UNITED NATIONS DEVELOPMENT PROGRAMME

GLOBAL ENVIRONMENT FACILITY

EXTERNAL PROJECT EVALUATION

**Enabling China to Prepare Its Initial National Communication
CPR/00/G31**

**Targeted Research Related to Climate Change
CPR/00/G33**

Final Report

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LIST OF ABBREVIATIONS

BOD	Biological Oxygen Demand
CAS	Chinese Academy of Sciences
CAAS	Chinese Academy of Agricultural Sciences
CCOS	China Climate Observation System
CICETE	China International Center for Economic and Technical Exchange
CH_4	Methane
CH4MOD	Model for Methane Emissions from Rice Paddies
CMA	China Meteorological Administration
CO_2	Carbon Dioxide
COD	Chemical Oxygen Demand
COP	Conference of the Parties to the UNFCCC
GDP	Gross Domestic Product
GEF	Global Environmental Facility
GHG	Greenhouse Gas
INC	Initial National Communication
IPCC	Inter-Governmental Panel on Climate Change
LULUCF	Land Use, Land Use Change and Forestry
MOST	Ministry of Science and Technology
MSW	Municipal Solid Waste
N_2O	Nitrous Oxide
NCCCC	National Coordination Committee on Climate Change
NDRC	National Development and Reform Commission (formerly SDPC)
NPD	National Project Director
NBS	National Bureau of Statistics
PDF	Project Development Funds
RMB	Renminbi
SDPC	State Development Planning Commission (now NDRC)
SEPA	State Environmental Protection Administration
SNC	Second National Communication
TOR	Terms of Reference
TPR	Tripartite Review
TR	Targeted Research
TVEs	Township/Village Enterprises
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
V&A	Vulnerability and Adaptation

1. EXECUTIVE SUMMARY

Two UNDP/GEF projects provided support to the Government of China to: 1) prepare its Initial National Communication under the United Nations Framework Convention on Climate Change (UNFCCC), and 2) perform targeted research to improve its capacity to prepare high quality National Communications to the UNFCCC in the future.

The Government of China views climate change as a major threat to its ability to achieve sustainable development, and its Initial National Communication was prepared as part of an overall set of climate change related activities. UNDP support for these projects is consistent with its programmatic interest in environmental protection, poverty alleviation and sustainable development and recognizes the impacts that climate change can have on these issues. Furthermore, UNDP supported these projects to enable China to build capacity to fulfill its commitment to the UNFCCC and to assist the country in achieving sustainable development.

These projects were needed because prior projects that developed estimates for China's emissions of greenhouse gases (GHGs) had major differences and deficiencies in each of the key sectors: energy, industry, agriculture, forestry, and municipal waste. In addition to the lack of accurate data on activity levels and emissions factors, the use of IPCC default methodologies were not always appropriate to the situation in China, and Chinese institutions lacked the capacity to make the types of measurements needed for an accurate calculation of GHG emissions.

The projects were executed by the National Development and Reform Commission (NDRC), which is the chair of the National Coordination Committee on Climate Change (NCCCC). The NCCCC is responsible for coordination of climate change policies and activities among relevant government agencies. A Project Management Office (PMO) with shared facilities and support staff was established for each project, and each project was implemented by domestic sub-contractors with support from international experts.

The evaluation determined that these projects have made a significant contribution to capacity building for establishing the methodology and database framework for developing national GHG inventories in China. Expert working teams have been established in each inventory sector with experience, expertise and international contacts and exposure, and several China-specific methodologies and models were developed that have broad applicability to other developing countries.

The two projects established or expanded measurement and monitoring systems at research centers for several of the lead institutes, and this capacity to measure emission factors and other related parameters provides a solid basis for continued measurement and monitoring work. Databases have been developed in all sectors that provide a starting point for performing future inventory calculations and for regularizing the inventory development process.

The evaluation provides two sets of recommendations. The first pertain to work needed in support of preparing China's Second National Communication (SNC). The second pertain to future-looking targeted research aimed at helping China improve its capabilities to perform vulnerability and adaptation (V&A) assessments.

1.1 Recommendations for Preparation of the Second National Communication

1.1.1 Capacity Building

To support preparation of the national GHG inventory for the SNC, a high priority should be given to capacity building to develop a systematic and routine process that will support future inventory preparation. First, the NCCCC should institutionalize further development, maintenance and quality control of the various inventory databases. Specialized institutions should remain in charge of specific sectoral databases, but one organization should have overall responsibility for coordination and quality assurance.

Second, the national statistical system and index should be improved to support the compilation of the national GHG inventory. Recommendations for improvements made by the INC Project team to the

National Bureau of Statistics (NBS) should be implemented, and the NBS should be actively involved in the project for the Second National Communication to further develop of the capacity for routine compilation of future national GHG inventories.

