THE GLOBAL TECHNOLOGY NEEDS ASSESSMENT

TECHNOLOGY NEEDS ASSESSMENT FOR CLIMATE CHANGE ADAPTATION AND MITIGATION

VIET NAM

SUMMARY REPORT









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Viet Nam Technology Needs Assessment for Climate Change Mitigation and Adaptation

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ABBREVIATIONS

AIT	Asean Institute of Technology
BRT	Bus rapid transit
CDM	Clean Development Mechanism
CHP	Combined heat and power
CLFs	Compact fluorescent lamp
DNA	Designated National Authority
DMHCC	Department of Meteorology Hydrology and Climate Change
DOF	Department of Forestry (Forestry Administration)
EVN	Viet Nam Electricity
FIPI	Forest Inventory and Planning Department
GHG	Green house gases
IPCC	Intergovernmental Panel on Climate Change
IPR	Intellectual property right
LULUCF	Land use, Land use change and Forestry
MARD	Ministry of Agriculture and Rural Development
MCDA	Multi Criteria Decision Assessment
MOET	Ministry of Education and Training
MONRE	Ministry of Natural Resources and Environment
MOF	Ministry of Finance
MOFA	Ministry of Foreign Affairs
MOIT	Ministry of Industry and Trade
MOST	Ministry of Science and Technology
MOT	Ministry of Transportation
PCs	Municipal People's Committees
MPI	Ministry of Planning and Investment
NTP	National Target Programme to Respond to Climate Change
DOT	Department of transportration
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change

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I. Introduction

Climate change, most prominently demonstrated by global warming and rising sea level, is one of the biggest challenges to mankind in the 21st century. Natural disasters and extreme weather events are on the rise in many parts of the world. The global average temperature and mean sea level have been increasing at an ever-faster rate - a major threat to all nations, particularly those with a long and low-lying coastline like Viet Nam. While all countries will face some social and economic consequences of climate change, the developing and least developed countries, particularly their poor population, will probably be most seriously affected.

Viet Nam is considered one of the countries most vulnerable to climate change, especially to sea-level rise. In fact, it is now facing many climate change impacts on livelihoods, and natural resources, social integrity, infrastructure and economic development. Climate change consequences for Viet Nam can seriously threaten the hunger eradication, poverty reduction, Millennium Development Goals accomplishment and sustainable development of the country. Today, climate change is no longer merely an environmental problem - it has become a social and economic issue. Responding to climate change is an imperative vital to Viet Nam's development.

On the one hand, climate change may adversely impact Viet Nam's socio-economic development. On the other hand, it represents opportunities for Viet Nam to speed up the transfer, development and deployment of environment friendly technologies for climate change adaptation and mitigation and the transition towards a low-carbon economy.

Recognizing the climate change risks at its early stages, the Government of Viet Nam (GoV) signed and ratified the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol. The GoV has issued a number of directives and decisions for the implementation of the UNFCCC, the Kyoto Protocol and promulgated the National Target Program to Respond to Climate Change (NTP). Viet Nam's Second National Communication (SNC) to the UNFCCC was completed and submitted to the UNFCCC Secretariat in December 2010, with support from the Global Environment Facility (GEF), the United Nations Environment Program (UNEP), and the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP). SNC presents the GHG inventory for the base year 2000 and GHG emission estimates for three main sectors: energy, agriculture and land use, land use change and forestry (LULUCF) for 2010, 2020 and 2030. It also introduces a number of adaptation measures and GHG mitigation options and deployment of eco-friendly technologies in Viet Nam.

Climate change adaptation and GHG mitigation technology transfer to developing countries is one of the most prominent items on agendas at the Conferences of Parties (COPs) to the UNFCCC. Through technology transfer, developing countries can cut their GHG emissions, which in turn will enable them to achieve their sustainable development goals and fulfill their obligations to the UNFCCC's common goal of "*stabilizing the GHG concentration in the*

atmosphere and preventing dangerous anthropogenic interference with Earth's climate system."

Despite the impressive economic growth rate over the past decade, Viet Nam's industry is still underdeveloped due to outdated technologies. Therefore, assessing technology needs is an important step in transferring climate change technologies to ensure sustainable development. One of the main tasks of the NTP is "*Development of a science and technology program on climate change*", which focuses on technology research and development in support of climate change mitigation and adaptation.

The Project *Global Technology Needs Assessment*, coded 1215227, is funded by GEF and implemented by UNEP and the UNEP Risoe Centre (URC) in 36 developing countries in two rounds. Viet Nam was chosen as one of the 15 first-round participant countries and the duration of the TNA project activity in Viet Nam was 18 months, commencing in mid-2010.

The TNA project is an item of the Poznan Strategic Program on Technology Transfer, proposed by GEF, to help developing countries to develop and update their technology needs according to Article 4.5 of the UNFCCC.

The purpose this TNA project is to assist the participant developing country in identifying and analyzing their priority technology needs, which can form the basis for a portfolio of climate change mitigation and adaptation technology projects and programs to facilitate the transfer of, and access to, the selected mitigation and adaptation technologies.

The project's specific goals include: (1) identifying and prioritizing adaptation and mitigation technologies, and contributing to the national sustainable development goals; (2) identifying barriers to the acquisition, deployment, and diffusion of prioritized technologies; (3) developing TAPs to overcome the barriers and facilitate the transfer, adoption, and diffusion of selected technologies in the participant countries.

II. Institutional arrangement for the technology needs assessment (TNA) and stakeholder involvement

1. Overview

The Ministry of Natural Resources and Environment (MONRE) is appointed by Viet Nam's GoV as the national Focal Point to implement the UNFCCC and the Kyoto Protocol.

The Department of Meteorology, Hydrology and Climate Change (DMHCC), under the auspices MONRE, is responsible for: i) coordinating the implementation of the UNFCCC and the Kyoto Protocol, ii) hosting the Standing Office of the Steering Committee of the UNFCCC and Kyoto Protocol, and the UNFCCC Secretariat contact point, iii) coordinating with other agencies to monitor and evaluate climate change impacts and propose climate change response plans; and iv) acting as Designated National Agency (DNA) of the CDM. DMHCC was the coordinating agency in the development of Viet Nam Second National Communication to the UNFCCC.

The National Steering Committee for the UNFCCC and Kyoto Protocol constitutes 18 members from 13 ministries, including the Ministry of Natural Resources and Environment, Foreign Affairs, Industry and Trade, Culture, Sports and Tourism, Planning and Investment,

Finance, Transportation, Science and Technology, Labor, War Invalids and Social Affairs, Construction, Agriculture and Rural Development, Education and Training, Justice, and the Viet Nam Union of Science and Technology Associations. It is an inter-ministerial organization responsible for assisting the Minister of MONRE in instructing, managing and coordinating the UNFCCC and Kyoto Protocol implementation activities, and CDM projects in Viet Nam.

2. Institutional arrangement of Viet Nam TNA project

The National Supervising Agency: Ministry of Natural Resources and Environment.

National Coordination Institution/Executing Agency: Department of Meteorology, Hydrology and Climate Change, Ministry of Natural Resources and Environment.

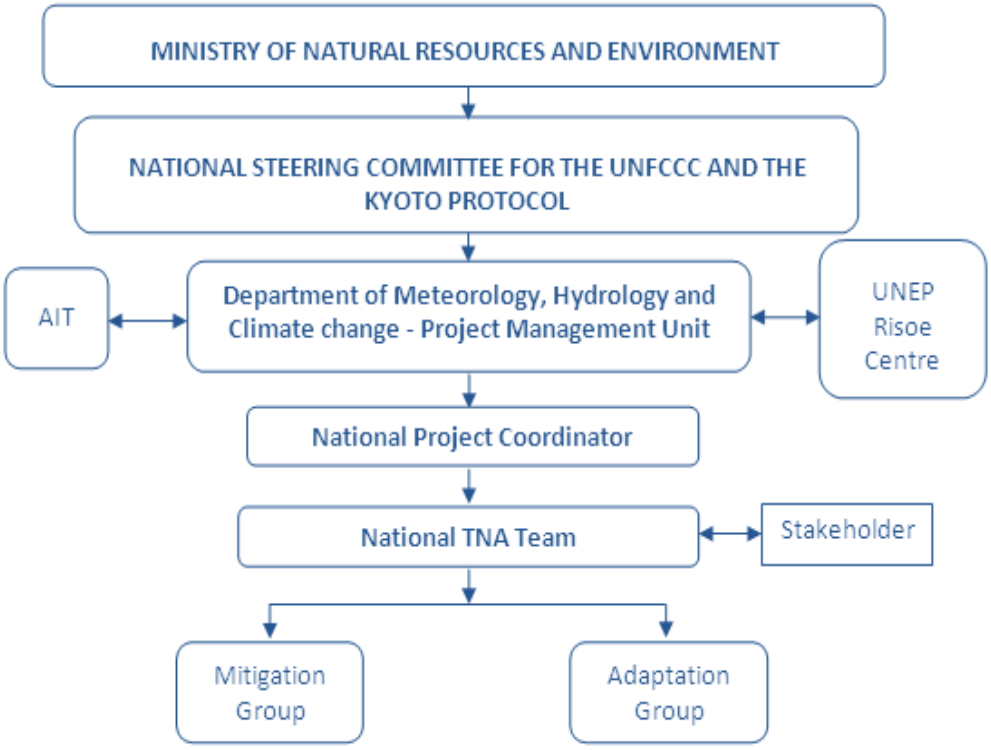


Figure 1: Institutional arrangement for the TNA Project

Institutional arrangement of the Project is as follows:

- ***National Steering Committee for the UNFCCC and Kyoto Protocol:*** The TNA process was led by the National Steering Committee for UNFCCC and Kyoto Protocol.
- ***Project Management Unit (PMU)***: The PMU has to coordinate and execute the implementation of the Project based on the Project Document and the TNA Handbook, and is responsible to MONRE leaders and the National Steering Committee for UNFCCC and Kyoto Protocol for all activities of the Project.
- ***National Project Coordinator, National TNA team and consultants:*** The Project Coordination was capable of providing vision and leadership for the overall effort, facilitating the tasks of communication with the National TNA Team members, and managing outreach to stakeholders, formation of networks, information acquisition, and coordination and communication of all work products. The National TNA Team comprised two groups of experts: mitigation and adaptation. The team included members familiar with national development objectives and sector policies, overall insights in climate change science, and potential climate

change impacts for the country, adaptation needs and mitigation options of climate change. For the list of agency/organization which experts work in, see table below.

