intakes, and canals.**

■ Temperature rise

⇒**Increase in water consumption, changes in the period and amount of meltwater availability**

■ Sea level rise

⇒ **Water salinization and poor drainage** due to seawater intrusion

Adaptation measures

- ■ Development/improvement of reservoirs
- ■ Installation of water saving irrigation systems
- ■ Development of drainage
- ■ Development/ improvement of irrigation and drainage facilities
- ■ Enhancement of water management
- ■ Development of participatory irrigation agriculture

Maladaptation

▽Maladaptation in Adaptation measures

・Water-related conflict with other water users occur in the event of changes in water sources or water intake positions

▽Maladaptation common in non-Adaptation measures

・Future climate change impact would cause insufficient capacity in the facility, consequently affecting its safety.

・Excessive water intake of groundwater would cause salt water intrusion, and water quality would become unsuitable for agricultural use.

・ Drainage to outside area within the regions covered by the same drainage facility in the even of flooding would offset the effects of drainage.

2. Irrigation and Drainage

(2) Irrigation: Guidelines for Adaptation project

Necessity of adaptation measures

Climate change impacts, such as decrease in precipitation, change of precipitation patterns, and prolongation of drought, are likely to increase **crop damage.**

Vulnerability assessment

①Collect meteorological and hydrological records
②Estimate the future precipitation and its pattern and the amount of irrigation water,
③Study the past crop damage and countermeasures at the time of drought.
④Interview relevant authorities about their involvement and compensation abilities.
⇒Assess vulnerability to climate change in the target area based on the above ① to ④.

Adaptation measures

Mitigate drought damage through development/ expansion/ improvement of irrigation facilities, installation of water saving irrigation systems, etc.

Items to assess in project implementation

- Sensitivity to future climate change
- Activity of agricultural extension offices and NGOs
- Disaster resilience capability of regulatory agencies
- Existence and ability of research and development
- Compensation for crop and structural damage by climate disasters
- Financing schemes for farmers
- The socio-economic condition of farmers

Alternative items to assess in monitoring and review

- Expansion of irrigated area and/or improvement of the target return period by various measures
- Improvement of water management
- Progress on the development of participatory irrigation agriculture
- Changes in the awareness of stakeholders

Effect of adaptation measures

Crop damage in the event of drought caused by climate change will be reduced

2. Irrigation and Drainage

(3) Irrigation: Guidelines for regular development project with Adaptation options

Necessity of adaptation options

New irrigation facilities should be constructed, or existing ones be rehabilitated or extended in order to improve agricultural productivity. Potential risks of **reduction in irrigation efficiency** because of water shortage are likely to increase due to climate change impacts.

Vulnerability assessment

Identify meteorological and hydrological aspects of the project in the planned base year.

Adaptation options

Introduce appropriate measures against climate change in project implementation.

Items to assess in project implementation

- Sensitivity to future climate change

Alternative items to assess in monitoring and review

- Expansion of irrigated area and/or improvement of the target return period by various measures
- Improvement of water management
- Progress on the development of participatory irrigation agriculture
- Changes in the awareness of stakeholders

Effect of adaptation options

Expected irrigation farming will be maintained even in the event of climate change.

2. Irrigation and Drainage

(4) Drainage: Guidelines for Adaptation project

Necessity of adaptation measures

Climate change will increase and intensify flood, hence **there is a risk of flood damages on crops to increase.**

Vulnerability assessment

①Collect past meteorological and hydrological records
②Estimate the future precipitation and its pattern and the amount of water discharge
③Study the past crop damage and countermeasures at the time of floods
④Interview relevant authorities on their involvement and their compensation capabilities.
⇒Assess vulnerability to climate change in the target area based on the above ① to ④.

Adaptation measures

To mitigate flood damage on crops through development, expansion, and improvement of drainage facilities

Items to assess in project implementation

- Sensitivity to future climate change
- Activities of agricultural extension offices and NGOs
- Disaster resilience capability of regulatory agencies
- Existence and ability of research and development
- Compensation for crop and structural damage by climate disaster
- Financing scheme for farmers
- The socio-economic condition of farmers

Alternative items to assess in monitoring and review

- Expansion of irrigated area and/or improvement of the target return period by various measures
- Improvement of water management
- Progress on the development of participatory irrigation agriculture
- Changes in the awareness of stakeholders

Effect of adaptation measures

Crop damage in the event of drought caused by climate change will be reduced

2. Irrigation and Drainage

(5) Drainage: Guidelines for regular development project with Adaptation options

Necessity of adaptation options

New drainage facilities should be constructed, or existing ones be rehabilitated or expanded to mitigate flood damage and insufficient drainage. Climate change may cause **reduced drainage functions** because of increased discharge in natural drainage and frequency/intensity of flood.

Vulnerability assessment

Identify meteorological and hydrological aspects of the project in the planned base year.

Adaptation options

Introduce appropriate measures against climate change in project implementation.

Items to assess in project implementation

- Sensitivity to future climate change

Alternative items to assess in monitoring and review

- Expansion of irrigated area and/or improvement of the target return period by various measures
- Improvement of water management
- Progress on the development of participatory irrigation agriculture
- Changes in the awareness of stakeholders

Effect of adaptation options

Crop damages due to flood will be reduced even in the event of climate change

3. Farmland Management Enhancement

3. Farmland Management Enhancement

(1) Concept of Adaptation projects in the farmland management enhancement sub-sector

Basic concept

Reduce vulnerability of agriculture mainly through non-structural measures such as breeding, improvement of cultivation and post harvesting, and enhancement of farmers' organization.

Vulnerability

<Major climate change impacts>

- ■ Reduction in precipitation, change of precipitation pattern
  ⇒ **Insufficient growth** due to water shortage, devastated damage by drought.
- ■ Increase / intensification of precipitation and extreme climate phenomenon.
  ⇒**Wind damage on crops and structures** and **salt damage** by tidal wave.
- ■ Temperature rise
  ⇒ **Crop damage** due to high temperature, **Increase in air conditioning cost in greenhouse cultivation**
- ■ Sea level rise
  ⇒ **Salt damage on agricultural field** due to seawater intrusion

Adaptation measures

- ■ Improvement of cultivation and extension of agricultural knowledge and technology
- ■ Improvement in breed varieties
- ■ Strengthening of post harvesting
- ■ Other agricultural support (strengthening farmers' organization and rural finance, etc.)

Maladaptation

▽Maladaptation in Adaptation measures
・Increase in disease outbreak, insect damage, and alien species migration in association with breeding.
▽Maladaptation common in non-Adaptation measures
・Change of agricultural conditions such as temperature, precipitation, water availability, etc.

3. Farmland Management Enhancement

(2) Guidelines for Adaptation project

Necessity of adaptation measures

Climate change impacts, such as **conventional farm crops becoming unsuitable to agricultural condition, change of cropping season, exacerbation of quality deterioration after harvesting**, are likely to be caused.

→

Vulnerability assessment

①Collect past meteorological records
②Study future cultivation conditions
③Study crop damage and countermeasures for drought
④ Study of irrigation / drainage facilities and compensation abilities to crop damage
⇒Assess vulnerability to climate change in the target area based on the above ① to ④.

→

Adaptation measures

To enhance farmland management through alternation/development of breed varieties, improvement of cultivation and post harvesting, strengthening farmers' organization, etc.

Items to assess in project implementation

- Sensitivity to future climate change
- Development and operation of irrigation facilities
- Activities of agricultural extension offices and NGOs
- Existence and ability of research and development
- Compensation for crop and structural damage by climate disasters
- Financing scheme for farmers
- The socio-economic condition of farmers

Alternative items to assess in monitoring and review

- Improvement of cultivation (review of cropping pattern, condition of farming guidance and dissemination of agricultural know-how)
- Improvement of cultivation (installation of greenhouses and introduction of precision machinery in farming)
- Condition of development and introduction of new crop varieties
- Strengthening post harvesting (condition of facility installation and operation)
- Condition of other agricultural support (farmers' organization, financial scheme)
- Changes in the awareness of stakeholders

Effect of adaptation measures

Crop damage by climate change will be reduced.