1.1.2   Improvements to Inventory Methodology and Data Quality

Energy. Regularize data collection and processing, periodic checks of field measurements, maintenance of databases, compilation of the inventory, and its quality control, reporting and verification.   Build on the Tier 2 approach for road transport, particularly for CH_4 and N_2O emissions from vehicles. Improve accuracy and regularized calculation of transport fuel consumption. Improve activity data and CH_4 emission factors from small and medium coal mines, oil and gas system and biomass use for energy.

Industrial processes. Maintain the emissions database from the current five industrial processes and expand the database to more industry sub-sectors and the additional GHGs per the IPCC guidelines. Incorporate capacity building efforts to develop activity data and emission factors for the new sub-sectors and gases.

Agriculture. Continue development of the CH4MOD and IAP-N models and expand field measurements in support of the models. Improve CH_4 emission factor measurements from winter-flood paddy fields. Improve N_2O emission measurements from cropland for more climatic regions, cropland types and field management practices. Consider converting IAP-N to a process model to provide greater spatial resolution and allow modeling of temperature and precipitation impacts. Continue to make improvements to the current models for livestock and manure management systems. Expand data collection and analysis to better characterize livestock feed quality and quantity. Perform lab tests and field measurements to develop China-specific enteric CH_4 conversion rates and emission factors.   Develop data on the design and usage of China-specific animal manure management systems, and measure the methane emission factors from these systems for each climate zone. Improve the livestock population data available through the national statistical system.

Forestry. Continue the use of remote sensing data to monitor forest area and land use change. Develop better correlations between remote sensing data and forest biomass data using dynamic simulations of net carbon stocks in coordination with the field measurements and remote sensing data. Expand field research of soil carbon for different land uses (forest land, croplands, grassland, barren land, etc.) Develop provincial activity data for forest conversion, and develop more China-specific soil carbon emission factors, especially factors for land use conversions between forest land and other land use (cropland, grassland, etc.) Continue to update biomass expansion factor (BEF) database especially for forest types with few samples and trees outside of forests. Continue to measure and update biomass of bamboo and tree crops (fruits and nuts).

Municipal Waste. Improve the MSW sampling analysis from at least two representative cities (one large and one small-medium) in each of the seven regions. Monitor methane emission from 3 to 5 landfills over a several-year period. Improve wastewater activity database through sampling analysis by region and industry type.   Upgrade national statistics survey to include an index for MSW generation, management systems and composition.

1.1.3   Public Awareness

For the SNC, continue outreach to the general public regarding China's climate change strategy and sustainable economic development. Raise the awareness of provincial and local leaders of the potential regional and local impacts of climate change and the need for their full cooperation and support of the central government policies for mitigation and adaptation. Generate awareness within China's growing business community of the economic benefits of being on the "right" side of the climate change issue.

1.1.4   Projections of Future GHG Emissions

The Government of China needs to understand the impact of a broad range of social and technological policies on the potential emissions of GHGs in the future. A focussed capacity building activity is needed to support the development of methodologies and models for forecasting energy demand and GHG emissions that would allow the evaluation of possible policies for sustainable economic

development and climate change mitigation and would provide input to the V&A assessment.

1.2   Recommendations on Targeted Research for Vulnerability and Adaptation

Support research on the design of a China Climate Observation System (CCOS) and the development of climate change scenarios that can be linked directly with an integrated assessment model.   Support development of an integrated assessment model to analyze regional vulnerability of social, health, economic and environmental systems.   Strengthen understanding of extreme climate events and coordinate these results with the National Committee for Disaster Reduction.   Develop adaptation strategies that can be incorporated into national, regional, and local sustainable development plans.

1.3   Lessons Learned

A developing country like China was able to prepare a high-quality INC with funding support and capacity building from the international community.   Indeed, Chinese experts were able to make important improvements to the models and methodologies that make them more appropriate to a developing country situation, and UNDP should promote the use of these methodologies in other developing countries.

2.   PROJECT CONTEXT

This report evaluates two UNDP/GEF projects which provided support to the Government of China to prepare its Initial National Communication under the United Nations Framework Convention on Climate Change (UNFCCC). The first, Enabling China to Prepare Its Initial National Communication, will be referred to as the INC Project, and the second, Targeted Research Related to Climate Change, will be referred to as the TR Project. When necessary, the evaluation report will identify the projects separately, but in general it will cover the impacts of the projects as a whole.

The UNFCCC underscores the importance of carrying out work in a number of areas to address the issue of global climate change: current emissions must be understood; potential impacts should be evaluated; adaptation measures should be formulated; and, finally, steps must be taken to limit total global emissions of greenhouse gases.

For the developing countries, the one of the major obligations is submission of "National Communications," and Article 4.3 of the UNFCCC stipulates that financial resources will be provided to the developing country parties to meet their costs of complying with this obligation. As the entity of financial mechanism for the Convention, the GEF has the responsibility of providing the financial resources necessary to enable the People's Republic of China, as a developing country party to the UNFCCC, to fulfill its commitment of submitting an Initial National Communication.