Table 1 : List of agency/organization

P.o	Agency/ Organization
1	Department of Science and Technology, Ministry of Natural Resources and Environment
2	Institute of Strategy and Policy for Natural Resources and Environment, Ministry of Natural Resources and Environment
3	Science Institute of Meteorology, Hydrology and Environment, Ministry of Natural Resources and Environment
4	Viet Nam Administration of Forestry, Ministry of Agriculture and Rural Development
5	Institute of Energy, Ministry of Industry and Trade
6	Institute of Industrial and Chemical Safety Technology, Viet Nam Union of Science and Technology Association
7	Viet Nam Electricity
8	Centre for Ozone Protection, Department of Meteorology, Hydrology and Climate Change, Ministry of Natural Resources and Environment
9	Research Centre for Climate change and Sustainable Development
10	Department of Meteorology, Hydrology and Climate Change, Ministry of Natural Resources and Environment
11	Institute of Agricultural Environment, Ministry of Agriculture and Rural Development
12	Water issues Research Institute, Institute of Geological Sciences, Viet Nam Academy of Science and Technology
13	Institute of Environmental Technology, Viet Nam Academy of Science and Technology
14	Institute of Industrial and Chemical Safety Technology, Viet Nam Union of Science and Technology Association
15	Viet Nam Administration of Forestry, Ministry of Agriculture and Rural Development

The advisory agencies and international technical assistance, including: URC and AIT

III. The main results of the project

A. Climate change mitigation technology

1. Technology needs assessment for climate change mitigation

1.1. Criteria and process of sector prioritization

a. Criteria of sector prioritization

Sector prioritization process and criteria for subsequent assessment of mitigation technology needs were carried out in accordance with the *Handbook on conducting technology*

needs assessment for climate change by the UNFCCC and the UNDP, published in November 2010.

Sectors identified for mitigation are based on their shares in national GHG emissions, their potential for feasible GHG mitigation options, their capacity to employ low-carbon technologies, and their contribution to overall national development goals. These are: Energy, Industrial process, agriculture, LULUCF, waste.

The hosts held up conference to correspond experts to choose priority sectors to mitigate GHG emissions and agreed on 4 priority criteria, including:

+ Economic benefits: the level of contribution of sector into national economy, via ratio of sector over GDP, energy saving;
+ Social benefits: level of contribution of sector to employment, hunger eradication and poverty reduction, enhancing health and cultural living;
+ Environmental benefits: show significant of sector to development of land, air, water, ecology environments;
+ GHG emission mitigation potential: large reduction of GHG when technologies are applied.

b. Process of sector prioritization

The method of giving points to sectors was designed by experienced experts/stakeholders. The points based on characterization of how the deployed low emission technology (direct and indirect) could bring improvements to sectors. After all reviews and opinions were collected from experts/stakeholders, they agreed 3 high priority sectors were: energy, agriculture and LULUCF. The three sectors were foci in national development strategy.

1.2. Result of technology prioritization

According to UNEP guidelines on TNA, the Multi Criteria Decision Analysis (MCDA) were used to assess the needs of technologies for mitigation GHG to climate change. Criteria were based on current research that estimated potential effects of criteria on searching suitable technologies. The criteria for assessing priority mitigation technologies, including: economic benefits, social benefits, environmental benefits, GHG emission mitigation potential. In each sector, based on criteria above, technologies were given score and weighted for each criterion and arranged in priority order. The more the point was, the higher rank was.

In the framework of implementation of TNA for reducing the GHG emissions, 03 priority areas were selected to evaluate the technology priorities including energy, agriculture, LULUCF.

The list of prioritized technologies of reducing GHG emissions are summarized in the table below:

Table 2 - List of prioritized mitigation technologies to reduce greenhouse gases emissions

P.o	Sector/Technology	Availability/Scale
1	***Energy Sector***	
	- Wind power technology	Short term/Medium
	- Energy-saving compact fluorescent lamps	Short term/Small and Medium
	- Large-Scale Heat and Power (Cogeneration)	Short and Medium term/Medium
	- Bus rapid transit	Medium and Long term/Large
2	***Agriculture sector***	
	- Biogas	Short term/Small and Medium
	- Nutrition improvement through controlled fodder supplements	Short and Medium term/Small
	- Wet and dry irrigation in certain rice growth stages	Short and Medium term/Medium
3	***LULUCF Sector***	
	- Sustainable forest management	Short term/Large
	- Afforestation and reforestation	Short term/Large
	- Rehabilitation of mangrove	Short term/Large

The prioritized technologies to reduce GHG emissions were selected in the group of high GHG emissions with different scopes and have the ability to perform in the short, medium and long terms;the mitigation options for reducing GHG emission that used prioritized technologies are feasible, highly potential to reduce GHG emissions and consistent with the goal of national sustainable development.

Several identified priority mitigation technologies

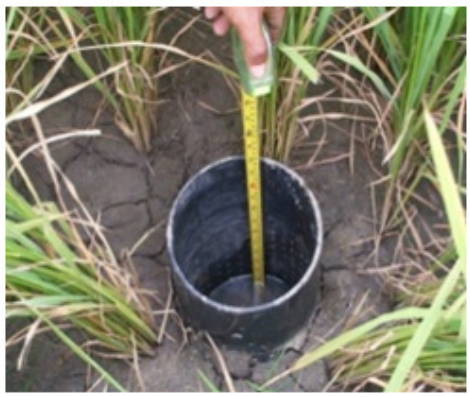
Wind power technology

Energy-saving compact fluorescent lamps

Bus rapid transit

Large-scale Heat and Power (Cogeneration)

Biogas technology



Wet and dry irrigation in certain rice growth stages

Nutrition improvement through controlled fodder supplement

Afforestation and reforestation

Rehabilitation of mangrove

Sustainable forest management

2. Technology action plans

Based on the technology assessment needs in 1.2, priority technologies were identified for each sector. However, the application of these technologies needs to comply with the nation-driven development plans and policies of the sector. Moreover, current mechanisms still, to some extent, barricade the diffusion of technologies. Therefore this report on TAP provides brief information on barrier analysis and solution proposals for technologies, based on which an action plan was produced to apply the priority GHG mitigation technology.

2.1. Analysing barriers to application of reduction greenhouse gas mitigation technologies

A proposed method for technology innovators to find barriers and problems is mapping market.

By this method, the group of experts discussed and exchanged information to build up a comprehensive map of the entire existing market elements related to the technologies and the lingkages between them. The main factors considered included:

- Enabling environment that allows the introduction of new technologies (such as legal, institutional, organizational, ...)
- The market players (such as manufacturers, wholesalers, retail dealers, consumers, households producers ...)
- Supporting services (such as finance, quality management, performance, standards, etc ...).

Based on this map, the Steering Committee and other stakeholders to identify existing problems in the system, from which barriers would be found out for each technology and common barriers to all technologies in the same field of sector. Next, by simple voting groups, implementation groups(they are experts who works in agencies/organizations are mention in Table1) pointed out the barriers that need to be addressed prior to deciding which measures short-term, medium term and long term for each field.

2.2. Action plans for sector prioritization

a. Energy

- **Preliminary targets and barriers**

In Viet Nam's National Energy Development Strategy by 2020, vision towards 2050, the Government emphasized on "increasing the share of new and renewable energies to 5% and 11% of the total primary commercial energies by 2020 and 2050, respectively." According to the business-as-usual scenario, the National Target Program on Energy Conservation and Efficiency aims at saving 5-8% of the total energy consumption for 2011-2015.

Based on the above general targets, specific targets for wind power, compact flourescent light bulbs, bus rapid transit and combined heat and power (CHP) generation were identified.

However, there were a number of barriers to the energy technologies, including lack of investment, high investment costs, inadequate capacities for technology transfer and application, and various environmental impacts.

- **Prioritization and characterization of technology acceleration measures**

Table 3: Prioritization and characterization of technology acceleration measures for energy sector

Measure (grouped under core elements)	Prio -rity	Why is it important?	Who should do it?	How should they do it?	Time-scale	Monitorin, reporting and verification for measure	Estimated costs 1,000USD
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
I. Wind power technology Category: Medium scale, short-term Innovation stage: Deployment – Diffusion							
Creation of networks							
Build a communication system to provide information to stakeholders	2	It helps stakeholders to make easier decisions on which technology they are going to invest on	MOST	Study information needs, review the existing information channels and develop a suitable information system	2012-2020	MOIT	20
Policies and measures							
Develop investment incentive and subsidization schemes	1	Wind power production has not been able to exploit its full potential and there is a lack of investment incentives or subsidization schemes to accelerate the purchase of wind electricity	MOIT, MOF	Develop investment incentives and subsidization schemes for wind power	2012-2015	MOIT	100

Establish a market-driven pricing system	1	This helps the sector to develop towards a competitive and equitable electricity market	MOIT, MOF	Set an appropriate roadmap taking into consideration negative impacts of electricity price increase on production and household activities	2012-2015	MOIT	50
Market support actions							
Build wind maps to locate appropriate sites for wind power plants	1	It enhances capacity factor and reduces investment costs to appeal to investors	MOIT and EVN	Carry out wind observation in potential sites; Build wind maps	2012-2020	MOIT	1,000
Provide financial support mechanisms and incentives for local production of wind power	1	It helps to reduce investment costs, lower the price and increase competitiveness of technology	MOIT, MOF	Review the existing legislation to form the basis for making financing incentives for wind power projects; develop new support policies for local wind power equipment manufacturing	2012-2015	MOIT	100
Make legal obligations for local electric utilities to purchase wind electricity	1	It helps to develop and facilitate national wind power market	MOIT and EVN	Review the existing legislation to formulate a legally binding framework of wind electricity purchase	2012-2015	MOIT	100
Develop infrastructure and maintenance services	2	It helps to maintain the operation of wind power stations	MOIT and EVN	Investigate and assess the demand for equipment replacement in order to develop infrastructure and maintenance services	2012-2020	MOIT	5,000