3. Farmland Management Enhancement

(3) Guidelines for regular development project with Adaptation options

Necessity of adaptation options

Projects for farmland management enhancement should be implemented. It is necessary to consider that, as a result of climate change, **conventional farm crops would become unsuitable for cultivation, cropping seasons will change, and quality would deteriorate more rapidly after harvesting**

→

Vulnerability assessment

Project meteorological and hydrological aspects in the planned base year.

→

Adaptation options

Introduce appropriate measures against climate change in project implementation.

Items to assess in project implementation

- Sensitivity to future climate change

Alternative items to assess in monitoring and review

- Improvement of cultivation (review of cropping pattern, condition of farming guidance and dissemination of agricultural knowledge and technology)
- Improvement of cultivation (Installation of greenhouse and precision agriculture, agricultural input)
- Condition of development and introduction of new crop varieties
- Strengthening post harvesting (condition of facility installation and operation)
- Condition of other agricultural support (farmers' organization, financial scheme)
- Changes in the awareness of stakeholders

Effect of adaptation options

Farming practice will be maintained even in the event of climate change.

4. Forest Preservation / Afforestation

4. Forest Preservation / Afforestation

(1) Concept of Adaptation projects in the forest preservation/afforestation sub-sector

Basic concept

Mitigate forest vulnerability to climate change by strengthening forestry management, improving management facilities, and promoting systematic reforestation efforts. Human-induced impacts on forests should also be reduced.

Vulnerability

<Major climate change impacts>

- Reduction in precipitation, change of precipitation pattern, increase in drought frequency and severity
  ⇒ Decrease in forest productivity and increase of **forest fire** due to reduction in water availability.
- Increase / intensification of precipitation and extreme climate phenomenon.
  ⇒**Decrease in forest stability** due to soil erosion, washout of forest floor due to **slope fairer**.
- Temperature rise
  ⇒ **Decrease in available water** due to increase in evaporation and emergence of **new pest damage**.

Sea level rise
⇒ **Erosion of coastal forests** due to seawater intrusion

Adaptation measures

- Seedling and Gene management
- Forest fire countermeasures
- Pest control
- Afforestation management
- Promotion of forest succession
- Forestry product management
- Securing/conservation of non-wood forest resource

Maladaptation

▽Maladaptation in Adaptation measures

・If climate change (temperature, precipitation, extreme climate phenomena) and associated forest fire and pest damage are not considered in promoting reforestation and / or forestry management, forest vulnerability to climate change may increase. Sea level rise due to climate change may destroy coastal forests, causing the area to be unsuitable for forest growth.

▽Maladaptation common in non-Adaptation measures

・Types and degrees of climate change impacts and forest growth in response to them may increase vulnerability to climate change.

4. Forest preservation / Afforestation

(2) Afforestation: Guidelines for regular development project with Adaptation options

Necessity of adaptation measures

In regions where forests are devastated due to human activities, such as grazing and firewood collection, efforts including reforestation and forest management and restoration should be intensified. Such efforts should also include construction of seedling production facilities, distribution of seedlings, and improvement of infrastructure for forestry activities. Changes in temperature and precipitation need to be considered as elements causing **impacts on vegetation, the aggravated frequency and severity of forest fire and pest damage.**

Vulnerability assessment

Based on results of the climate change analysis in the target year, analyze the forest fire and pest damage in comparison with past meteorological conditions in the target and surrounding areas.

Adaptation measures

Introduce appropriate measures against climate change in project implementation.

Effect of adaptation measures

Forest areas will be expanded and forest quality be increased as expected even in the event of climate change.

Items to assess in project implementation

- Sensitivity to climate change
- Adaptive capacity to climate change

Alternative items to assess in monitoring and review

- Expansion of forest roads, progress in the introduction of fire extinguishing tools
- Expansion of fireproof belts and pest control belts
- Frequency of fire prevention patrol
- Changes in awareness of stakeholders

4. Forest preservation / Afforestation

(3) Mangrove afforestation: Guidelines for regular development project with Adaptation options

Necessity of adaptation measures

In order to restore and conserve mangrove forests which have been significantly reduced, plant mangroves, construct seedling production facilities, give assistance to sustainable fishery and agriculture to support livelihood, and develop eco-tourism. As future climate change impacts, **changes in inundation areas** due to sea level rise **as well as in tidal current and water temperature** should be considered. If sediment inflow from upstream greatly affects mangrove growth, **sediment supply volumes** need to be considered in association with changes in precipitation or rainfall patterns.

Vulnerability assessment

Based on the climate change analysis results in the target year, understand the tidal level, water temperature, and salinity as in the assumed target year.

Adaptation measures

Introduce appropriate measures against climate change in project implementation.

Effect of adaptation measures

Planted mangroves will take roots and grow as expected even in the event of climate change.

Items to assess in project implementation

- Sensitivity to future climate change

Alternative items to assess in monitoring and review

- Capacity building of the authorities responsible for reforestation

5. Ecosystem Integrity

5. Ecosystem Integrity

(1) Concept of Adaptation project in the ecosystem integrity sub-sector

Basic concept

Reduce human-induced impacts that negatively affect the ecosystem vulnerability to climate change to effectively preempt their negative results. Promoting recovery from impacts by disasters such as cyclones is also considered as one of the adaptation measures.

Vulnerability

<Major climate change impacts>

- Desert: **Impacts on vegetation and growth of flora and fauna** in deserts in the winter rainfall zone.
- Grassland/ savanna: **Impacts on vegetation coverage, reduced vegetation volumes**
- Mediterranean ecosystem : **Desertification and fire**
- Tundra and the Arctic / Antarctic: **Shift to tundra vegetation and migration of species from southern areas.**
- Mountain region: **water shortage in the summer growth season and shrinkage of spatial distribution**
- Freshwater wetland, lakes, and rivers: **deteriorating water quality, change in sediment load inflow**
- Ocean and shallow sea area: **frequent coral reef bleaching, decrease in biodiversity in coastal and shelf sea areas, deterioration of water quality** due to reduction in carbonate ion concentration

Adaptation measures

- Direct adaptation measures
  - ・Infrastructure improvement, securing water right
  - ・Establish corridors, restore / create habitats.
- Indirect adaptation measures
  - ・Mitigate stresses to factors other than climate change
  - ・Promote adaptive management

Maladaptation

▽Maladaptation in Adaptation measures
・Infrastructure (seawall, breakwater, etc.) for conservation of coastal area may adversely affect ecosystem.
・Promotion of eco-tourism may increase anthropogenic disturbance.
▽Maladaptation common in non-Adaptation measures
・Transplanting and moving individual organisms/plants from one pleace to another may cause unintended impacts on ecosystems.
・Infrastructure (seawall, breakwater, etc.) for conservation of coastal area may adversely affect ecosystem.

5. Ecosystem Integrity

(2) Guidelines for Adaptation project

Necessity of adaptation measures

Ecosystem in lakes and wetlands may be affected by future climate changes, e.g., precipitation and rainfall patterns, which might cause **water quality deterioration and physical water area shrinkage** associated with changes in freshwater inflow, increase in sediment and nutrient salt inflow and increase in the number of secondary products and acceleration of stratification due to temperature rise. Ecosystem in coastal wetlands may be further affected by sea level rise and associated **changes in water depth, tidal levels, salinity and tidal current conditions**

→

Vulnerability assessment

①Collect past meteorological and hydrological data and ecosystem records.
②Assess future precipitation patterns and material inflow from the catchment area.
③Study ecosystem changes caused by past external factors
④ Evaluate the ability to manage catchment area and ecosystems
⇒Assess vulnerability to climate change in the target area based on the above ① to ④.