UNDP's overarching mandate is to help developing countries, and it is the developing world that will likely be hardest hit by the expected altered weather patterns, changes in food production, rising sea levels, and impacts to public health. Thus, climate change poses not only an environmental challenge, but also seriously threatens achievement of the Millennium Development Goals and *Xiaokang,* the well-of society.

The Government of China views climate change as a major threat to its ability to achieve sustainable development, and China was one of the first countries to ratify the UNFCCC. Over the past 10 years, China has demonstrated its commitment to developing policies to address global climate change concerns.   As early as 1990, the National Coordination Committee on Climate Change was established under the State Council to be responsible for deliberation of climate change issues and coordination of climate change policies and activities among relevant government agencies. China was also an early signatory to the Kyoto protocol and ratified that commitment in 2002. Through activities such as Agenda 21, the Energy Conservation Law of 1998 and the Renewable Energy Law currently under development, China has demonstrated its commitment to sustainable development and policies that will mitigate climate change. Last year, the Interim Measures for Operation and Management of Clean Development Mechanism Project in China came into force, which demonstrate

China commitment to international cooperation on climate change issues. Preparation of China's Initial National Communication to the UNFCCC is part of this overall set of climate change related activities.

These projects are consistent with UNDP's programmatic interest in environmental protection, poverty alleviation and sustainable development. Addressing climate change is an important issue for UNDP because of the impacts that climate change can have on these issues and because of the synergies between climate change mitigation and adaptation strategies and policies to promote the environment, poverty alleviation and sustainable development.

2.1 Problem and Project Need

An Initial National Communication should include: a national inventory of GHG emissions and sinks, a general description of steps taken or envisaged to implement the UNFCCC, and any other information the party deems relevant to convey.

Climate change studies implemented prior to these projects developed estimates for China's emissions of greenhouse gases (GHGs), but the results had major deficiencies in each of the key sectors (energy, industry, agriculture, forestry, and municipal waste) and in some sectors the estimates vary by over 100%. In general, these variations were due to: the lack of accurate data on activity levels and emissions factors, the use of IPCC default methodologies that are not appropriate to the situation in China, and to the lack of capacity in Chinese institutions to make the types of measurements needed for an accurate calculation of GHG emissions.

In addition, significant policy-related issues needed to be addressed in order to prepare the general description of steps for the Initial National Communication. In particular, formulation of the general steps required that consensus be developed on programs and policies such as: (1) programs related to sustainable development, research and systematic observation, education and public awareness, and training; (2) policy options for monitoring systems and response strategies; (3) policy frameworks for implementing adaptation measures and response strategies, with a view to integrating climate impact information into the national planning process; (4) building capacity to integrate climate change concerns into medium and long-term planning; and (5) programs that contribute to addressing climate change and its adverse impacts.

2.2 Objectives and Major Indicators

These two projects have similar development objectives: to build up China's capacity in the climate change field and strengthen its ability to implement the UNFCCC and contribute to the broader global objective of effectively addressing the climate change issue. The more specific objectives of these projects was to promote such cooperation and knowledge that will strengthen China's capacity to prepare high quality National Communications to the UNFCCC in the future and to have the information required to formulate climate change related policy.

Indicators for the end of project situation included the following components:

1. Capacity increased among relevant parties in the Chinese Government for developing climate change policy; and capacity increased within China's research community for producing results to inform that policy. In particular, China's capacity for preparing its national communications, as outlined in the UNFCCC, and the greenhouse gas inventories included therein will be strengthened.

2. A national inventory prepared, providing detailed information on the total emission (and/or uptake) of greenhouse gases in China in 1994 from each of the following five sectors: energy, industrial processing, agriculture, forestry and land use change, and waste.

3. Consensus reached on preparation and submission of greenhouse gas inventory results.

4. Consensus reached on a general description of steps taken or envisaged by China to implement the Convention, as well as on any other information China deems relevant to convey in its National Communication.

5. Information about climate change disseminated to the Chinese public and to the policy-making sector.

6. An Initial National Communication prepared in line with China's obligations and including a greenhouse gas inventory for 1994 and a general description of steps.

2.3   Participants and Organizational Structure

In 1998, the National Coordination Committee on Climate Change (NCCCC) was restructured under SDPC (currently NDRC) to be responsible for deliberation of climate change issues and coordination of climate change policies and activities among relevant government agencies. The Committee has 16 members and is chaired by the NDRC.   The Office of the Committee served as the National Executing Agency for both projects, and Project Steering Committees were formed to provide guidance for the execution of both projects.