Skills training and education							
Facilitate training and education on the technology, form groups of technicians and share experience with international experts	1	To build designing, operating and maintenance capacity of technicians, designers, installation and O&M staff	MOIT, EVN	Assess capacities and training needs, make plans for training and experience sharing with foreign partners	2012-2020	MOIT	1,500
II. Compact fluorescent lamps Category: Small scale, short-term Innovation stage: Deployment – Diffusion							
Creation of networks							
Raise awareness on technology	1	Consumers will be informed and able to make decisions on their product choice.	MOIT and EVN	Study information needs, review the existing information channels and develop a suitable information system	2012-2015	MOIT	20
Policies and measures							
Provide import tax or loan incentives for CFL production	1	Helps to encourage large-scale application of CFLs and reduce investment costs and product price	MOIT, MOF	Review the existing legislation Develop and enforce CFL development policies	2012-2015	MOIT	50
Make regulatory requirements for lighting quality and the quality verification procedures	1	Because lighting quality of domestic CFLs do not meet the requirements of consumers	MOST	Review current lighting quality regulations and standards Consult international regulations and standards to form a basis for Viet Nam	2012-2015	MOST	100

Establish a market-driven pricing system	1	Helps to develop the sector towards a competitive and equitable electricity market	MOIT, MOF and EVN	Set an appropriate roadmap, taking into consideration negative impacts of increase in electricity costs on production and people's lives	2012-2015	MOIT	100
Market support actions							
Raise public awareness on the social, economic and environmental benefits of CFLs	1	Helps to facilitate replacement of incandescent lights by CFLs to save energy	MOIT	Plan and budget awareness raising activities Develop support mechanisms for awareness raising campaigns	2012-2015	MOIT	500
Provide financial support to research, innovation or investment on production technologies	1	Helps to enhance product quality to meet consumers' demand	MOIT, MOF	Review current incentive mechanisms to make appropriate amendments	2012-2015	MOIT	500
Formulate detailed regulations for and control over the labeling of the product	1	Helps to enhance product quality to appeal to consumers	MOIT	Review current incentive mechanisms to make appropriate amendments	2012-2015	MOIT	100
International cooperation and IPR							
Collaborate with foreign major manufactures to improve the quality of local products	1	Helps to reduce the cost and improve CFL quality	MOIT	Assess current capacities and production technologies, find partners and facilitate cooperation	2012-2020	MOIT	1,000

III. Bus rapid transit Category: Large and small scale, short, medium and long-term Innovation stage: Deployment – Diffusion							
Creation of networks							
Create BRT information systems on for commuters	2	Helps passengers to easily use BRTs.	PCs, DOT	Provide information through appropriate channels Set up a system of appropriate sign posts.	2012-2015	MOT	50
Policies and measures							
Reduce discourage private vehicles, and support BRT development	1	Facilitates the development of public transportation and reduces traffic congestion in cities	MOT, MOF, PCs	Review current policies to make appropriate amendments	2012-2020	MOT	200
Create financing mechanisms and loan incentives	1	Building BRT routes requires large investment costs, while cities are in need of budget for upgrading the transportation system; thus, there is a need for financing mechanisms and loan incentives for BRTs	MOT, MOF, PCs	Develop financing mechanisms for BRTs through the tax system for other private vehicles to encourage people to use public transportation, including BRTs.	2012-2015	MOST	100
Market support actions							
Develop infrastructure for relevant forms of public transits to facilitate commuting by BRTs	1	Create a synchronized network of transportation to encourage passengers to use BRTs	MPI, MOT MOF	Prioritize, supervise the synchronized transportation development,	2012-2030	MOT	10,000

Raise awareness on the benefits of BRTs	1	To enhance public awareness on the socio-economic and environmental benefits of BRTs	MOT, MOF, PCs	Plan and budget awareness raising activities Create facilitating mechanisms for awareness raising programs	2012-2015	MOT	1,000
Reasonable ticket fares	2	To encourage people to use public transportation	PCs, DOT	Study the ticket fare standard and ticketing system in developed countries to draw lessons and choose an appropriate model for Viet Nam	2012-2015	MOT	500
IV. Heat and power cogeneration Category: Large and small scale, short, medium and long-term Innovation stage: Deployment – Diffusion							
Creation of networks							
Facilitate existing network of stakeholders	1	Forms a basis for integrating CHP in the General Development Planning of the sector	MOIT	Create networks Build coordination mechanisms Formulate regulations and sanctions for implementation	In 5 years	MOIT	25
Create a coordination mechanism between stakeholders	2	Facilitates the cooperation and information sharing between experts of different principles in the application of CHP	MOIT	Create networks Build coordination mechanisms Formulate regulations and sanctions for implementation	In 5 years	MOIT	15

Policies and measures							
Formulate incentive policies and binding legal obligations for technology deployment	1	Encourages businesses to deploy this technology	MOIT, MPI	Create networks Build coordination mechanisms Formulate regulations and sanctions for implementation	In 5 years	MOIT	17.5
Publish technical materials on new technologies for manufacturing industries employing CHP	2	Facilitates desk research in the R&D of CHP for the deployment of this technology in high potential sectors.	MOIT, MPI	Create networks Build coordination mechanisms Formulate regulations and sanctions for implementation	In 5 years	MOIT	17.5
Organizational/behavioral change							
Review and plan	1	So far, CHP has not been included in industrial zone planning. This measure will form the basis for integration of CHP in planning industrial zone	MOIT, MPI	Review industrial zone planning Amend and finalize the planning	In 5 years	MOIT	35
Staff training on the CHP technology	2	This measure will help address the lack of CHP experts and facilitate the CHP diffusion	MOIT, MOET	Identify demand for information and training needs to plan and implement the training roadmap	In 5 years	MOIT	25
Strengthen technical management capacity and raise community awareness on the benefits of this technology	2	This measure will address insufficient management capacity and limited understanding of CHP	MOIT	Organize training courses and awareness raising campaigns	In 5 years	MOIT	15

Skills training and education							
International experts, have staff members trained	1	Capacity and experience of national experts are limited	MOIT, MOET	Review and develop a training plan, open training courses in colleges and vocational schools	In 5 years	MOIT	125
Create funds for training and education	2	Because of limited financial resources for research and education	MOIT, MOF	Identify needs, plan and establish funds	In 5 years	MOIT	10
International cooperation and IPR							
International cooperation in CHP technology development and transfer	1	This measure will help to build capacity, develop human resources and facilitate technology transfer to CHP deployment	MOIT	Identify needs, and develop transfer plan	In 5 years	MOIT	250

*** Note:**

(1) Measures were grouped under the core elements for a technology acceleration action plan. Using a simple process, expert groups (they work in angencies and organizations which was mentioned in Table 1 and they came from national steering committee for the UNFCCC and the Kyoto Protocol) were requested to categorize each measure into level 1, 2 or 3 according to their view on the importance of the measure to the action plan. The priority levels reveal the importance of the measure, divided into 3 levels from 1 to 3 with the following specifications:

- 1: very important, should be carried out in the short term.
- 2: important, can be carried out in new future (the next 5-10 years) or when possible.
- 3: fairly important, should be carried out but in a longer term, no need to be done in the short time.

b. Agriculture

- **Preliminary targets and barriers**

There are four preliminary targets in agriculture: developing a healthy, diverse and sustainable commodity agriculture; transfer and application of advanced technology to production; developing a market for science and technogy in rural areas; linking and coordinating with the National Target Programs, and other socio-economic programs in selecting and diffusing suitable technologies; enhancing technical capacity for local people and staff.

Based on the above general targets, specific targets for biogas technology, wet and dry irrigation, nutrition improvement for diary cattle were identified.

Some major barriers to the development and transfer of technologies were aslo indentifed including: lack of understanding of technology benefits, inertia of old traditional practices and inadequate capacity for technology application.

- **Prioritization and characterization of technology acceleration measures**

Table 4 - Prioritization and characterization of technology acceleration measures for agriculture sector

Measure (grouped under core elements)	Prio -rity	Why is it important?	Who should do it?	How should they do it?	Time-scale	Monitoring, reporting and verification for measure	Estimated costs 1,000USD
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
I. Biogas Category: Short-term, small and medium scale Innovation stage: Deployment – Diffusion							
Creation of networks							
Review, restructure and strengthen existing agricultural incentives	1	Helps to rationalize and promote the role and activities of organizations which have been or can be engaged in the network	MARD	Restructure towards deep-root structure, identify advantages and barriers to form a basis for strengthening the existing system.	2 years	MARD	25
Assign technology focal points	2	Helps to direct and uniformly instruct the technology innovation	MARD	Establish a central committee and a network of local representatives	2 years	MARD	25
Policies and Measures							
Develop mechanisms to support R&D of biogas technology and implement pilot projects	1	Helps to create tools to encourage organizations and individuals to research, develop and apply technologies	MARD	Formulate support policies to meet the demand for new technologies, create technology development budget	3 years	MARD, MOST	15

Create loan and tax incentives	2	Helps to find solutions to overcome financial barriers to encourage stakeholders to apply technologies in production activities.	MARD	Develop and enforce tax incentives to accelerate technology diffusion	2 years	MOF	5
Review and assess policies	3	Helps to increase effectiveness of existing policies and align them to current conditions	MARD	Review and assess effectiveness and disadvantages of existing policies	5 years	MARD	15
Organizational/behavioral change							
Enhance management capacity of agricultural facilitating authorities	1	Maximize the potential of organizations and minimize the disadvantage of limitations in management	MARD in coordination with related agencies	Organize management skills training courses, draw lessons, create operating procedures and measures	2 years	MARD	50
Build capacity for technology experts	1	To encourage the involvement of technical experts and ensure work efficiency	Institutes, departments and organizations	Identify information and training needs, develop plans and organize training courses for technicians.	1 years	MARD	25
Formulate coordination mechanisms between stakeholders	3	There is a need for close coordination between managers, scientists and farmers	MARD	Consult with stakeholders to formulate a feasible mechanism	5 years	MARD	2.5
Market support actions							
Develop concessional loan mechanisms for farmers	2	To make budget and facilitate technology development and diffusion	State Bank, MARD	Develop loan policies through Agricultural Bank (AgriBank)	2 years	MOF	250