→

Adaptation measures

Introduce waste water treatment facilities, plant trees and manage farmlands in the whole catchment area. In order to reduce loads such as sediment inflow in the catchment area, plant trees, promote hillside works and construct sediment control facilities such as sediment dams, and control soil erosion in farmlands. Establish the protection and preservation zones as well as buffer zones to alleviate stresses to ecosystem.

↓

Items to assess in project implementation

- Sensitivity to future climate change
- Risks associated with climate change
- Ecosystem protection and preservation activities

Alternative items to assess in monitoring and review

- Water quality, sediment volume
- Area of conservation zones
- Buffer zone

Effect of adaptation measures

Climate change impacts on ecosystem will be reduced.

5. Ecosystem Integrity

(3) Guidelines for regular development project with Adaptation options

Necessity of adaptation options

The target wetland have been affected by impacts on ecosystems due to water quality deterioration, and shrinkage in wetland area caused by land development in the catchment area, nutrient salt inflow due to urbanization, increase in sediment inflow, unsustainable fishery, and coastal development. In order to conserve wetland ecosystems, requirements include reduction of inflowing load volume by managing the catchment area, promoting sustainable use, and protecting / conserving important zones. Among future climate change impacts, **changes in precipitation, increase in inflowing load volume due to changed rainfall patterns, and water quality deterioration due to temperature rise** need to be considered. For coastal wetlands, **changes in water depth, tidal level, and salinity associated with sea level rise, and physical damages due to increased disasters such as cyclones** should also be considered.

→

Vulnerability assessment

Obtain the results from climate change analysis in the target year, and precipitation and rainfall patterns in the catchment area to compute inflow volume of nutrient salts, sediment loads, and freshwater from the catchment area.

→

Adaptation options

Introduce appropriate measures against climate change in project implementation.

↓

Items to assess in project implementation

- Sensitivity to future climate change
- Risks associated with climate change
- Protection and preservation activities

Alternative items to assess in monitoring and review

- Water quality, sediment load volume
- Areas of protection / preservation zone
- Areas of buffer zone

Effect of adaptation options

Wetlands will be conserved as expected even in the event of climate change.

6. Flood Control

6. Flood Control

(1) Concept of adaptation projects in the flood control sub-sector

Basic concept

Mitigate flood damage induced by climate change, through structural and non-structural measures.

Vulnerability

<Major climate change impacts>

- Temperature rise
  ⇒**Increase of flood** due to glacier melting
- Increase/ intensification of precipitation and extreme events such as cyclones
  ⇒Increase of river flood, **collapse of dams** and **curtailed flood control function of facilities** due to sedimentation.
- Sea level rise
  ⇒**Expansion of inundated area**

Adaptation measures

- Development / improvement of flood control facility
  ・River improvement, control of river water outflow
- Evacuation and guidance on evacuation measures
  ・Improvement of systems and preparation of hazard maps
- Cross-sectoral measures
  ・Urban development and catchment area protection plans, etc.

Maladaptation

▽Maladaptation in Adaptation measures

・The areas protected by river dikes seem to be safe. If more inhabitants are convinced that such areas are safe and decide to resettle in the dike-protected areas, risk of damage to persons and / or property due to dike failure would increase.

・The awareness of inhabitants on disaster prevention might be reduced due to the development of flood control facilities, and their responsiveness to possible future changes would weaken.

▽Maladaptation common in non-Adaptation measures

・Future change of river discharge, river and sea water level would cause insufficient facility capacity, which eventually might lead to flood damage.

6. Flood Control

(2) Guidelines for Adaptation project

Necessity of adaptation measures

Although flood control measures have been implemented in the target river in which farming land spreads in inundated area as well as land development in the downstream basin. Climate change would alter precipitation patterns, increase extreme events, and cause backwater effect by sea level rise. Hence, **intense flood will more frequently occur in the target river basin.**

→

Vulnerability assessment

①Collect past meteorological and hydrological records
②Estimate future hydrological volumes
③Study past damage conditions by flood and heavy rain.
④ Assess the risk of important protection area and the relevant community's risk management capacity.
⇒Assess vulnerability to climate change in the target area based on the above ① to ④

→

Adaptation measures

To increase the flood control capacity in the target area through structural measures such as development of flood control facilities, and non-structural measures such as evacuation.

↓

Items to assess in project implementation

- Sensitivity to future climate change
- Risk of priority protection areas
- Community-based disaster / criers management
- Disaster resilience capacity of regulatory agency
- Existence and capability of R&D labs
- Compensation for flood damage
- Land use situation and land use regulation

Alternative items to assess in monitoring and review

- Improvement of target return period in the entire river basin or the target area
- Improvement of target return period in the priority protection area
- Quantity and quality of land areas for storage, infiltration and retarding
- Changes in the number of inhabitants and economical activities in the entire river basin, priority protection areas, and flood prone areas
- Changes in the awareness of stakeholders on flood disasters

Effect of adaptation measures

Flood damage by climate change will be reduced.

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6. Flood Control

(3) Guidelines for regular development project with Adaptation options

Necessity of adaptation measures

Increase flood control capacity of the target river in association with economic growth and land development . Potential risks of flood disasters in more extended areas, or in greater magnitudes, are likely to occur in the target river basin and areas. The climate change impacts are expected to increase the amount of precipitation, change rainfall patterns, **increase frequency and scale of flood** and increase backwater effects due to sea level rise

→

Vulnerability assessment

Project hydrological aspects in the planned base year using the analysis results of climate change projection for the target year.

→

Adaptation measures

Introduce appropriate measures against climate change in project implementation.

↓

Items to assess in project implementation

- Sensitivity to future climate change
- Risk of priority protection areas

Alternative items to assess in monitoring and review

- Improvement of target return period in the whole river basin or the target area
- Improvement of target return period in priority protection areas
- Quantity and quality of land area for storage, infiltration and retarding
- Changes in the number of inhabitants and economical activities in the entire river basin, priority protection areas, and flood prone areas
- Changes in the awareness of stakeholders on flood disasters

Effect of adaptation measures

The expected damages from the flood disaster will be reduced even in the event of climate change

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7. Coastal Protection

7. Coastal Protection

(1) Concept of adaptation projects in the coastal protection sub-sector

Basic concept

Reduce vulnerability against coastal damage intensified by climate change primarily through technical measures

Vulnerability

＜Major climate change impacts ＞
- Sea level rise
  ⇒**Loss of land, prolonged inundation, decreasing overflow protection functions**
- Increase / intensification of typhoons and cyclones
  ⇒**Increase of inundation in the coastal land, decrease of the function of coastal protection structures**
- Sea temperature rise
  ⇒**Worsening coastal environment** due to coral bleaching and dying
- Change of ocean currents
  ⇒**Changing characteristics of sand beach** caused by sand drifts

Adaptation measures

- Development / improvement of coastal structure
- Non-structural engineering (including environmental engineering)
  ・Sandy shore restoration, afforestation of mangroves, conservation of coral reefs
- Non-structural measures for evacuation
  ・Development of warning systems, preparation of hazard maps
- Cross-sectoral measures
  ・Urban planning, land-use planning

Maladaptation

∇Maladaptation in Adaptation measures
・Due development of flood control facilities, rear of the coast are recognized safe area and promoting settling of inhabitants, which result in increase of damages in the event of disaster.
・Due development of flood control facilities, the awareness of inhabitants of disaster prevention might be reduced, and their responsiveness to possible future climate change would weaken.
∇Maladaptation common in non-Adaptation measures
・Future sea water level rise and higher velocity would cause inadequacy in facility height, tolerability and safety.
・Changes in coastal management will affect the different stakeholders, such as dredging industry, fishery processing industry, warehousing industry and logistics industry. Coordination amongst stakeholders is crucial.