SDPC established a Project Management Office (PMO) for each project and designated a National Project Director (NPD), as a part of government in-kind input, to lead each PMO and be responsible for the overall staffing, planning, and reporting of project activities. SDPC also designated a National Project Manager as part of government in-kind input, to serve under the NPD and be responsible for effective management of the project and to oversee implementation of all project activities. A full-time National Project Coordinator (NPC) was recruited by the PMO for each project to manage the day-to-day project activities. Physically, these project offices shared facilities and some support staff.

Each project was implemented by domestic sub-contractors. International experts were recruited to help ensure the effective transfer of international guidelines, methodologies and approaches, and to help ensure that the capacity development activities are implemented to international standards.

CICETE provided services to NDRC (SDPC) for project execution, including procurement and payment of all services, subcontracts and equipment in accordance with UN rules and procedures, as well as technical and financial reporting.

The primary implementation arrangements for both projects are shown in Table 1.

Table 1: Primary Project Implementation Arrangements

Position	National Communication Project	Targeted Research Project
NPD	NDRC, Office of NCCCC	NDRC, Office of NCCCC
NPM	NDRC, Office of NCCCC	NDRC, Office of NCCCC
NPC	Energy Research Institute	Chinese Research Academy of Agricultural Sciences
Primary Sub-contractor Energy / Transport	Center for Energy, Environment and Climate Change, Energy Research Institute	Center for Energy, Environment and Climate Change, Energy Research Institute
Primary Sub-contractor Industry / Forestry & Land use	Center for Energy, Environment and Climate Change, Energy Research Institute	Forest Ecology & Environment Institute, Chinese Academy of Forestry
Primary Sub-contractor Agriculture / Agriculture	Institute of Atmospheric Physics, Chinese Academy of Sciences	Institute for Agricultural Environment and Sustainable Development, Chinese Academy of Agricultural Sciences
Primary Sub-contractor Forestry & Land Use	Forest Ecology & Environment Institute, Chinese Academy of Forestry	
Primary Sub-contractor Waste	Center for Climate Impact Research, Chinese Academy of Environmental Sciences	
Primary Sub-contractor Public Awareness	The Administration Center for China's Agenda 21	

3.   PROJECT IMPLEMENTATION

3.1   Enabling China to Prepare Its Initial National Communication (CPR/00/G31/A/1G/99)

3.1.1   Immediate Objective 1: Preparation of Energy Sector Inventory

This is the most significant GHG emissions sector, and a coordinated approach was used involving over 70 organizations and more than 200 experts. A total of 18 sub-reports were prepared.

The work was organized according to four sub-tasks: CO_2 and N_2O from fossil fuel combustion, CH_4 from biomass burnt for fuel, CH_4 emissions form coal mining and post mining activities, and fugitive CH_4 emissions from the oil and gas system. The GHG emissions inventory was developed by sub-sector, energy device and fuel type, and in many cases, the emission factors for similar energy devices were differentiated by sub-sector.

The major difficulties encountered were poor or unavailable data from the national statistics, lack of measured data for emission factors, data discontinuities due to government restructuring, and inappropriate methodologies for data collection.   In many cases the project had to make significant adjustments to national statistical energy balance to facilitate top-down checking of specific sector or sub-sector results.

For the fossil fuel combustion activity, the major improvements made by the project were a survey of the carbon content and calorific value of coals in China, and surveys of power plants, industrial boilers, heat boilers, and major industry sectors for fuel conversion factors (fraction of carbon oxidized).

For fossil fuel use in transportation, the CO_2 emissions were based on apparent fuel consumption, fuel-based emission factors and oxidized fractions. The IPCC recommended emission factors and oxidized fractions were used for each fossil fuel category. Fuel consumption data for transportation are available from the energy balance table developed by the National Bureau of Statistics, but modification to the data were required to shift transport fuel consumption in non-transport sectors to transport sectors through expert estimates.   For rail transport, the IPCC Tier 1 approach was used, and for road and water transport, the IPCC Tier 2 approach was used. For air transport, the IPCC Tier 3 approach was used based on activity data from each type of airplane obtained from the airline companies.

CH_4 emissions from biomass combustion in the residential sector were based on measurements available from experts for two types of cook stoves and for crop stalks and firewood. For biomass used in commercial and industrial sectors, and for the combustion of charcoal and manure, IPCC default emission factors were used. Activity data was developed from statistical data, questionnaires and expert consultations.

CH_4 emissions from coal mining and post-mining activities were estimated based on a combination of IPCC Tier 2 (using the coal field mean emission value) and Tier 3 (using field measurements by coal mines) methods. The Tier 3 method was applied to the state owned key coalmines. The activity level data came mainly from China's coal statistical resources, questionnaires, and expert consultation. The emission factors were primarily obtained from coal mine field measurements, sampling surveys, case studies and expert judgement.

The fugitive CH_4 emissions from oil and natural gas production, processing, transmission, storage and distribution were estimated using the IPCC Tier 3 method.   The activity data was collected from China's oil and gas system, mainly from the numerical statements of China's major oil and gas companies, statistical yearbooks and other domestic statistical resources. CH_4 emissions factors for the various processing steps were mainly estimated with reference to IPCC default emission factors, and a few specific factors were estimated based on international data.