Market support actions							
Create funds for training and education	3	To make a fixed and constant budget for research and human resources development	MARD	Mobilize resources from international partners	5 years	MARD, MOST	5
International cooperation and IPR							
International cooperation in development and transfer of the technology	3	To learn and enhance understanding and knowledge of the technology	MARD	Organize study tours or research groups Exchange materials and information on technology	5 years	MARD	25
II. Wet and dry irrigation Category: Short- and medium-term, medium scale Innovation stage: Deployment – Diffusion							
Creation of networks							
Review, restructure and strengthen existing agricultural incentives	1	Helps to rationalize and promote the role and activities of organizations which have been or can be engaged in the network	MARD	Restructure towards deep-root structure, identify advantages and barriers to form a basis for strengthening the existing system.	2 years	MARD	25
Assign technology focal points	2	Helps to direct and uniformly instruct the technology innovation	MARD	Establish a central committee and a network of local representatives	2 years	MARD	25

Policies and Measures							
Develop mechanisms to support R&D of the technology and implement pilot projects	1	Helps to create tools to encourage organizations and individuals to research, develop and apply technologies	MARD	Formulate support policies to meet the demand for new technologies, create technology development budget	3 years	MARD, MOST	15
Create loan and tax incentives	2	Helps to find solutions to overcome financial barriers to encourage stakeholders to apply technologies in production activities.	MARD	Develop and enforce tax incentives to accelerate technology diffusion	2 years	MOF	5
Review and assess policies	3	Helps to increase effectiveness of existing policies and align them to current conditions	MARD	Review and assess effectiveness and disadvantages of existing policies	5 years	MARD	15
Organizational/behavioral change							
Enhance management capacity of agricultural facilitating authorities	1	Maximize the potential of organizations and minimize the disadvantage of limitations in management	MARD in coordination with related agencies	Organize management skills training courses, draw lessons, create operating procedures and measures	2 years	MARD	50
Build capacity for technology experts	1	To encourage the involvement of technical experts and ensure work efficiency	Institutes, departments and organizations	Identify information and training needs, develop plans and organize training courses for technicians.	1 years	MARD	25

Formulate coordination mechanisms between stakeholders	3	There is a need for close coordination between managers, scientists and farmers	MARD	Consult with stakeholders to formulate a feasible mechanism	5 years	MARD	2.5
Market support actions							
Develop concessional loan mechanisms for farmers	2	To make budget and facilitate technology development and diffusion	State Bank, MARD	Develop loan policies through Agricultural Bank (AgriBank)	2 years	MOF	250
Market support actions							
Create funds for training and education	3	To make a fixed and constant budget for research and human resources development	MARD	Mobilize resources from international partners	5 years	MARD, MOST	5
International cooperation and IPR							
International cooperation in development and transfer of the technology	3	To learn and enhance understanding and knowledge of the technology	MARD	Organize study tours or research groups Exchange materials and information on technology	5 years	MARD	5
III. Nutrition enhancement Category: Short- and medium-term, small scale Innovation stage: Deployment – Diffusion							

Creation of networks							
Review, restructure and strengthen existing agricultural incentives	1	To rationalize and promote the role and activities of organizations which have been or can be engaged in the network	MARD	Restructure towards deep-root structure, identify advantages and barriers to form a basis for strengthening the existing system.	2 years	MARD	25
Assign technology focal points	2	To direct and uniformly instruct the technology innovation	MARD	Establish a central committee and a network of local representatives	2 years	MARD	25
Policies and Measures							
Develop mechanisms to support R&D of the technology and implement pilot projects	1	Create tools to encourage organizations and individuals to research, develop and apply technologies	MARD	Formulate support policies to meet the demand for new technologies, create technology development budget	3 years	MARD, MOST	15
Create loan and tax incentives	2	Find solutions to overcome financial barriers to encourage stakeholders to apply technologies in production activities.	MARD	Develop and enforce tax incentives to accelerate technology diffusion	2 years	MOF	5
Review and assess policies	3	To increase effectiveness of existing policies and align them to current conditions	MARD	Review and assess effectiveness and disadvantages of existing policies	5 years	MARD	15

Organizational/behavioral change							
Enhance management capacity of agricultural facilitating authorities	1	Maximize the potential of organizations and minimize the disadvantage of limitations in management	MARD in coordination with related agencies	Organize management skills training courses, draw lessons, create operating procedures and measures	2 years	MARD	50
Build capacity for technology experts	1	To encourage the involvement of technical experts and ensure work efficiency	Institutes, departments and organizations	Identify information and training needs, develop plans and organize training courses for technicians.	1 years	MARD	25
Market support actions							
Develop concessional loan mechanisms for farmers	2	To make budget and facilitate technology development and diffusion	State Bank, MARD	Develop loan policies through Agricultural Bank (AgriBank)	2 years	MOF	250
Skills training and education							
Create funds for training and education	3	To make a fixed and constant budget for research and human resources development	MARD	Mobilize resources from international partners	5 years	MARD, MOST	5
International cooperation and IPR							
International cooperation in development and transfer of the technology	3	To learn and enhance understanding and knowledge of the technology	MARD	Organize study tours or research groups Exchange materials and information on technology	5 years	MARD	5

* Note (1): See note under Table 3

c. LULUCF

- **Preliminary targets and barriers**

Sustainable forest management is considered the basis for forestry development with the target of increasing the national forest coverage to 45% in 2020. Therefore, the following tasks need to be considered: completing bordering and planning for the three types of national forest; sustainable management, planning and use of protection forest and special use forest; planning for afforestation and reforestation.

Based on the above general targets, specific targets for sustainable forestr management, afforestation and reforestation, and mangrove rehabilitation were identified.

Some barriers to the technology transfer and diffusion in this sector are lack of budget and investment for forest technologies, lack of information on complex forest ecosystems, insufficient land planning for forest development and lack of capacity for technology development and diffusion.

- **Prioritization and characterization of technology acceleration measures**

Table 5 - Prioritization and characterization of technology acceleration measures for LULUCF sector

Measure (grouped under core elements)	Prio -rity	Why is it important?	Who should do it?	How should they do it?	Time-scale	Monitoring, reporting and verification for measure	Estimated costs 1,000USD
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
I. Sustainable forest management Category: Short-term, large scale Innovation stage: Deployment – Diffusion							
Network establishment of experts							
To set up a National Working Group (NWG) on sustainable forest management	1	- Raising awareness for the state, forest owners and communities about sustainable forest management and forest certification - Support forest owners and communities to implement sustainable forest management and forest certification	DOF	- To establish a national network of Viet Nam, Association of Science and Technology in Forestry following FSC model through demo tests of subject by forest owners	1 year	MARD	30
Policies and measures							
To develop the legal framework	1	- To serve as basis for national forest setting and set up landmarks - To serve as basis for construction of sustainable forest management model	MARD	- To review, the current legal documents; - To construct and issue regulations that are still lack.	5 years	DOF	225

Develop national standards system on sustainable forest management	1	To serve as basis for verification of sustainable forest management	MARD	- Research, reference to international experience; - Workshop consultation with stakeholders; - Develop and promulgate a system of national standards.	5 years	DOF	75
Change behavior / organization							
Balancing among economic, environmental and social objectives		To ensure management and sustainable use of forest	MONRE, MARD	To determine the value of forest to the social's components, for integration into the planning development and management.	Annually	MARD	110
Actions to support markets							
Preferential loans for forestry businessmen	2	Create capital, to encourage the development and application of technology.	Central bank, MARD	Develop policies through Agribank.	2 years	MOF	10
Training skills and education							
To enhance the training for staffs	1	Prepare the necessary human resources to receive technology transfer	MARD	-Survey, planning and training. -Open training and retraining.	5 years	MOET	150

International cooperation and intellectual property							
International cooperation in research and transfer technology	1	Facilitate capacity building, human resource training, and improving technology transfer.	MARD, MOFA	Survey the needs, then making a plan for technology transfer.		MARD, MONRE	25
II. Afforestation and reforestation Category: Short-term, large scale Innovation stage: Deployment – Diffusion							
Network establishment of experts							
Establishment of associations of forestry businessmen	2	To promote the role and effects of institutions and units aimed at supporting mutual cooperation in order to develop technology	MARD, MONRE, localities	-To promulgate legal documents for the establishment of societies, associations; -Develop operational regulations.	5 years	MARD	25
Building and developing a network of research institutes and research centers	2	To assist technique for forestry production entities;	MARD	To invest in infrastructure construction, new equipment and additional research facilities, laboratory	5 years	MARD	3,125
Policies and measures							
Finishing processes, technical rules of planting, enrichment planting, forest exploitation	1	To improve quality and economical efficiency of forest	DOF	-To review and assessment, workshops on the issued regulations -To amend and supplement the regulatory process	5 years	DOF	30

Testing, evaluating, assessing and renewing policies	1	-To solve the limitation or arising issues / new obstacles -To facilitate technology development	DOF	-To organize investigation and seminars to gain experiences. -Additional editing and improving policies	5 years	DOF	60
Change behavior / organization							
Improving management capacity	1	To maximize the potential development of the units and reduce the limitations due to the lack of executive ability.	MARD	-To organize training skills management workshops to exchange management experience and gain experiences. - To develop processes and operational measures;	Annually	MARD	1,100
Actions to support market							
Promote the demonstration of reforestation models that have FSC certificate	2	- To promote the achievements; -To socialize the application of technology.	MARD	To provide training and workshops; technical and legal assistance for people to participate in FSC plantation programs.	Annually	GoV	3,750
Increasing budget investment, innovation of appropriate methods		To facilitate and encourage the application of technology.	MPI, MOF, MARD	-Survey the needs and develop a plan; -To amend the existing regulations related to investment.	Annually	GoV	180