7. Coastal Protection

(2) Guidelines for Adaptation project

Necessity of adaptation measures

Climate change will raise the sea water level and increase the incidence and intensity of cyclones, which will translate to **inundation, coastal erosion, storm surge-related damage and high waves at coastal areas. Groundwater level rise** associated with sea level rise will exacerbate the risk of ground uplift, buoyancy increase of buried pipes and manholes, and **soil liquefaction** in coastal areas. Other concerns are coral bleaching and fish kills due to sea temperature rise, and **decline of preventive measures for coastal areas against coastal erosion and environmental deterioration.**

→

Vulnerability assessment

①Collect past marine weather records (tide level, wave, etc.)
②Study future marine and weather conditions
③Study the records on damage by inundation and high waves and countermeasures currently under way
④Assess the community's risk management capacity to disasters
⇒Assess vulnerability to climate change of target areas based on the above ① to ④.

→

Adaptation measures

Introduce countermeasures for inundation, coastal erosion and groundwater level rise, strengthen disaster management, and promote conservation of coastal environment by means of structural and non-structural measures.

↓

Items to assess in project implementation

- Sensitivity to future climate change
- Community-based disaster management and crisis management
- Disaster resilience capacity of regulatory agency
- Existence and capability of R&D labs
- Compensation for storm surge and high wave damage
- Land use conditions and land use regulation

Alternative items to assess in monitoring and review

- Improvement of the target return period / safety factors of facilities
- Implementation record of projects (beach nourishment, mangrove afforestation, transplanting of coral reef)
- Changes in the awareness of stakeholders

Effect of adaptation measures

Damages due to inundation, coastal erosion, groundwater level increase, storm surges and high waves induced by climate change will be reduced. Coastal environment will be conserved and coral reefs will be protected against wave forces.

7. Coastal Protection

(3) Guidelines for regular development project with Adaptation options

Necessity of adaptation measures

Increase coastal protection capacity in view of land development in the coastal area following economic growth. Potential risks of **flood inundation, coastal erosion, storm surge and high wave damage are** likely to increase in the target coastal areas due to climate change impacts, such as sea level rise and intensification and increase of cyclones.

→

Vulnerability assessment

Project marine weather and meteorological aspects in the planned base year using the analysis results of climate change projection for the target year.

→

Adaptation measures

Introduce appropriate measures against climate change in project implementation.

↓

Items to assess in project implementation

- Sensitivity to future climate change

Alternative items to assess in monitoring and review

- Improvement of target return period/safety factors of facilities
- Projects implementation records, such as beach nourishment, mangrove afforestation and coral reef transplanting.
- Changes in the awareness of stakeholders

Effect of adaptation measures

The expected coastal protection function will be maintained in the event of climate change.

8. Sediment-related Disaster Prevention

8. Sediment-related Disaster Prevention

(1) Concept of Adaptation project in the sediment-related sub-sector

Basic concept

Reduce vulnerability against climate change through structural and non-structural measures.

Vulnerability

<Major climate change impacts>

Increase of precipitation, intensity / frequency of heavy rain and of extreme events (cyclones)
⇒**Increase of frequency and scale of debris flow by landslide, degrading water quality** due to the rise of groundwater level in the slope

- Temperature rise
⇒**Debris flow** due to outbreaks of glacial lakes
- Sea level rise
⇒**Land desolation** due to the reduction of drainage capacity

Adaptation measures

- Development/Improvement of sediment-related disaster prevention facilities
- Forecasting, early warning, and evacuation measures
- Cross-sectoral measures
  - ・Urban planning, watershed conservation, etc.
  - ・Crisis management planning, including that for earthquake disasters

Maladaptation

▽Maladaptation in Adaptation measures

・Due to development of breakwater, inside breakwater are recognized safe area and promoting settling of inhabitants, which result in increase of damages in the event of disaster.

・Due to the development of sediment-related disaster prevention facilities, the awareness of inhabitants of disaster prevention might be reduced and their responsiveness to possible future climate change would weaken.

・The rise of groundwater level tends to invite farmland development and settlement of residents to slopes, which might intensify damage.

▽Maladaptation common in non-Adaptation measures

・Intensification and increase of precipitation would exceed the design capacity of facilities, consequently causing collapse even in low risk areas.

・Farm land development and settlement tend to proceed at the slope collapsed area, where land clearing can be readily conducted for agricultural activities regardless of formal or informal ones. Consequently, such lands are usually vulnerable against massive water flow, which would potentially increase a risk of large-scale sediment-related disaster.

8. Sediment-related Disaster Prevention

(2) Guidelines for Adaptation project

Necessity of adaptation measures

Climate change causes precipitation increase at short times and total amount of rainfall due to continuous rain. The change of temporal and spatial distribution in rainfall will **change the frequency, scale and timing of sediment-related disasters, expand collapsed areas and increase the probability of multiple disastrous events.** Direct damage from a sediment-related disaster will increase mainly in the upstream area, while consequential damage due to debris flow will increase in the downstream area, raising the risk of land desolation in the upstream area, and causing **adverse effects to downstream dams, river channels and river mouth.**

→

Vulnerability assessment

①Collect past meteorological records
②Assess future precipitation conditions (intensity, frequency and amount of rainfall)
③Study past sediment-related disasters and current countermeasures
④Assess risks of priority protection areas and the community's risk management capacity

⇒Assess vulnerability to climate change based on the above ① to ④.

→

Adaptation measures

Introduce appropriate measures to strengthen the responsiveness of the target area to sediment-related disasters through structural measure such as sediment disaster prevention facilities, etc. and non-structural measure such as forecasting, warning, and evacuation, etc.

Items to assess in project implementation

- Sensitivity to future climate change
- Risk of priority protection areas
- Community-based disaster / crisis management
- Disaster resilience capacity of regulatory agency
- Existence and capability of R&D labs
- Compensation for flood damage
- Land use conditions and land use regulation

Alternative items to assess in monitoring and review

- Improvement of planned safety factors of the target section and facilities
- Changes in the awareness of stakeholders

Effect of adaptation measures

Sediment-related disaster by climate change will be reduced.

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8. Sediment-related Disaster Prevention

(3) Guidelines for regular development project with Adaptation options

Necessity of adaptation measures

It is necessary to plan or reconsider sediment-related disaster prevention works in association with economic growth and land development. **Potential risks of sediment-related disasters in more extended areas and in greater magnitudes** are likely to arise in the target river basin and areas due to climate change. The anticipated climate change impacts are considered to increase the amount of precipitation, change rainfall patterns, and increase the frequency and scale of extreme events such as torrential rainfall and tropical cyclones.

→

Vulnerability assessment

Project the amount and patterns of rainfall in the planned base year using the analysis results of climate change projection for the target year.

→

Adaptation measures

Introduce appropriate measures in project implementation with consideration of the increased sediment-related disaster damage associated with climate change.

Items to assess in project implementation

- Sensitivity to future climate change
- Risk of priority protection areas

Alternative items to assess in monitoring and review

- Improvement of target safety factor of the target section and facilities
- Changes in the awareness of stakeholders

Effect of adaptation measures

The expected damages from the sediment-related disaster will be reduced or reduced even in the event of climate change.

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9. Disaster Prevention Information System

9. Disaster Prevention Information System

(1) Concept of Adaptation project in the disaster prevention information system sub-sector

Basic concept

Reduce vulnerability to disasters from climate change by developing and effectively using observation systems for natural phenomena and early warning systems in order to prevent human suffering from increasing natural disaster risks.