Uncertainty in CO_2 emissions are less than 5%, but uncertainties in CH_4 from biomass burnt as energy and N_2O emissions from power generation are 35% and 50% due to highly device-specific emission factors, a large variety of devices, and poor (or no) data on devices in China. For traditional biomass,

activity level is also a source of uncertainty due to the non-commercial nature of the resource.

An important conclusion from this work was that the national energy balance statistics are not well suited for GHG inventory work. The project made specific recommendations (provided in a report) to the National Bureau of Statistics (NBS) on how to improve the energy balance table in support of GHG inventory work.

As a result of this project, an inventory database for GHG emissions from the energy sector was created and is currently maintained at ERI. They believe a central coordination mechanism for data base management is needed. They also believe that an organization dedicated to GHG inventory work is needed to maintain and strengthen capacity and to continually improve the database.

They recommended that maintenance of the capacity established by this project is best accomplished by promoting activities to minimize data uncertainty, improve methodologies, and participate in IPCC process.

3.1.2 Immediate Objective 2: Preparation of Industrial Processes Inventory

The inventory of CO_2 and N_2O emissions from the industry sector was analyses according to five sub-sectors (cement, lime, calcium carbide, iron & steel, and adipic acid) whereas previous estimates had only considered cement.

The project used clinker production as the activity level for cement emissions in accordance with IPCC guidelines (not cement production – which has various clinker contents in China – which was used in earlier estimates). Also, cement in China has varying amounts of magnesium (Mg), which results from the limestone composition variations in China. Therefore, the project developed a modification to the IPCC guidelines to adjust for the Mg content in clinker.

Lime production was analyzed by province and end-use application to build up to the national level. This was necessary to account for the different compositions of limestone found in China and because the different quality requirements lead to different CO_2 emission factors during production.

Cement, calcium carbide and iron & steel emissions were also analyzed by province to build up to the national level, and surveys were used to collect data from each industry sub-sectors on activity levels and emission factors. This was necessary because statistical data on activity levels are poor in China because of the small dispersed nature of most industries. This is especially true for lime production, which is often done by small township/village enterprises (TVEs) that do not keep records.

For adipic acid there were only 5 plants operating in 1994, and each was visited and monitored. This was especially necessary because emissions factors depend on the effectiveness of pollution control devices required for air pollution purposes.

In the future, additional capacity building will be needed to expand the inventory to include more industry sub-sectors and to implement the new UNFCCC guidelines that encourage additional industrial gases (HFCs, PFCF and SF6). Future industry sub-sectors could include nitric acid, non-ferrous metals, and building materials.

The project expressed the concern that future survey responses may not be as good as for the first national communication because of the move to a market economy and reduced influence by the government to encourage reporting.

A future problem foreseen by the project is that the NBS stopped collecting clinker production data in 1998. The project team recommended that they begin to collect this data again, and NBS agreed, but the earliest new data will be 2004, but there will be a problem for the 2000 inventory.

As a result of this project, an inventory database for GHG emissions from the industrial sector was created and is currently maintained at ERI. They believe a central coordination mechanism for data base management is needed.

3.1.3 Immediate Objective 3: Preparation of Agricultural Sector Inventory

The inventory of GHG emissions from the agricultural sector was analyzed according to four sub-sectors: CH_4 from rice paddies, N_2O from cropland, CH_4 from livestock, and CH_4 and N_2O from

manure management.

Rice paddies. Rice paddy data was collected at the county level and divided into four types of fields: single crop, double crop-early, double crop-late and winter flood. Key analysis parameters included: grain yields, soil type, water regime, climate data, fertilizer amounts, and residue returns. These and other data were collected by references and survey, and CH_4 emissions were calculated using the CH4MOD model.

The CH4MOD model is based on IPCC methodology, and uses 10km by 10km cells that combine the paddy types, soil types, climate data, etc. to calculate CH_4 production, oxidation and emissions from each cell. The model was validated against 94 measurements from field observation all over the major paddy planting regions, whereas the IPCC model only compared well with 2 or 3 of the field measurements. Field observations in Wuxi (Jiangsu) and Yanting (Sichuan) were funded by both the INC and TR projects.

Uncertainties are largely caused by survey data on factors such as fertilizer amounts and residue returns that were applied province wide. The largest uncertainties exist for winter-flood paddy fields because only two field sites exist that did not represent the large differences in climate types and field management practices, and the field observation time was not sufficient to set up new sites.

Cropland. IPCC Guidelines and Good Practices were followed to develop province-level activity data based on harvest area and production of 18 crops types, fertilizer use and rural population (to determine human and animal manure availability).