Training skills and education							
Cooperation with partner countries to implement programs in forestry research	1	- To promote the experience and good results which have been made -To prepare the necessary human resources and strengthen the coordination among the units involved	MARD, DOF, MOT	- To review of experiences - To construction plans for cooperation - To conduct collaborative research programs	5 years	MOET	250
International cooperation and intellectual property							
International cooperation for mutual understanding and enlist the support of international community	2	-To acquire the experience, new planting techniques; -To mobilize international resources to support reforestation.	MARD, MONRE, MOFA	- To organize the survey team, learning experience; -To mobilize international aid for afforestation programs.	5 years	MARD, MONRE	1,000
III. Rehabilitation of mangrove Category: Short-term, large scale Innovation stage: Deployment – Diffusion							
Network creation							
Development of information system related to the objects	2	Information technology is not currently popular and widely disseminated	MARD and locality	To investigate and survey the existing channels of information and building suitable systems	3 years	MARD	150

The policies and measures							
Building regulations on specific management, rehabilitation and development system of coastal mangroves forest	1	There should be separate regulations, suitable to manage and restore mangroves forest	MARD	Survey actual needs; Compiling and promulgating regulations	5 years	DOF	25
Socializing the right to use and exploitation of mangroves forest	1	Increasing economical efficiency of mangroves forest; Strengthening the responsibility of people to protect mangroves forest.	MARD	Preference to develop land allocation to households, determine to withdraw improper uses of land.	3 years	DOF	250
Change behavior / organization							
Demonstration of successful models of mangroves forest	2	Promoting the achievement; Socializing application of technology.	MARD	-To provide training and workshops; - Technical and legal assistance for people to participate in FSC plantation programs.	Annually	MARD	200
Development of a plan of system of mangroves forest nationwide	1	For management and development of mangroves forest	FIPI	- To investigate and survey in order to create database; -To develop master plans and detailed plans for each area.	Annu-ally	MARD	75

Actions to support markets							
Develop financial policies and preferential credits for application of technology	1	To encourage all economic sectors to participate in recovery mangrove forest; Increasing economic efficiency of mangrove forest	MARD, MOF	-To review existing related legal documents. -To construct and apply development of policies for mangrove forest.	Annu-ally	GoV	15
Training skills and education							
Enhancing scientific and technical capacities	1	Scientific and technical skills and knowledge to recover mangroves forest of people are limited.	MARD	To organize training on rehabilitation techniques for mangroves forest	5 years	MOET	75
International cooperation and intellectual property							
International cooperation for mutual understanding and enlist the support of the international community	2	-To acquire the experience, new planting techniques; -To mobilize international resources to support reforestation.	MARD MONRE MOFA	-To organize the survey team to gain experience; -To mobilize international support for afforestation programs.	5 years	MARD, MONRE	100

* Note (1): See note under Table 3

B: Climate change adaptation technology

1. Technology needs assessment for climate change adaptation

1.1. Criteria and process of sector prioritization

a. Criteria of sector prioritization

Process and criteria to prioritize sectors for adaptation were in accordance with the *Handbook on conducting technology needs assessment for climate change* by the UNFCCC and the UNDP(November 2010). Several results in this report comefrom the NTP's official assessment reports (appraised by the GoV in December 2008) and Viet Nam's Second National Communication to the UNFCCC (December 2010).

Sectors identified for adaptation are those to which effective adaptation measures can be applied, according to the national communications, the National Target Program to Respond to Climate Change, climate change action plans and the National Climate Change Strategy.

The sector prioritization involved consultation meetings held between the TNA adaptation team and the stakeholders involved in the TNA process for discussion and agreement on the prioritized sectors.

Sectors/sub-sectors put forward for assessment include: Water resources, agriculture, coastal zone, forestry, aquaculture, energy, transportation, healthcare.

Four criteria for assessment and identification of the priority sector were agreed, including the following:

+ Economic contribution: contribution of the sector to the national economic development, expressed by the GDP share of the sector;
+ Social contribution: contribution of the sector to the job market, poverty alleviation, improving cultural life and human health, etc.;
+ Environmental development contribution: highlighting the implications of the sector for the development of soil, water resources, air, landscape and biodiversity, etc.;
+ Reduction of vulnerability to climate change: opportunities to reduce economic loss and environmental damage through application of adaptation technologies.

b. Process of sector prioritization

The method of giving points to sectors was designed by experienced experts/stakeholders. After all reviews and opinions were collected from experts/stakeholders, they agreed that agriculture, coastal zones, water resources and forestry sectors were sectors highly vulnerable to climate change and thus identified as priority sectors for adaptation in this report.

1.2. Result of technology prioritization

According to UNEP guidelines on TNA, the MCDA were used to assess the needs of technologies for adaptation to climate change. Criteria were based on current research that estimated potential effects of criteria on searching suitable technologies. And criteria for assessing priority adaptation technologies, including: economic benefits, social benefits, environmental benefits, potential for vulnerability reduction. In each sector, based on criteria

above, technologies were given score and weighted for each criterion and arranged in priority order. The more the point was, the higher rank was.

In the framework of implementation of TNA to adapt to climate change, 04 priority areas were selected to evaluate the technology priorities including agriculture, LULUCF, water resources and coastal zone management.

The list of prioritized technologies to adapt to climate change are summarized in the table below:

Table 6 - List of prioritized adaptation technologies to reduce greenhouse gases emissions

P.o	Sector/Technology	Availability/Scale
1	***Agriculture sector***	
	- Plant Genetic/Breeding	Long term/Large
	- Rice to upland grain	Long term/Medium
	-Triple cropping to double cropping + shrimp/fish/poultry crop	Long term/Small
2	***LULUCF Sector***	
	- Plant Science/ Genetics	Short term/Large
	- Agro-forestry	Short term/Small
3	***Coastal Zone Management***	
	- Sea - dyke	Short and Medium term/Large
	- Coastal wetland Rehabilitation	Short and Medium term/Large
4	***Water resources***	
	- Rooftop rainfall harvesting for household usages	Short term/Small
	- Harvesting runoff water	Short term/Small and Medium
	- Integrated River Basin Management	Short and Medium term/Large

Several identified priority adaptation technologies

Rice to upland grain

Plant genetic/Breeding

Triple cropping to double cropping + shrimp/fish/poultry crop

Sea dyke

Coastal wetland rehabilitation

Agro-forestry

Rooftop rainfall harvesting for household usages

Harvesting runoff water

Integrated river basin management

2. Technology action plans

Based on the technology assessment needs in 1,2, priority technologies were identified for each sector. However, the application of technologies needs to comply with the nation-driven development plans and policies of the sector. Moreover, current mechanisms still, to some extent, barricade the diffusion of technologies. Therefore this report on technology TAP provides brief information on barrier analysis and solution proposals for technologies, based on which an action plan was produced to apply the priority adaptation technology.

2.1. Analysing barriers to application of climate change adaptation technologies

The process of analysing barriers to application of climate change adaptation technologies as the same of reduction GHG mitigation technologies see 2.1part A

2.2. Action plans for sector prioritization

a. Agriculture

- **Preliminary targets and barriers**

There are four preliminary targets in agriculture: developing a healthy, diverse and sustainable commodity agriculture; transfer and application of advanced technology to production; developing a market for science and technology in rural areas; linking and coordinating with the National Target Programs, and other socio-economic programs in selecting and diffusing suitable technologies; enhancing technical capacity for local people and staff.

Based on the above general targets, specific targets for plant genetics/plant breeding, shifting from rice to upland grains, shifting from triple cropping to double cropping and a shrimp/fish/poultry crop were identified.

Barriers to application of these technologies were categorized into socio-economic, technical and environmental groups. In terms of socio-economy, the major problem is investment, or lack thereof, and restructuring the distribution market for products. In technical terms, infrastructure and national technical capacity are not sufficient. In terms of environment, the technologies may have some side effects such as causing pollution or changes in the natural gene pool.

- **Prioritization and characterization of technology acceleration measures**

Table 7 - Prioritization and characterization of technology acceleration measures for agriculture sector

Measure (grouped under core elements)	Prio -rity	Why is it important?	Who should do it?	How should they do it?	Time-scale	Monitoring, reporting and verification for measure	Estimated costs 1,000 USD
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
I. Plant genetics/Plant breeding Category: Large scale, long-term Innovation stage: Deployment – Diffusion							
Creation of networks							
Strengthening and creating national focal centers	1	Helps to rationalize and increase the role of existing organizations Helps to create national focal research centers	MARD	Review and assess the capacity of existing agencies Restructure the organizational structure towards specialization Establish focal centers	2 years	MARD MOST	96
Policies and measures							
Support policies for fundamental and long-term research	1	Current support policies do not provide enough incentive for fundamental and long-term research	MARD	Review existing relevant support policies Make and bring into force new support policies Create funds for technology R&D	5 years	MARD MOST, MOF	240

Pilot programs for testing of applicability of research outcomes	1	Many research outcomes have not been implemented Lack of financial resources for piloting and duplicating the results	MOST, MARD, MOF, Local People's committees	Summarize, categorize and assess existing research outcomes Select technologies and carry out pilot projects	5 years	MOST,MOF MARD	480
Organizational/behavioral change							
Support for organizations and individual experts in technology research	1	There is need for strengthening the operation of organizations and for the participation of leading experts	MARD, MOST	Review and assess needs of existing organizations Develop research support plans and programs Implement research and assess research outcomes	3 years	MARD MOHA MOET	240
Market support actions							
Localization of GM products to the eco-region	1	Genetically modified products must be evaluated for their suitability to the eco-region before going into large-scale production	MARD	Assess limitations of seeds in each natural, soil and ecological condition Experiment and select the best seed for each eco-region	7 years	MARD MONRE MOST	240
Large-scale testing for GM crops	2	Helps to identify the sustainable traits of GM products	MARD, provinces	Develop a test network Determine representative eco-regions and carry out testing experiments Organize workshops for assessment	5 years	MARD	192