Vulnerability

<Major climate change impacts>
The basis of disaster prevention information systems is the improvement of observation systems of meteorology, hydrology, tide levels and slopes. The impacts of climate change are observation target itself. This sub-sector is very important to grasp change in the climate. **Therefore, impact on disaster information systems by climate change is not considered in this sub-sector.**

Adaptation measures

- ■ Development and improvement of meteorological observation systems
- ■ Development and improvement of hydrological observation systems
- ■ Development and improvement of tidal level observation systems

Maladaptation

▽Maladaptation in Adaptation measures
・Although various observation systems, monitoring frameworks and early warning systems are established, extreme events due to climate change may damage the installed measurement instruments and the overall systems, leading to their malfunction.
▽Maladaptation common in non-Adaptation measures
・The established systems may not be fully utilized because of lack of operational and institutional capacities of the organization in charge. This will potentially result in malfunction of the system particularly in emergency.
・Catastrophic disaster may attack an area that does not covered by the observation system.

9. Disaster Prevention Information System

(2) Guidelines for Adaptations projects

Necessity of adaptation measures

The frequency and intensity of natural disasters associated with climate change are likely to increase. The target area is very vulnerable since reliable or properly functioning observation systems for natural phenomenon are not available. The adaptation project for the disaster prevention information system sub-sector will need to establish observation systems for natural phenomena to disseminate early warning for evacuation, thereby minimizing human casualties caused by disasters and reducing overall vulnerability to natural disasters.

→

Vulnerability assessment

①Collect past metrological records.
②Project future weather conditions
③Study observation facilities damaged by natural disasters
④Study the current states of the existing observation facilities and warning systems

⇒Assess vulnerability to climate change based on the above ① to ④.

→

Adaptation measures

Enable the dissemination of early warning through development and proper operation of observation and monitoring systems for natural phenomena.

↓

Items to assess in project implementation

・ Past damage on observation and measurement facilities
・ Development level of observation and measurement facilities
・ Development level of early warning systems
・ Budget situation related to observation systems
・ Present conditions of human resources and organization capacity

Alternative items to assess in monitoring and review

・ O&M conditions (the number of measurement instruments and locations installed)
・ The number of early warning systems went forth in the past.

Effect of adaptation measures

Human casualties due to natural disasters caused by climate change will be reduced.

10. Rural / Urban Development

10. Rural / Urban Development

(1) Concept for Adaptation project in the rural / urban development sub-sector

Basic concept

Reduce vulnerability to climate change through crosscutting and multi-sectoral approach aiming at rural development based on structural measures (e.g. development of small / medium-scale infrastructures) and non-structural measures (e.g. poverty alleviation and assistance in improvement living standards).

Vulnerability

<Major climate change impacts>

- Decrease in rainfall and change in rainfall patterns
  ⇒**Reduction in the amount of drinking water, poor agricultural productivity,** shortage of water for livestock.
- Increase in rainfall amount and intensity, increase in frequency and intensity of extreme events
  ⇒**Damage to crops and agricultural / livestock facilities, isolation of certain areas**
- Increase in frequency, intensity, and duration of drought
  ⇒**Disastrous crop failure for rain-fed agriculture**
- Sea level rise
  ⇒**Damage to agricultural soil and domestic water**
- Other
  ⇒**Pest damage and increase of the vector of infectious diseases**

Adaptation measures

- Introduction of irrigation and drainage facilities
- Enhancement of farm management
- Development of hygiene management facilities
- Development of rural roads and bridges
- Rural Electrification
- Structural measures and rural disaster prevention facilities
- Non-structural measures for rural disaster prevention
  ・Development of disaster warning systems
- Other rural assistance
  ・Enhancement of community organizations, micro-credit

Maladaptation

▽Maladaptation in Adaptation Measures
・Project benefits may be unevenly distributed within the target areas. This might create regional gaps in beneficiaries, resulting in the increase of vulnerability to climate change for some residents.
▽Maladaptation common in non-Adaptation Measures
・Project benefits may be distributed only to limited beneficiaries. This may create a regional gap within the target areas.

10. Rural / Urban Development

(2) Rural development: Guidelines for Adaptation project

Necessity of adaptation measures

Basic human needs (BHN) in rural areas are exposed to the risk of climate change impacts, which can potentially **worsen existing living standards**.

Vulnerability assessment

①Collect past meteorological records
②Project future rural environment
③Study rural damage in the past abnormal climate
④Study improvement conditions of countermeasure facilities and residents' socioeconomic conditions.
⇒Assess vulnerability to climate change in the target area based on the above ① to ④.

Adaptation measures

Promote rural infrastructure development and assistance in improving rural living standards. Maintain primary living standards in rural areas.

Items to assess in project implementation

・ Sensitivity to future climate change (conditions of rural infrastructures and their functional validity)
・Conditions of rural infrastructures and their functional validity
・ Organizational capacity and conditions of communities
・ Involvement of the regional / local government department and NGOs concerned
・ The socioeconomic conditions of rural residents

Alternative items to assess in monitoring and review

・ Improvement of the target return period of extended and newly developed facilities
・ Improvement of the target return period of target areas through O&M improvement
・ Changes in the number of beneficiaries
・ Changes in the awareness of stakeholders

Effect of adaptation measures

Vulnerability to climate change of rural areas will be reduced.

10. Rural / Urban Development

(3) Rural development: Guidelines for regular development project with Adaptation options

Necessity of adaptation measures

Since the anticipated climate change will cause **difficulty in maintaining the expected livelihood and living standards in the rural areas**, it is necessary to consider measures against climate change impacts.

Vulnerability assessment

Predict the climate conditions in the planned base year using the analysis results of climate change projection for the target year. Also identify the major problems and risks brought by climate change. This will aid in planning necessary adaptation options.

Adaptation measures

Introduce appropriate measures against climate change in project implementation.

Items to assess in project implementation

- Sensitivity to future climate change

Alternative items to assess in monitoring and review

- Improvement of the target return period of extended and/or newly developed facilities
- Improvement of the target return period in target area through O&M improvement
- Changes in the number of beneficiaries
- Changes in the awareness of stakeholders

Effect of adaptation measures

The rural system will function properly and the area can sustain living standards even in case the target areas are affected by climate change.

10. Rural / Urban Development

(4) Urban development: Guidelines for Adaptation project

Necessity of adaptation measures

Climate change will impact on regular functions of cities/urban areas, and **make it difficult to maintain ordinary livelihood**.

Vulnerability assessment

①Collect past meteorological records
②Project future urban environment
③Study urban damage in the past abnormal climate
④Study improvement conditions of countermeasure facilities and residents' socioeconomic conditions.
⇒Assess vulnerability to climate change in the target area based on the above ① to ④.

Adaptation measures

Promote the development of urban infrastructure to improve and sustain the basis for urban living.

Items to assess in project implementation

Sensitivity to future climate change (conditions of urban infrastructures and their functional validity)
・Conditions of urban infrastructures and their functional validity
・ Involvement of the regional / local government department and NGOs concerned

Alternative items to assess in monitoring and review

- Improvement of the target return period of extended and / or newly developed facilities
- Improvement of the target return period in target areas through O&M improvement
- Changes in the number of beneficiaries
- Changes in the awareness of stakeholders

Effect of adaptation measures

Vulnerability to climate change in urban areas will be reduced.

10. Rural / Urban Development

(5) Urban development: Guidelines for regular development project with Adaptation options

Necessity of adaptation measures

Since the anticipated climate change will cause **difficulty in maintaining the current livelihood and living standards** in the urban areas, it is necessary to consider adaptation options to climate change impacts.

Vulnerability assessment

Project the climate conditions in the planned base year using the analysis results of climate change projection for the target year. Also identify the major problems / risks brought by climate change.

Adaptation measures

Introduce appropriate measures against climate change in project implementation.

Effect of adaptation measures

The urban system will function properly and the area can sustain living standards even in case the target areas are affected by climate change.