Key sources for determining nitrogen input to cultivated soil included: supplements of nitrogen fertilizer and manure, residues returned, bio-fixation nitrogen and nitrogen deposition. The key parameters for the above sources included: harvest index, dry weight fraction, nitrogen content in crop, etc. Survey data was collected to determine the ratio of residues returned to cropland, ratio of residues burned in the field, and nitrogen deposition mainly derived from volatilization of manure (including livestock and rural population) and $NH_3 + NOx$ emissions from croplands.

A nitrogen cycle model, IAP-N, was developed based on IPCC methodology and applied to six region types using nine cropland types, and regional-based survey data. N_2O emission factors for the model were collected from 54 field sites at 12 observation centers covering 9 provinces of China.

The limited number of observation sites relative to different climatic regions, croplands types and field management practices was the major sources of uncertainty on direct emission factors.

IPCC default values were used for indirect N_2O emission factors and for N_2O emission from field burning because of the lack of actual observation data and because these are relatively small contributors to overall emissions.

Livestock. IPCC Guidelines and Good Practices were followed to determine whether Tier 1 (default) or Tier 2 (energy requirement based) methodologies should be used to calculate enteric fermentation CH_4 emission factors for each livestock type.

Tier 1 livestock included horses, mules/donkeys, camel and swine. Swine have very low emission factors but are important in China because of their high numbers. Tier 2 livestock included dairy cattle, yellow cattle, buffalo, sheep and goats, and each was divided into three sub-categories of mature, growing and young. Two livestock management systems were modelled: pasture grazing and residue feeding.

A network of 5 regional universities with local animal extension centers were used to collect data. Livestock populations were determined from statistical data. Surveys were conducted in 2 or 3 representative counties for 31 provinces to determine and daily feed intake for each tier 2 livestock type. IPCC default emission factors were used for Tier 1 livestock type. Emission factors were calculated based on IPCC GPG for Tier 2 livestock types.

Sources of uncertainty included: population data - statistics on animal populations are different from data required for GHG inventory; production characteristics - lack of data for different feeding regimes; and CH_4 conversion rate - no experimental data on methane conversion factors in China.

Manure. IPCC Guidelines and Good Practices were followed to determine whether Tier 1 or Tier 2 methodologies should be used. Tier 1 sources are horses, mules, donkeys and camels. Tier 2 sources are swine, non-dairy cattle, dairy cattle, buffalo, goats, sheep and chickens.

Populations were determined by province from statistical data, and climate data was based on average conditions for each province. For Tier 1 sources, emissions are livestock population times the appropriate IPCC factors for methane production capacity (based on animal type and climate zone) and N_2O emission factors (based on total nitrogen excreted).

For Tier 2 livestock, volatile solids were calculated according to the energy intake and feed digestibility based on survey data collected on: average weight gain per day, feeding situation, milk production, work hours, etc. Nitrogen excretion by animal was taken from literature sources.

The fraction of each manure stream handled by different management systems was investigated by survey work in each of the representative counties in each province. Only the IPCC defined management systems were modelled. Methane conversion factors were calculated based on provincial average temperatures. IPCC default N_2O emission factors were used for the various animal manure management systems.

Major sources of uncertainty were: animal population – differences were found between surveys and the statistical yearbook data; volatile solids calculation - due to uncertainty in energy intake and digestibility; methane conversion factors from different manure management systems, and differences between IPCC values and Chinese published data on nitrogen excretion rates. Using average climate conditions for each province was another major source of uncertainty.

3.1.4 Immediate Objective 4: Preparation of Forestry Sector Inventory

The project reported two land use categories only: forestry and forest conversions. The category for abandonment of managed land was not estimated, as there is no activity data available, and it is not believed to be important in China.

Data on forested area and land use cover by province was developed from the national statistical data base, but many adjustments were needed to harmonize the data caused by different data category definitions used over the years.

Data on forest type and soil carbon content was collected from about 2500 samples of biophysical parameters, such as wood density, biomass density and forest biomass productivity. Measurements were also made for shrub land biomass: 79 records, bamboo stand biomass: 78 records, litter fall and decomposition rate to develop China-specific emission factors. The 1994 inventory for the land-use change and forestry sector was prepared based on these updated parameters and IPCC 96 Guidelines.

CO_2 emissions from cropland were not estimated because the activity data was very poor and included lots of uncertainty over factors such as residue fractions returned to the soil, and lime applications to fields. This is an important contributor to GHG inventory that needs improved data collection to be included in the next inventory.

Uncertainty in BEF for forests was moderate due to good data collection, but high for trees outside of forest. Uncertainty for bamboo and tree crops was high due to few data points. Uncertainty is high for forest conversion because activity data and emission factors were estimated for the country as a whole, not by province due to past data collection methods.

Adopting the new LULUCF Good Practice Guidelines will be a big challenge because of the increased land use categories (6) and the need to collect land use inter-conversion activity data. More emission factors will be required, which will require a large amount of field work.