Skills training and education							
Strengthening capacity of agronomy educational institutions	2	Helps to prepare required human resources ready for the innovation and transfer of the new technology	MOET MARD	Standardize the quality of lecturers Build lecturers' capacity	5 years	MOET, MOF	240
International cooperation and intellectual property rights (IPR)							
International cooperation/ international consultants/ overseas staff training	1	Helps to take advantage international experience, develop human resources, and accelerate technology transfer and diffusion	MARD MOET MOFA	Make agreements on international cooperation and training Develop overseas training programs	10 years	MARD MOST	480
II. Shifting from rice to upland grains Category: Medium scale, long-term Innovation stage: Deployment – Diffusion							
Creation of networks							
Creating a network of experts on agriculture, hydrology, industrial and fruit crops	1	There is a need for inter-sectoral coordination in assessing adaptive capacity of crop varieties.	MARD, MOST	Select experts of various principles Create a network and define the role of the stakeholders	3 years	MARD	86
Policies and measures							
Locating areas that needs shifting from rice to upland grains	1	There is a need for relocation of suitable areas for technology application	MARD	Investigate, assess the water scarcity and economic efficiency of wet rice cultivation practice Locate areas the need the new technology	5 years	MARD	144

Organizational/behavioral change							
Increasing the leading role of the central and local governments	1	Uniform instruction from the central through to local levels is the determining factor in the technology development	MARD, provinces	Integrate the technology into action plan at the national and local levels Form multi-sectoral taskforces and steering committees	4 years	GoV	480
Raising awareness of agricultural extension agencies on climate change	2	Agricultural extension agencies have limited understanding of climate change Agricultural extension agencies is the responsible organization for adaptation technology transfer	MARD	Prepare materials on climate change and adaptation measures Organize training courses for agricultural extension officials	5 years	MARD	240
Market support actions							
Analyzing the advantages of the technology	1	Helps to raise awareness of public to change their cultivation behaviors.	MARD	Carry out research experiments and observations. Assess and demonstrate the advantages of the new technology	3 years	MARD	144
Introducing crop varieties with higher value than rice crops	2	Helps farmers to choose an appropriate method that can produce high economic benefits.	MARD	Organize exhibitions-workshops to promote the new technology and capacity of service suppliers	5 years	MOST; MARD	240
Multiplying the proven success modal	2	Because they are modals that have proven to be scientifically successful and have low risks.	MARD	Integrate into annual plans Conduct study tours to learn about existing modals	5 years	MARD	240

Skills training and education							
Public awareness raising	1	Because of the long-standing traditional cultivation practices, people may not accept the new technology	MARD	Organize training courses and workshops to introduce about the technology and share experience	10 years	MARD, MOST	192
III. Shifting from triple cropping to double cropping plus shrimp/fish/poultry farming Category: Small scale, long-term Innovation stage: Deployment – Diffusion							
Creation of networks							
Creating a network of experts with expertise on agriculture, hydrology, plant protection and livestock veterinary	1	There is a need for inter-sectoral coordination in assessing adaptive capacity of rice and fish/waterfowl	MARD, MOST	Select experts of various principles Create a network and define the role of the stakeholders	3 years	MARD	86
Policies and measures							
Locating areas that needs shifting triple cropping to double cropping plus shrimp /fish/poultry farming	1	There is a need for relocation of suitable areas for technology application	MARD	Investigate, assess the water scarcity and economic efficiency of triple cropping Locate areas the need the new technology	5 years	MARD	192

Support policies for the deployment of the technology	1	There is no appropriate support policy for technology diffusion Helps to facilitate the deployment of research outcomes in production	MOST, MARD, MOF, MPI	Demonstrate the science and necessity of the technology Develop and bring into force appropriate policies and tax incentives to diffuse the technology	3 years	MOF	48
Organizational/behavioral change							
Increasing the leading role of the central and local governments	1	Uniform instruction from the central through to local levels is the determining factor in the technology development	MARD, provinces	Integrate the technology into action plan at the national and local levels Form multi-sectoral taskforces and steering committees	4 years	Gov	480
Raising awareness of agricultural extension agencies on climate change	2	Agricultural extension agencies have limited understanding of climate change Agricultural extension agencies is the responsible organization for adaptation technology transfer	MARD	Prepare materials on climate change and adaptation measures Organize training courses for agricultural extension officials	5 years	MARD	240
Rules and mechanisms for coordination between sectors and organizations	3	Coordination between relevant agencies is weak. There is a need for a coordination mechanism to strengthen the implementation	MARD, MONRE, People Committee	Review existing legal documents Consult with stakeholders to make appropriate, feasible policies Develop and bring into force new coordination mechanism	2 years	GoV, National Steering Committee for Climate Change	5

Market support actions							
Creating market outlets for new products	2	Helps to ensure the market outlets for new products	MARD, MOIT, MOF	Research the market and create linkages with business organizations Organize marketing campaign for the product Create a new market for the product	5 years	MARD, MOIT	48
Planning and building appropriate infrastructure	1	Helps to ensure sustainable development Facilitate the deployment of the new technology	MPI, MARD, MOC, Provinces	Investigate, design and develop investment plan for each period according to the priority level. Plan and implement according the planning.	5 years	MPI, MARD	4,798
Multiplying the proven success modal	2	Because of the long-standing traditional cultivation practices, people may not accept the new technology	MARD	Integrate into annual plans Conduct study tours to learn about existing modals	5 years	MARD	240
Skills training and education							
Public awareness raising	1	Because of the long-standing traditional cultivation practices, people may not accept the new technology	MARD	Organize training courses and workshops to introduce about the technology and share experience	10 years	MARD, MOST	144
Mainstreaming into the official educational system	2	Helps to prepare required human resources ready for the innovation and transfer of the new technology	MOET, MARD	Prepare teaching materials and textbooks Increase extracurricular activities	5 years	MOET, MARD	24

* Note (1): See note under Table 3

b. Forestry

- **Preliminary target and barriers**

Sustainable forest management is considered the basis for forestry development with the target of increasing the national forest coverage to 45% in 2020. Therefore, the following tasks need to be considered: completing bordering and planning for the three types of national forest; sustainable management, planning and use of protection forest and special use forest; planning for afforestation and reforestation.

Based on the above general targets, specific targets for plant science/plant genetics and agro-forestry were identified.

Barriers to application of these technologies were categorized into socio-economic, technical and environmental groups. In terms of socio-economy, local budgets are not sufficient for technology development, in addition to inadequate policies for handing over forestland to local people. In technical terms, infrastructure and national technical capacity are not sufficient. Areas for forest production are fragmented while forest product quality and quantity are still low or unstable. In terms of environment, applying these technologies may accelerate land degradation due to overexploitation.

- **Prioritization and characterization of technology acceleration measures**

Table 8: Prioritization and characterization of technology acceleration measures for forestry sector

Measure (grouped under core elements)	Prio -rity	Why is it important?	Who should do it?	How should they do it?	Time-scale	Monitoring, reporting and verification for measure	Estimated costs 1,000 USD
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
I. Plant science/plant genetics Category: Large scale, long-term Innovation stage: Deployment – Diffusion							
Creation of networks							
Creating network for technology application	1	Helps to facilitate the diffusion of new scientific achievements into economic activities	MOST, MARD, Forestry Administration	Assess existing networks Create options for strengthening capacity of the networks Create a network for technology application	3 years	MOST MARD	144
Policies and measures							
Developing seed selection procedure	1	Ensures and enhances the efficiency of application of the technology	MARD	Develop criteria and standards of the procedure Carry out pilot projects to apply the procedure, draw lessons for a complete, appropriate procedure.	1 year	MARD	14

Organizational/behavioral change							
Increasing research for new climate change-tolerant varieties	1	Helps to meet the national demand Facilitates the creation of new varieties that can tolerate changing climate conditions Increases national research activities	MOST, MARD, research institutes	Make research plans for creation of new varieties Invest on research facilities, equipment and infrastructure Pilot and diffuse the technology on a large scale	7 years	MOST, MARD	240
Market support actions							
Raise awareness on research outcomes	2	Helps to expand and promote the outcomes of research	MARD, MOST,	Introduce the research outcomes through mass media Organize workshops for introduction of the research outcomes and experience sharing	3 years	MARD	72
Product subsidization	2	Subsidization is needed to encourage the deployment of this technology	MARD, MOF	Develop product subsidization schemes Mobilize financial resources from forestry support funds	5 years	MARD, MOF, MPI	360
Skills training and education							
Capacity building for staff members	1	Helps to form a basis for technology innovation and transfer	MARD, MOET	Develop capacity building programs and materials for staff members Organize training courses and forums to exchange experience	3 years	MARD, MOET	58

International cooperation and IPR							
Bilateral and multilateral cooperation	2	Helps to take advantage of international resources and experience Gains rapid access to latest scientific achievements	MARD, MOST, MOET	Organize overseas study tours Develop cooperation with experienced international organizations	10 years	MARD, MOST	96
II. Agro-forestry Category: Small scale, short-term Innovation stage: Deployment – Diffusion							
Creation of networks							
Establishing agro-forestry extension taskforces	1	Helps to take advantage of experts involved in the taskforces	MOST	Create a network of agro-forestry extension at the local level, consisting of local official and providing allowance	5 years	MOST, MONRE	355
Raising public awareness on natural resources protection	1	Helps to raise awareness of people in order for them to make the right, sustainable decisions	Provinces	This will be done through mass media, by extension taskforces and training courses	5 years	People Committee	14
Policies and measures							
Facilitating investment on development	2	Helps to encourage people to use the technology Helps to promote the technology on a larger scale	MOF, SB, MARD	Review, develop and implement loan policies, measures with convenient, simple procedures	3 years	MOF, MARD	288

Organizational/behavioral change							
Land planning for agro-forestry in mountainous regions	1	Creates land resources for the technology application Accelerate the diffusion of technology in potential localities	MPI, MARD, MONRE	Investigate and develop uniform planning for all regions Implement the planning	3 years	MPI, MARD, MONRE	288
Implementing sustainable agro-forestry modal	1	Helps to change the traditional behaviors and accelerate the diffusion of the technology	MOST	Choose an area to apply the modal Assess the results of the modal application Multiply the application on a large-scale	3 years	MARD, MOST	96
Market support actions							
Developing system for product distribution and consumption	2	Helps to increase the product value and household income Contributes greatly to the poverty alleviation program in rural and mountainous areas	MARD, MOIT, local People's Committee	Organize a system of market outlets for the products Establish wholesale markets	2 years	MARD, MOIT	96
Skills training and education							
Capacity building for agro-forestry extension officials	1	Helps to relay the knowledge to people Ensures the efficiency of the modal	MARD, DARDs	Organize training courses for agro-forestry extension officials	3 years	MARD	14

International cooperation and IPR							
Bilateral and multilateral cooperation	2	Helps to take advantage of international resources and experience Gains rapid access to newest scientific achievements	MARD, MOST, MOET	Organize overseas study tours Develop cooperation with experienced international organizations	10 years	MARD, MOST	96

* Note (1): See note under Table 3

c. Water resources

- **Preliminary target and barriers**

Development of integrated water resources management (IWRM) will enhance adaptive capacities of human communities and natural ecosystems to climate change, increase living standards and ensure water security and sustainable water resources development. Prioritizing development of climate change adaptation technologies in water resources management will ensure water security, poverty alleviation, social security, public healthcare, enhance living standards and protect water sources in the context of climate change.