Items to assess in project implementation

- Sensitivity to future climate change

Alternative items to assess in monitoring and review

- Improvement of the target return period of expanded and newly developed facilities
- Improvement of the target return period of target areas through O&M improvement
- Changes in the number of beneficiaries
- Changes in the awareness of stakeholders

11. Bridge, Road and Railway

11. Bridge, Road and Railway

(1) Concept for Adaptation project in the bridge, road and railway sub-sector

Basic concept

Secure the safety of traffic as a requisite for roads and railways to climate change impacts and mitigate damages on related structures and users.

Vulnerability

<Major climate change impacts>

■ Increase/ intensification of precipitation
⇒**Overtopping and washing out of Bridges** due to the increase in base flow and flood discharge, flooding drainage facilities and inundation on subways, **traffic restrictions/interruptions** due to landslides

■ Increase/ intensification of extreme event such as cyclone
⇒**Reduced bridge safety, washing away of railways, roads and bridges, embankment failure due to changes in wind velocity, increase of traffic restrictions** due to strong wind and heavy rain

Adaptation measures

■ Raise and replace bridges and implement wind resistance measures for bridges

■ Raise roadbeds and change routes

■ Improve existing drainage facilities and construct new ones

■ Non-structural measures
(Develop hazard maps, introduce evacuation route systems)

Maladaptation

∇Maladaptation in Adaptation measures
・Power loss would cause malfunction to system operations that are used for non-structural measures, consequently, exacerbating the damage.
∇Maladaptation common in non-Adaptation measures
・Road development will cause the resettlement of inhabitants along roads. In case the site is sensitive to climate change impacts, damages will exacerbate.
・Future climate change impacts will affect the safety of bridges, roads and railways.

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11. Bridge, Road and Railway

(2) Guidelines for Adaptation project

Necessity of adaptation measures

Climate change would intensify flood, which can cause inundation, slope failures and landslides, affecting roads, railways, and subways. There are **certain risks in road and railway functions that are adversely affected or lost** due to climate change impacts.

Vulnerability assessment

①Collect past meteorological and hydrological records
②Project future meteorological and hydrological conditions
③Study past traffic damage during past abnormal climate
④Study the existence of alternative transportation and risk management capacity of regulatory authorities.
⇒Assess vulnerability to climate change in the target area based on the above ① to ④.

Adaptation measures

Enhance the disaster prevention capacity of bridges, roads and railways through measures such as realignment of routes, slope stabilization, enhancement of drainage capacity and flood prevention, and the raising, reinforcement or replacement of bridges.

Items to assess in project implementation

・Sensitivity to future climate change
・Alternative transportation and detours
・Crisis management of regulatory agencies and management bodies
・Disaster resilience capacity of regulatory agencies and management bodies
・Existence and capability of R&D labs

Alternative items to assess in monitoring and review

・ Improvement of the target return period and safety factors of facilities
・ Progress in preparing and distributing hazard maps.
・ Shortening time for detecting damage and the duration of traffic suspension
・ Shortening the duration of evacuation guidance
・ Shortening time for leading to detours or alternative transportation
・Changes in the awareness of stakeholders

Effect of adaptation measures

The impacts of climate change related to structural damage, traffic restriction and interruption, as well as damage on related facilities and users, will be reduced.

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11. Bridge, Road and Railway

(3) Guidelines for regular development project with Adaptation options

Necessity of adaptation measures

New bridges, roads and railways should be constructed, or existing facilities be replaced or extended. Potential risks due to climate change, such as the **reduction of safety of bridges, inundation damage on roads and railways, slope failure and landslides and underground flooding** such as in the subway, etc. need to be considered.

Vulnerability assessment

Project meteorological and hydrological aspects at the planned base year using the analysis results of climate change projection for the target year.

Adaptation measures

Introduce appropriate measures against climate change in project implementation.

Effect of adaptation measures

The safety of bridges, roads and railways, as well as traffic, will be maintained in the event of climate change.

Items to assess in project implementation

- Sensitivity to future climate change

Alternative items to assess in monitoring and review

- Improvement of the target return period and safety factors of facilities
- Progress in preparing and distributing hazard maps.
- Shortening time for detecting damage and the duration of traffic suspension
- Shortening the duration of evacuation guidance
- Shortening time for leading to detours or alternative transportation
- Changes in the awareness of stakeholders

12. Port and Airport

12. Port and Airport

(1) Concept for Adaptation projects in the port and airport sub-sector

Basic concept

Maintain port functions by reducing vulnerability to climate change mainly through the development and improvement of structures.

Vulnerability

<Main climate change impacts>

- Sea level rise
  ⇒**Decreasing wave overtopping prevention function of breakwaters and sea walls, increasing risk of ground liquefaction**
- Increasing wave height and increasing / intensifying cyclones
  ⇒**Increasing damage to structures by high waves**
- Sea temperature rise
  ⇒**Worsening water quality** in enclosed water areas
- Change of ocean current
  ⇒Changing characteristics of littoral drift **that will result in the burial of waterways**

Adaptation measures

- Development / improvement of port structure
- Raising the ground level of facilities
- Non-structural measures
  ・Improvement of cargo handling to mitigate materials and equipment loss due to storm surges and high waves.
  ・Facilitation of water circulation in inside breakwaters to mitigate water quality degradation.
  ・Securing alternative routes for logistics.

Maladaptation

▽Maladaptation in Adaptation measures
・None expected.
▽Maladaptation common in non-Adaptation measures
・Future rise of the sea water level, increase in wind forces, etc. would cause shortages in the height and tolerance of structures, consequently affecting their safety.

12. Port and Airport

(2) Guidelines for Adaptation projects

Necessity of adaptation measures

Climate change will raise the sea water level and increase the frequency and intensity of storm surges and high waves, which will cause **damage to seawalls and port facilities, inundation in aprons, damage to buildings, containers and machinery by high waves**. The rise of groundwater level will cause ground uplift and the buoyancy force of buried pipes and manholes, as well as the **risk of soil liquefaction**.

Vulnerability assessment

①Collect past tidal level and wave records.
②Project future marine and meteorological conditions.
③Study past damage by high wave and tide, and the current conditions of countermeasure facilities
④Study availability of alternative logistics functions and risk management capacity of regulatory authorities.
⇒Assess vulnerability to climate change in the target region based on the above ① to ④.

Adaptation measures

Strengthen the disaster mitigation capacity of port facilities through the development, reinforcement, and leveling of seawalls and port facilities, etc.

Items to assess in project implementation

- Sensitivity to future climate change
- Alternative transportation
- Disaster resilience capability of regulatory agencies and management bodies
- Existence and capability of R&D labs
- Compensation for storm surge and high wave damage

Alternative items to assess in monitoring and review

- Improvement of the target return period and safety factors of facilities
- Changes in the awareness of stakeholders

Effect of adaptation measures

The impacts of climate change, such as damage to structures, equipment and materials and inundation, will be reduced, and port function will be maintained.

12. Port and Airport

(3) Port: Guidelines for regular development project with Adaptation options

Necessity of adaptation options

Construction of new ports or expansion of existing ones for the development in maritime trade.
As future impact of climate change, potential risks of **damage on revetments and port structures by sea level rise and extreme events, damage by high waves,** buoyancy increase of buried pipes and manholes by sea level rise need to be concerned.

Vulnerability assessment

Project marine weather and meteorological aspects in the planned base year using the analysis results of climate change projection for the target year.

Adaptation options

Introduce appropriate measures against climate change in project implementation.

Items to assess in project implementation

- Sensitivity to future climate change
- Alternative transportation

Alternative items to assess in monitoring and review

- Improvement of the target return period and the safety factors of facilities
- Changes in the awareness of stakeholders

Effect of adaptation options

Port functions will be maintained even in the event of climate change.

12. Port and Airport

(4) Airport: Guidelines for Adaptation project

Necessity of adaptation measures

Climate change will increase precipitation, cloud amount and wind speed, and change the bird ecosystem. These conditions may adversely affect the safety of flight operation, especially during takeoff and landing, and cause damage to the airport.