As a result of this project, three Chinese experts are lead authors on the 2003 Good Practice Guidance for this sector, and five Chinese experts are lead authors for the 2006 guidelines for the combined Agriculture and Forestry sector.

3.1.5 Immediate Objective 5: Preparation of Municipal Waste Sector Inventory

The waste sector was analysed according to two sub-sectors: CH_4 emissions from municipal solid

waste (MSW) and CH_4 emissions from waste water treatment.

MSW. The inventory of methane emissions from MSW was estimated for seven regions in China using the Tier 1 approach. Annual MSW generation data was taken from the statistical yearbook by major city and province, and these were corrected based on a survey and national expert judgement where visual estimates of weight were recorded rather than actual weight measurements.

MSW was collected from six sample sites for two cities (Chongqing and Shenyang). The site types were a) synthesis of resident, commercial and manufacturing, b) new developing districts, c) old residential districts, d) synthesis supermarkets with foods stuffs, e) modern supermarkets with daily article for use, and f) a landfill with 1000 tons of daily input. The organic waste collected from each site was classified according to six waste types (kitchen waste, paper, rubber and plastic, textiles, wood and straw, and others) and analyzed to determine the proportion of each organic type in the total waste and the degradable organic content (DOC) for each waste type.

The 1996 IPCC guideline DOC equation was used to calculate the overall waste DOC for each city, and the more appropriate of the two data points was used for each of the seven regions. The overall methane emissions from MSW for each region were calculated using the 1996 IPCC guideline equation based on the MSW disposal rate (assumed to be 95%), the DOC value, and the IPCC default methane correction factors for the various waste management types used. The percentages of MSW in each region deposited in each waste management type (managed, unmanaged-deep and unmanaged-shallow) were determined from local and national expert judgement for each region.

Wastewater. The methane emission inventory from wastewater was based on national data on municipal and industrial wastewater generation and COD/BOD values and IPCC default emission factors. Calculations were made for the seven regions, but these were only used as a check on the national calculation.

3.1.6 Immediate Objective 6: Drafting of Initial National Communication and Incorporation into Development Strategies and Processes

China's Initial National Communication consists of seven chapters: 1) National Circumstances, 2) National Greenhouse Gas Inventory, 3) Impacts of Climate Change and Adaptation, 4) Policies and Measures Related to Climate Change Mitigation, 5) Research and Systematic Observation, 6) Education, Training and Public Awareness, and 7) Needs for Funds, Technologies and Capacity Building.

The document was prepared by a variety of expert teams led by NDRC, ERI, CAS, CAAS, CMA, SEPA and Remin University, respectively. The report went through 5 major reviews. The first three reviews were primarily technical in nature and were conducted in workshop settings. The first addressed the overall structure of the report and each chapter. The second addressed the contents and details in each chapter, and the third focused on writing style and editorial changes. A steering committee review was performed before the document was submitted to the NCCCC, which coordinated a review of the report at the ministry level. Finally, the report was reviewed and approved by the State Council. UNDP provided comments at several points in this review process.

The official Initial National Communication was released to the public on 9 November 2004, which is 3 years and 2 months following the project inception in October 2001. The delivery date is 10 months longer than originally anticipated, but given some delay due to SARS, the challenging nature of the technical work, and the complexities of the review process for government approval, this is considered an acceptable result.

A highly professional document was prepared in Chinese, with an English Executive Summary, and this document and the contents of the Initial National Communication were presented at a side event at COP-10 in December 2004.

3.1.7 Immediate Objective 7: Increased Public and Political Awareness and Action Related to Climate Change

Under this sub-project, a nation wide survey for public awareness on climate change was conducted. The surveys were distributed to the 31 sustainable development districts set up by MOST. About 650

surveys were completed.

The survey result indicated that through recent publicity organized by the government and social groups, the public in China is becoming familiar with the issue of climate change. Yet, the level of public awareness on climate change in general is still weak. There is a general concern, but it is not built on a clear understanding of the causes and consequences of climate change. Furthermore, half of the persons surveyed expressed a view of not very optimistic when asked whether mankind can respond/adapt to and cope with the negative influence of climate change. Most of the persons surveyed expressed the belief that government should play important role in the process of climate change mitigation.

The survey questionnaire was distributed through the provincial S&T departments. The educational background of the surveyed persons was probably higher that the general public, and the overall public awareness on climate change in China may lower than the survey indicated. Therefore, raising the public's awareness on climate change will likely be a long-term task.

Training materials on climate change were prepared by well-known experts and officials who participated in climate change convention negotiations, and a includes many aspects of climate change issues such as scientific knowledge, economic and social impacts, vulnerability and adaptation, response policy, international conventions, etc.

A book titled "Global Climate Change -- A Challenge for Humankind" was written by the project team together with experts and published by China's largest publisher. The book aims to provide to the government officials, scientists, teachers and students with a book for their reference when doing study and research on global climate change issues.