Barriers to application of these technologies were categorized into socio-economic, technical and environmental groups. In terms of socio-economy, there is not enough investment. Besides, conflicts over access to water sources are of major public concern. In technical terms, there is not enough space in urban areas for rainwater storage. Also, it is hard to determine the scale of large reservoirs in rural areas. Currently, authority has yet reached a consensus on the institutional arrangements of the Integrated River Basin Management Committee. In addition, there is a need for a uniform database and information sharing mechanism for stakeholders. In terms of environment, water pollution will have negative impacts on downstream lives and ecosystems, such as epidemic outbreak.

- **Prioritization and characterization of technology acceleration measures**

Table 9: Prioritization and characterization of technology acceleration measures for water resources sector

Measure (grouped under core elements)	Prio-rity	Why is it important?	Who should do it?	How should they do it?	Time-scale	Monitoring, reporting and verification for measure	Estimated costs 1,000 USD
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
I. Rooftop rainfall harvesting for household usage Category: Small scale, short-term Innovation stage: Deployment – Diffusion							
Creation of networks							
Developing a network of technical experts	1	Provides technical support for household in applying the technology	MOC, Local People's Committee	Create a network of local experts Organize training course on technology application	2 years	MOC, MARD	38
Policies and Measures							
Support policies for local deployment of the technology	1	Initial supports for poor people or remote areas are needed Encourage deployment of technology in a larger scale	MOF, MARD	Develop and implement support policies for new technology development Create support funds	2 years	MOF, MARD	10

Organizational/behavioral change							
Change in water use behaviors	2	Urban residents do not have the habit of using rainwater or using water efficiently Freshwater becomes scarcer Helps reducing inundation in urban areas	TTTT, MONRE	Organize awareness raising campaigns for public communities. Organize workshops, meetings.	2 years	MONRE	5
Market support actions							
Detailed Investigation of climate and rainfall patterns, rainwater quality in target areas	1	Develops a database to ensure feasibility and improve efficiency of technology	MONRE, MOC	Identify potential locations for the technology Investigate and collect rainfall data and conditions for technology application	3 years	MONRE	29
Promoting technology and assess market potential	2	Creates an enabling environment for technology	MONRE, Media agencies	Organize technology exhibitions Organize awareness raising campaigns	2 years	MONRE, MOC	29
Skills training and education							
Mainstreaming into the official educational program	3	Helps to raise awareness on water saving and efficiency	MOET, MONRE	Prepare teaching materials Mainstream into official educational programs	5 years	MOET, MONRE	24

II. Runoff water harvesting Category: Medium scale, short-term Innovation stage: Deployment – Diffusion							
Creation of expert networks							
Establishing focal points	1	There is need to rationalize and strengthen the role of organizations in the network Management and operation in localities should be coordinated	MOHA MARD Local People's Committee	Review functions of relevant organizations Establish focal points	2 years	MONRE MARD	5
Developing a network of technical experts	1	Provides technical support for local deployment of technology	MARD Local People's Committee	Create a network of local experts Organize training courses on technology application	2 years	MONRE MARD	48
Policies and measures							
Support policies to encourage local deployment of the technology	1	Initial supports for poor people or people in remote areas are needed Provides encourage deployment of technology in a larger scale	MOF, MARD	Develop and implement support policies for new technology development Create support funds	2 years	MOF, MARD	10

Organizational/behavioral change							
Capacity building for water management, operation, protection and salinization	2	Ensure water sanitation and quality Water saving and efficiency	MONRE, MARD, Local People's Committee	Organise training and workshops on management skills and experience sharing	3 years	MONRE MARD	14
Issuance of rules on household water use	2	Reduces conflicts in water use Ensures water efficient use and water quality	MONRE, MARD, Local People's Committee	Consult with stakeholders Develop appropriate regulations Develop and implement regulations	2 years	MONRE MARD	5
Skills training and education							
Public awareness raising	2	Helps to diversify sources of water Enhances public community on efficient use of water	TTTT, MONRE, MARD, Local People's Committee	Develop materials and programs for awareness raising Organize training courses to raise awareness	3 years	TTTT MONRE	43
III. Integrated River Basin Management Category: Large scale, medium- and short-term Innovation stage: Deployment – Diffusion							
Creation of networks							
Assigning focal points for IRBM	1	Facilitates uniform basin-wide socio-economic management Ensures water efficiency Improves monitoring	MOHA MONRE MARD	Review functions of relevant organizations Establish a focal point Determine the role of the focal point	2 years	MOHA, MONRE MARD	14

Developing an expert network	1	Interdisciplinary experts are needed Ensures effective application of technology Provides technical support for focal agencies	MONRE MARD	Create a network of experts from related research and management institutes Conduct training courses on technology deployment	2 years	MONRE MARD	29
Policies and measure							
Integration into planning and development program at river	1	Facilitates technology deployment Serves sustainable development	MPI MONRE MARD	Review planning and socio-economic development programs in river basins Develop mainstreaming plan Integrate into programs and action plans of sectors and localities	3 years	MPI MONRE MARD	29
Organizational/behavioral change							
Change to basin-based management practices	1	Facilitates uniform basin-wide water management Helps to address limitations of administrative unit management of water resources	MONRE	Organize training courses on new management practices for managers	3 years	MONRE	29

Developing rules and regulations for coordination between organiztions and localities	2	Helps to avoid conflicts in water use Facilitates technology application	MONRE MARD MOIT Local People's Committee	Consult with stakeholders Develop appropriate regulations Develop and implement rules	3 years	GoV, MONRE	29
Market support actions							
Investigating environmental and socio-economic conditions in target river basins	2	Develops a database to ensure feasibility and improve efficiency of technology	MONRE MARD	Identify and choose typical river basins for technology application Investigate and gather data on natural and socio-economic conditions of the chosen locations	3 years	MONRE	29
Introducing succesful IRBM modals	2	Creates an environment for technology development and opportunities for cooperation between stakeholders	MONRE, media agencies	Introductory workshops on IRBM modals in the world Assess benefits of technology application in each basin	5 years	MONRE	48
Skills training and education							
International cooperation/International consultant/Overseas staff training	2	Helps to take advantage international experience, develop human resources, accelerate technology transfer and diffusion	MONRE MOET VAST	Develop international cooperation projects Organize training courses with participation of international experts	5 years	MONRE	72

* Note (1): See note under Table 3

d. Integrated Coastal Zone Management

- **Preliminary targets and barriers**

In the future, priority technologies for integrated coastal zone management in Viet Nam will be promoted to approach the international level through the following activities: capacity building and development of professional and skilled staffs; technology development and transfer; strengthening existing structures; securing socio-economic targets; protecting coastal zone ecosystems.

Barriers to application of these technologies were categorized into socio-economic, technical and environmental groups. In terms of socio-economy, construction in coastal zones and preservation areas requires high investment and long-term maintenance costs. In technical terms, there is a lack of data which causes difficulties to finding a suitable solution. In terms of environment, coastal zone structures can change coastal dynamics and impact on coastal ecosystems.

Based on the preliminary targets and identified barriers, TAP for each sectors were developed.

- **Prioritization and characterization of technology acceleration measures**

Table 10: Prioritization and characterization of technology acceleration measures for integrated coastal zone management sector

Measures (grouped by core elements)	Prio -rity	Why is it important?	Who should do?	How should they do it?	Time-scale	Monitoring, reporting and verification measures	Estimated costs 1,000 USD
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
I.Sea-dike technology Category: Large scale, short and medium-term Stage innovation: Research - Deployment							
The establishment of networks							
To Review, restructure and support the current network management	1	To rationalize and promote the effective role of the existing network.	MARD MOHA	-To review the functions and tasks, competency assessment, restructure in the direction of depth. -To strengthen the capacity of existing networks.	2 year	MARD MOHA	10
Building and development network of experts	2	Technical assistance, building capacity of management and applying technology.	MARD People Committee of provinces	-Creating a network of experts. -Provide management and technical training.	5 year	MARD	48
Policies and measures							
Develop policies to support local technology application	1	-Policies should be locally appropriate.	MOF, MARD	-To develop and promulgate policies to promote the technologies.	2 year	MOF, MARD	10