Vulnerability assessment

①Collect past meteorological data
②Project future meteorological conditions.
③Study past damage by weather conditions and restrictions in plane takeoff / landing.
④Study availability of alternative transportation and risk management capacity of regulatory authorities.
⇒Assess vulnerability to climate change in the target region based on the above ① to ④.

Adaptation measures

Ensure the safe takeoff / landing of planes and the safety of structures, mainly through the improvement of airport facilities.

Items to assess in project implementation

- Sensitivity to future climate change
- Alternative transportation
- Disaster resilience capability of regulatory agencies and management bodies
- Existence and capability of R&D labs

Alternative items to assess in monitoring and review

- Improvement of the target return period and safety factors of facilities
- Changes in the awareness of stakeholders

Effect of adaptation measures

The impacts of climate change on flight operations and structure safety will be reduced.

12. Port and Airport

(5) Airport: Regular development project with Adaptation options

Necessity of adaptation measures

Construction of new airports or expansion of existing ones.
As future impact of climate change, potential risks of structural damage and declining safety in takeoff and landing by the increase of rainfall, cloud and wind speed, and change of bird ecosystem need to be concerned.

Vulnerability assessment

Project weather conditions in the planned base year using the analysis results of climate change projection for the target year.

Adaptation options

Introduce appropriate measures against climate change in project implementation.

Items to assess in project implementation

- Sensitivity to future climate change
- Alternative transportation means

Alternative items to assess in monitoring and review

- Improvement of the target return period and safety factors of facilities
- Changes in the awareness of stakeholders

Effect of adaptation options

The safety of flight operation and airport function will be maintained even in the event of climate change.

13. Water Supply

13. Water Supply

(1) Concept of Adaptation project in the water supply sub-sector

Basic concept

Stabilize safe water supply by increasing water supply capacity and improving the water and sanitation environment, which could be exposed to climate change impacts.

Vulnerability

<Major climate change impacts>

■ Direct impacts
- Impact on water intake due to changes in water level
- Extended salinization at estuarine areas
- Worsening water quality due to changes in solar irradiation and water temperature

■ Indirect impacts
- Worsening sanitation conditions due to decreased water supply capacity
- Ground sinking due to the increase of groundwater use

Adaptation measures

- ■ Rehabilitation/development of water supply system
- ■ Water conservation measures
- ■ Enhancement of water resources management

Maladaptation

▽Maladaptation in Adaptation measures
- As a result of an adaptation project that has developed a water supply system considering future climate change impacts, many people may migrate from regions affected by water shortage. Such an unexpected population inflow may cause excessive water demand.

▽Maladaptation common in non-Adaptation measures
- Difficulty in securing water supply that meets additional water demand due to climate change.
- Water sources may become unsuitable as potable water source due to considerable change in water quality.

13. Water supply

(2) Guidelines for Adaptation project

Necessity of adaptation measures

Securing stable water supply in the future is threatened due to anticipated changes in rainfall intensity and patterns caused by climate change. This will reduce the available amount of water from the sources, and the rising temperature will affect the water quality at the source and increase per capita water consumption.

Vulnerability assessment

①Collect past meteorological records, river flow and groundwater amounts
②Estimate future precipitation aspects, available river discharges and groundwater resources
③Study past records on water supply and demand balance in the years of flood / drought, and morbidity due to water and vector-borne diseases
④Study management of water service providers and water sanitation measures.
⇒Assess vulnerability to climate change in the target area from the above ① to ④.

Adaptation measures

It will be necessary to increase water supply capacity through the development / expansion of alternative water sources, and improve safe water supply abilities through reduction of water leakages through structural / non-structural measures, construction / improvement of water treatment capability.

Effect of adaptation measures

The decrease of domestic / potable water due to climate change and the deterioration of water quality will be reduced.

Items to assess in project implementation

- Sensitivity to future climate change
- Organizational capacity and operation conditions of water service providers
- Available water volume and quality at alternative water sources
- Awareness of water conservation
- The socioeconomic conditions of the target area
- Budget for measures related to water supply against climate change impacts
- NGO activities related to water supply to address climate change impacts

Alternative items to assess in monitoring and review

- Improvement of the target return period of extended and/or newly developed facilities
- Changes in beneficiaries' awareness on water conservation
- Changes in the number of beneficiaries

13. Water supply

(3) Guidelines for regular development project with Adaptation options

Necessity of adaptation options

Due to the anticipated climate change impacts, there will be increased possibility of **reduced water supply** volume at intake points, **poor water quality**, and **increased water demand** caused by the rise of average temperatures.

Vulnerability assessment

Project the amount and patterns of rainfall, and river flow and groundwater levels at the planned base year using the analysis results of climate change projection for the target year. Also study the future water balance.

Adaptation options

Plan adaptation options that account for future climate change, namely, the expansion of water supply areas, the rehabilitation / upgrade of water intake and purification facilities and water conduits and water service pipes.

Items to assess in project implementation

- Conditions of water balance
- Conditions of water sources
- O&M system and capacity of water service providers

Alternative items to assess in monitoring and review

- Improvement of target return period for expanded and/or newly developed facilities
- Changes in beneficiaries' awareness on water conservation
- The number of beneficiaries

Effect of adaptation options

Enable steady supply of domestic/drinking water even in the event of climate change.

14. Sewerage / Urban Drainage

14. Sewerage / Urban Drainage

(1) Concept for Adaptation projects in the sewerage / Urban drainage sub-sector

Basic concept

Since the development and expansion of sewage systems are considered to be an adaptation project themselves, it is necessary to improve local living conditions, the social environment and hygiene conditions, which would deteriorate due to climate change.

Vulnerability

<Major climate change impacts>

■ In case sewage treatment systems exist:

・If they are combined sewage systems, the increased intensity of rainfall may cause flooding of contaminated water and discharging untreated water.

■ Impacts common to cases in which no sewage treatment system exists:

・Retention and inundation by sewage and contaminated water will worsen the hygienic environment and potentially cause the outbreak of water- and vector-borne diseases

Adaptation measures

■ Rehabilitation and expansion of the existing and newly implemented sewage systems

■ Educational activities to raise the awareness of local residents

Maladaptation

▽Maladaptation in Adaptation measures

・Climate change may not occur as projected, which may result in the excess or lack of facilities' capacity.

▽Maladaptation common in non-Adaptation measures

・Sewage systems developed may not be fully utilized if many households cannot be connected to the system due to financial reasons.

14. Sewerage / Urban Drainage

(2) Sewerage: Guidelines for Adaptation project

Necessity of adaptation measures

The intensity and frequency of rainfall will increase, and temperature will rise due to climate change, causing inundation and exacerbated hygienic conditions in urban areas. If the area's sewage and urban drainage systems are insufficient or ineffective, it will potentially cause outbreaks of infectious diseases such as cholera, typhoid, and diarrhea.

Vulnerability assessment

①Collect past meteorological data
②Project future temperatures and precipitation patterns, as well as sanitary conditions
③Study worsening sanitary conditions, drainage and discharge of wastewater
④Study the existence of sewage facilities. If they do not exit, study the current measures against infectious diseases

⇒Assess vulnerability to climate change in the target area based on the above ① to ④.

Adaptation measures

Improve the hygiene and living conditions of the environment in the target area through the development of sewage systems (the installation of sewage treatment plants, sewage networks and pump stations, etc.).

Items to assess in project implementation

- Sensitivity to future climate change
- Condition of preventive activities against infectious diseases
- Geographical distribution of existing medical institutions and healthcare centers
- Conditions and functions of existing sewage system

Alternative items to assess in monitoring and review

- Improvement of the target return period of expanded and/or newly developed facilities
- Changes in the number of the patients of infectious diseases
- Changes in the number of beneficiaries
- Changes in beneficiaries' awareness on hygiene

Effect of adaptation measures

The risk of worsening hygiene and living conditions of the environment due to climate change, as well as the number of infectious disease patients, will be reduced.

14. Sewerage / Urban Drainage

(3) Sewerage: Guidelines for regular development project with Adaptation options

Necessity of adaptation options

In order to improve the hygiene and living conditions in the urban areas, the project for the development/expansion/ rehabilitation of urban drainage systems will be implemented. Due to the anticipated climate change impacts, increased rainfall intensity is likely to cause inundation damage coupled with increased storm water in drainage systems, and it is highly concerned that hygienic conditions due to temperature rise will deteriorate.

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Vulnerability assessment

Based on climate change analysis data in the target year, clarify future changes in water quality, drainage conditions of rainwater and wastewater, and inundation.

→

Adaptation options

Introduce appropriate measures against climate change in project implementation.

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Effect of adaptation options

sewage system will function properly even in the event of climate change.

Items to assess in project implementation

- Morbidity and mortality rates of infectious diseases
- Present conditions of sewage and rainwater discharge
- Water quality

Alternative items to assess in monitoring and review

- Improvement of the target return period of expanded and/or newly developed facilities
- Changes in the number of infectious disease patients
- Changes in the number of beneficiaries
- Changes in beneficiaries' awareness of hygiene

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14. Sewerage / Urban Drainage

(4) Drainage: Guidelines for Adaptation project

Necessity of adaptation measures

Increase in intensity and frequency of rainfall and temperature rise due to climate change will cause inundation and exacerbated hygienic conditions in urban areas. If areas possess drainage systems that are malfunctioning or insufficient in capacity, it will potentially cause outbreaks of infectious diseases such as cholera, typhoid, and diarrhea. Storm water contaminated with solid waste and chemical materials will flow into the surrounding bodies of water (rivers, coastal areas, etc.).

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Vulnerability assessment

①Collect the available past meteorological records
②Project future temperature, precipitation pattern and hygiene conditions
③Study drainage and flooding conditions during rainfall
④Study existence of drainage networks. It they do not exist, study current measures against infectious diseases. ⇒assess vulnerability against climate change in the target areas based on the above ① to ④.

→

Adaptation measures

The development / rehabilitation of drainage systems (open and closed drainage channels, pump stations, etc.) will improve drainage capacity and hygienic conditions, reduce the risk of floods, and enhance socioeconomic activities in the target area.

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Effect of adaptation measures

Risks of flooding and inundation due to malfunctioning drainage systems, as well as the morbidity and mortality of infectious diseases, will be reduced. The basis for socioeconomic activities will be improved.

Items to assess in project implementation

- Sensitivity to future climate change
- Condition of preventive activities against infectious diseases
- Geographical distribution of existing medical institutions and healthcare centers
- Conditions and functions of existing sewage system

Alternative items to assess in monitoring and review

- Improvement of the target return period of expanded and/or newly developed facilities
- Changes in the number of the patients with infectious diseases
- Changes in the number of beneficiaries
- Changes in beneficiaries' awareness of hygiene

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14. Sewerage / Urban Drainage

(5) Drainage : Guidelines for regular development project with Adaptation options

Necessity of adaptation options

In order to improve the hygiene and living conditions in the environment of the target areas or cities, the project for the development / expansion / rehabilitation of urban drainage systems will be implemented. Due to the anticipated climate change impacts, increased rainfall intensity is likely to cause inundation damages coupled with increased storm water drainage and raise the concern of the deterioration of hygienic conditions.

Vulnerability assessment

Project the amount and patterns of rainfall in the planned base year using the analysis results of climate change projection for the target year, and assess possible flood and inundation by sewage and storm water.

Adaptation options

Introduce appropriate measures against climate change in project implementation.

Items to assess in project implementation

- Morbidity and mortality rates of infectious diseases
- Conditions of flood and Inundation damages
- Water quality

Alternative items to assess in monitoring and review

- Improvement of the target return period of expanded and/or newly developed facilities
- Changes in the number of the patients with infectious diseases
- Changes in the number of beneficiaries
- Changes in beneficiaries' awareness of hygiene

Effect of adaptation options

In the event of climate change, the developed drainage system in urban areas will function properly.

15. Medical / Health Care

15. Medical / Health Care

(1) Concept for Adaptation project in the medical/health care sub-sector

Basic concept

Strengthen preventive and responsive actions against outbreaks of infectious diseases caused by climate change.

Vulnerability

<Major climate change impacts>

- Air pollution
- Disaster
  ⇒Worsening of external injuries and nutrition conditions due to extreme climate phenomena
- Vector-borne diseases
  ⇒Enlargement of disease distribution area due to temperature rise and changes in precipitation
- Water-borne and food-borne diarrheal
  ⇒Promote proliferation of pathogens, and increase chances of transmission to humans

Adaptation measures

-Development of hospital/medical facilities and the capacity strengthening of medical personnel
-Countermeasures for beneficiaries
-Improvement of hygienic conditions

Maladaptation

∇Maladaptation in Adaptation measures

・It will be necessary to ensure that the strengthening of treatment system for infectious diseases will not lead to the negligence of other diseases or injuries in further.

∇Maladaptation common in non-Adaptation measures

・There is nothing particular under this condition.

15. Medical / Health Care

(2) Guidelines for Adaptation project

Necessity of adaptation measures

Temperature rise due to climate change is likely to shift or expand habitat areas of the vectors of infectious diseases. Climate-induced changes in locations and seasons may trigger an epidemic of infectious diseases, such as malaria and dengue fever. Flood, drought, and crop failure associated with change in rainfall intensities and patterns will increase risks of water- and food-borne diseases. Particularly in the areas with poor healthcare services and facilities as well as poor hygienic conditions, risks of exposure to these infectious diseases are considerably high, which will be exacerbated by climate change impacts.

Vulnerability assessment

①Collect the available past meteorological records
②Project future temperature / precipitation patterns
③Study the past morbidity and mortality of infections disease
④Study the potential risk of infectious diseases and the current public health measures. ⇒Assess vulnerability to climate change in the target area based on the above ① to ④.

Adaptation measures

The adaptation measures will strengthen preventive and responsive actions against infectious diseases and improve health conditions of people in the target areas by developing clinics or general hospitals, upgrading equipment, and strengthening capacity of healthcare personnel

Items to assess in project implementation

- Sensitivity to future climate change
- Population shares of socially-vulnerable people
- Number of doctors per population
- Number of existing medical institutions / healthcare centers
- Conditions of preventive activities against infectious disease
- National / regional budgets for medical care and infectious diseases
- NGOs activities

Alternative items to assess in monitoring and review

- Changes in budgets for disease prevention
- Number of patients

Effect of adaptation measures

The framework for treatment will be strengthened for infectious disease patients who may increase in number due to climate change impacts. The preventive measures against these diseases will also be undertaken.

15. Medical / Health Care

(3) Guidelines for regular development project with Adaptation options

Necessity of adaptation options

It is necessary to upgrade and expand medical/healthcare facilities and equipment in order to provide better healthcare services in the target areas. Climate change impacts are expected to increase infectious disease cases which would have been a minor issue in the target areas.

Vulnerability assessment

Study the past climate trends and concerned infectious diseases to assess their impacts on health.

Adaptation options

In the regular development project, focus may be put on to set up medical care or medical ward for cardiac and brain surgeries, other internal medicine, trauma care, adult disease, and HIV. In addition to these, adaptation measures to climate change will require preparation for the increasing concern on water / food and vector-borne diseases.

Items to assess in project implementation

- Morbidity of infectious diseases
- Mortality of infectious diseases
- Status of preventive activities against infectious diseases

Alternative items to assess in monitoring and review

- Changes in budgets for infectious diseases prevention
- Number of patients

Effect of adaptation options

In the event of serious climate change impacts, sufficient medical or healthcare services will be provided.

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