		- Expanding the scope of application of technology.		-To establish fund to support.			
Testing, evaluating and verifying policies.	3	Increase the effectiveness of policies, timely adjustments for real.	MARD	-To check out the reviews. -To organize the workshop on the effectiveness and limitations of the policies issued. -To propose amendment.	5 year	MARD	24
Change behavior / organization							
Strengthening management capacity	2	-The task-force to manage sea-dike is few. -The management level is still limited.	MARD	-To establish of additional coastal task-forces for sea-dike system. -To organize training management skills.	3 year	MARD	22
Promulgating rules and regulations of coordination among agencies	3	-To create consistency in management. -To facilitate the development of technology.	MARD	-To consult with stakeholders. -To develop appropriate regulations. -To promulgate and implement regulations	3 year	MARD	14
Actions to support market							
To survey and hydrological, geology and geomorphology conditions in selected areas	1	To create a full database and ensure the viability and improve the efficiency of applied technology.	MARD	-To identify and select potential areas to apply technologies. -To survey and collect hydrographic, geological, geomorphological conditions to apply technologies.	3 year	MARD	144

Skills training and education							
Supplement training of technical experts	3	-To ensure the process of technological innovation. -To create an important premise for the dissemination of technology	MARD MOET	-To evaluate the current capacity of expert. -To develop training programs. -To provide training.	5 year	MARD MOET	48
International cooperation and intellectual property							
International cooperation in training and technology transfer	1	Take advantage of international experience in human resource development, promoting technology transfer.	MARD	-To construct projects of international cooperation capacity building and technology transfer. -To train organizations with the participation of foreign experts.	5 year	MARD	72
II. Restoration of coastal wetlands Category: Large scale, short and medium-term Stage innovation: Research - Deployment							
The establishment of networks							
Building and developing a network of experts	2	Technical assistance and building management capacity for localities to apply technology.	MONRE MARD Local People's Committee	-To build a network of experts. -To provide management and technical training about technology application.	5 year	MONRE MARD	48

Policies and measures							
Developing policies to support and encourage research, testing and application of technology	1	-Policies are needed to encourage appropriate support for each type of wetland to be restored. -Expanding the scope of application of technology.	MOF, MARD	-To develop and promulgate policies to support the promotion of technology. -To create fund for support.	2 year	MOF, MARD	10
Change behavior / organization							
Strengthening management capacity	2	-To manage experience and use of wetlands lacking. -There is lack of specialized units	MONRE MARD	-To establish specialized units, and supplement management force. -To organize training of management skills.	5 year	MONRE	24
To promulgate rules and regulations of coordination among agencies	3	-To create consistency in management. -To facilitate the development of technology.	MONRE MARD	-To consult with stakeholders. -To develop appropriate regulations. -To promulgate and implement regulations	3 year	MONRE	14
Skills training and education							
International cooperation, supplement training of technical experts	2	-To take advantage of international experience. -To ensure the process of technological innovation. -To create an important premise for the dissemination of technology	MONRE MOET	-To evaluate of the current expert capacity. -To develop training programs. -To provide training.	5 year	MONRE MOET	48

* Note (1): See note under Table 3

IV. Project ideas

List of project ideas for international support for climate change mitigation and adaptation as follows:

1. The project ideas for international support for climate change mitigation

P.o	Name of proposed projects	The purpose of project
1	Designing financial support mechanisms and subsidizes for wind power	To design the financial support mechanisms and subsidizes for wind power in Viet Nam
2	Consult and research feasibility report to apply suitable cogeneration technology for Dung Quat economic zone	Improve general heat efficiency from emery supply; utilize onsite bio fuels and save energy through apply technology outline "Biofuel engine CHP plants + heat recovery steam generator (HRSG)" for Dung Quat economic zone.
3	International cooperation: Development of the bio energy in the live stock sector to replace energy used in agriculture zone and mitigate GHG emission	Improve farmer life, save burning material and reduce environmental pollution. Create methane for cooking in agriculture region to mitigate GHG emission.
4	Management of the irrigation to mitigate methane emission and improve water irrigation efficiency in Red and Cuu Long river deltas.	Saving water irrigation, improving rice productivity and production and famer's life and mitigate methane emission. Reducing methane emission on rice field Building perfect irrigation process to improve rice productivity Capacity building for technical officials to implement suitable irrigation process
5	Afforestation on sandy land at coastal zone of South Central.	Afforestation at Quang Nam and Quang Ngai provinces is to reduce desertification risk, protect land and residential areas, transportation routes and other infrastructures
6	Reforestation and protection of mangrove forests.	Combating mangrove degradation; protecting environment and developing aquaculture income

2. The project ideas for international support for climate change adaptation

P.o	Name of proposed projects	The purpose of project
1	Research on creating new high-yield and salt-and-drought-tolerance rice variety.	To collect the genes of the high-yield group; especially high-tolerant varieties
2	Building a conversion model to change rice-land into fruit-trees land.	Successful conversion of paddy land limited by climate change (CC) into dry land crops that achieve economic efficiency;
3	Planning for the cultivation 2 rice + fish / shrimp / 3 duck land converted from the 3 rice-crop land in Mekong Delta.	To successfully convert 3-rice-crop land includes an uncertain crop in the rainy season into 2-rice-crop and a crop planted waterfowl (ducks), seafood (fish / shrimp);
4	Developing high-quality timber trees for plantation economy.	To raise the value of forest production;
5	Develop the agro-forestry ecosystem combined with improvements on livelihood and environment in the two arid provinces of Ninh Thuan and Binh Thuan.	To assist people in arid regions in Ninh Thuan and Binh Thuan develop agro-forestry model;
6	Building 15 pilot rainwater collection systems for residents in the Northern mountainous of Viet Nam	To study a number of technologies for gathering rainwater runoff in accordance with geological and hydrology conditions in a mountainous are of Northern Vietnam;
7	Climate change and integrated management of river basins in Viet Nam	To analyze the effects of climate change on water resources in river basins, especially the change in water resources and water quality;
8	Research on scientific bases to assess impacts of sea dike system for sustainable development	To establish scientific impact assessment and socio-economic environment of the sea-dike system;
9	Building a model of sustainable management of coastal wetlands of Viet Nam	To develop a model of sustainable management of wetlands;

V. Prospects

The prioritized technologies which was selected for climate change mitigation and adaptation belong to high GHG emission, sensitive and vulnerable sectors. Their potential for feasible vulnerability mitigation and GHG mitigation options and their contribution to overall national development goals.

The TAPs to develop and transfer technologies for each technology in each sector. Implementation process has complied with the steps and processes in Technology Needs Assessment Guideline by the UNFCCC and the UNDP

The technology need assessment report released in accordance with the National Target Programme to Respond to Climate Change by disseminating the results through the issue this summary report and published information on the website to give the necessary information to the community.

As a consequence, and also a requirement of the report, which is the project ideas establishment to develop the technologies priority. Most of technology to cope with climate change are new technologies and encouraged to apply and developing them need financial and technical assistance. Therefore, these ideas will be proposed to looking forward international donors to develop project. In addition, the barriers and measures to overcome the barriers which are mentioned in the action plan will also be suggestion to help the Ministries/Departments in deploy and development feasible technologies to cope with climate change and to carry out the plans of sectors.

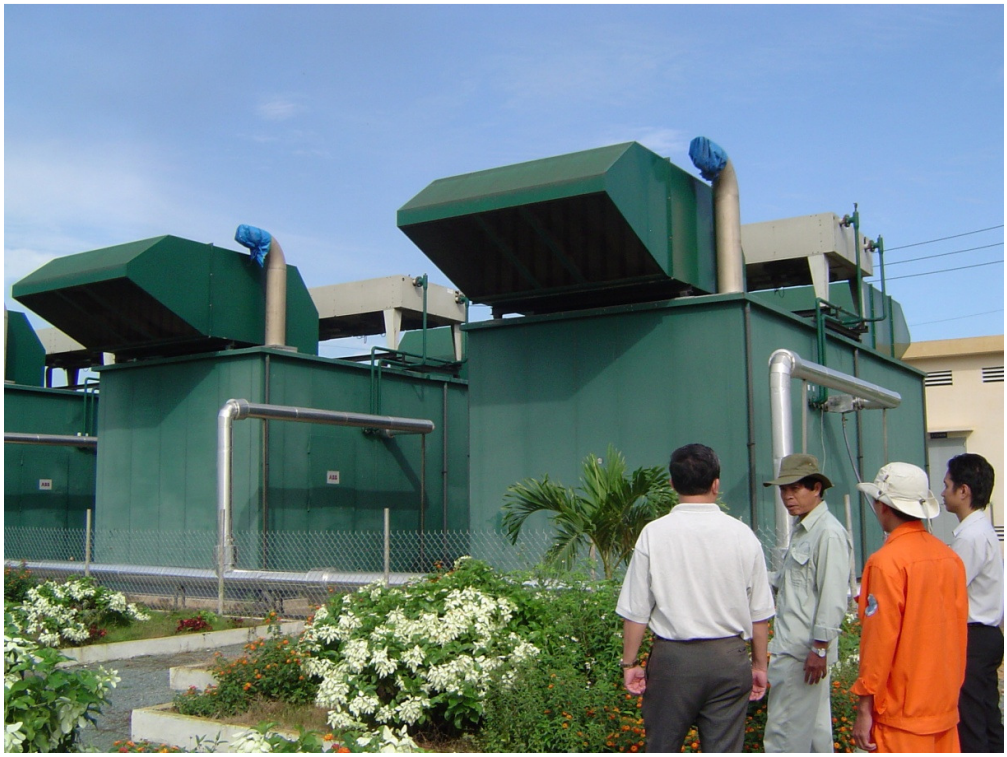
We hope that, this summary report will contribute to the dissemination of climate change mitigation and adaptation technology. So it will be useful for activites to cope with climate change and sustainable development in Viet Nam. And it will be useful materials to supportting implementation of the National Appropriate Mitigation Actions (NAMA) for developing countries, which is regarded as a effective solution to reduce GHG emissions and it is a opportunity for developing countries in negotiation about climate change and getting the technology transfer and financial support from UNFCCC./.

ANNEX: IMAGES OF THE PROJECT ACTIVITIES

1. Workshop on TNA respond to climate change, Hanoi, 30 December 2011

2. Final workshop of global TNA project initial phase, Hanoi, 12 June 2012

3. Survey potential of technology application in some localities



Dong Thach Landfill site, Ho Chi Minh city

Thai Nguyen Iron and Steel Factory

Survey at the project

Dinh Co Gas Processing Plant

For more information please contact:

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