A website, China Climate Change Information Network, was built to offers the public information on climate change both in Chinese and English. This is the official site for China's National Climate Change Coordination Committee.

A workshop with experts and scholars was held to prepare a Long-term Strategy for Public Awareness Raising on Climate Change. The strategy proposes objectives, tasks, actions, and implementing steps for raising awareness on climate change.

3.2 Targeted Research Related to Climate Change (CPR/00/G33/A/1G/99)

3.2.1 Immediate Objective 1: Strengthened Capacity for Estimating GHG Emissions of China's Road Transport Sector

The objective of this sub-task was to improve the quality of the road transport inventory by technology and fuel type. Work will not be completed until May 2005 after study tour to India.

This work was closely linked to and supported the road transport portion of the Initial National Communication (INC), and it contributed to the improvement of IPCC Tier 2 guidelines for developing countries in this sector.

Case studies were performed in Beijing and Chengdu to develop methodologies and data for activity and emission factors, and comparative analyses were performed on methodologies for other developing and industrialized countries. The problems are that China has no vehicle stock statistics (especially by type and fuel), no VMT data, and existing vehicles have varying fuel efficiency.

Another problem is that agricultural vehicles in China are used a lot for road transport (75% of the time for 3-wheelers and 90% for 4-wheelers based on survey results).

Vehicle stocks were estimated from data on annual vehicle sale, import and export, which are available and relatively accurate, and estimates of vehicles scrapped. Data methodology gives information on vehicle age distribution and accumulating mileage travelled, which is very important for CH_4 and N_2O inventory development.

VMT data, which exists for commercial vehicles (taxis, etc.) but not other vehicles, was developed by a combination of statistical information, surveys and expert estimation.

Fuel efficiency data development is still very uncertain. Currently, the labelled fuel economy of certain vehicle types that are popular in each vehicle group is used, but this ignores vehicle age, maintenance history and driving regime (urban or rural).

For the INC, the cross-check between the Tier 1 (based on transport fuel consumption) and Tier 2 methodologies was quite reasonable (i.e., road transport accounted for 90% of gasoline consumption emissions and 24% of diesel consumption emissions).

The project investigated ways develop country-specific emission factors for CH_4 and N_2O. This will require training on models, such as MOBILE5 or COPERT 90, special facilities and training on techniques to perform domestic measurements to validate the models, and sensitivity analysis to revise the model parameters as needed.

Vehicle tail-pipe emission tests carried out in both China (and other developing countries) take little consideration on GHG emission. One recommendation is to integrate GHG emission tests into the standard pollutant emission testing.

3.2.2 Immediate Objective 2: Strengthened Capacity for Estimating GHG Emissions and Sinks from Land Use Change and the Forestry Sector

The objectives of this sub-task were soil carbon research, remote sensing and land-use change, and correlation of biomass stocks with remote sensing data.

Field measurements and studies on carbon cycling in forest soils were conducted in four provinces, and these included measurements of forest litter and related seasonal dynamics, decomposition rates of litter above-ground and below-ground, and dynamics of soil organic carbon. Field measurements of GHG emissions by different agricultural soils were made in one province for three management methods: no-till, residue return and fertilizing.

Remote sensing was performed using 270 purchased Landsat TM images for1995-1996 in eastern China. The images covered 25 provinces and 4 million km. The grid resolution of the images is 250m. These images were decoded to develop maps of land use patterns and forest resource for based on the five land classifications: forest, shrubs, grasslands, fields, and waters (rivers, lakes and wetlands). One of the main challenges is the high cost to purchase the Landsat TM images.

Correlation of the main forest types to the remote sensing image data was performed for the Da Gangshan test area in Jiangxi province. This work was successful in forest type identification, but optical remote sensing data is not very good for forest biomass detection because it only reads superficial information. Some dynamics simulations of the change in net carbon stocks were made using the BGC model, but more training is needed.

Studies on soil carbon, and remote sensing biomass detection need to be stable and continued for very long time periods to best contribute to GHG accounting.

3.2.3 Immediate Objective 3: Strengthened Capacity to Estimate GHG Emissions from the Agricultural Sector

The objectives of this sub-task were to strengthen data collection, improve measurement systems and develop appropriate models for the agricultural sector.

CH_4 Emission from Rice Paddies and N_2O Emission from Croplands. The INC used only "no fertilizer" and "normal fertilizer" type fields. Under this TR Project, additional field measurements were taken for fields with no crops and common fertilizer; fields with organic and inorganic fertilizers; and land use change due to crop rotations.

Improvements were made to the CH4MOD model to improve soil modelling for flooding, drainage and intermittent irrigation, increase water management types to five, secretion of rice root, residue additions to soil, environmental factors, and bubble formation. The CH4MOD model was validated against 94 data observations cases representing all the main rice production regions, a time span of cases from 1988 to 1999, flooding, drainage, moister water management types, organic fertilizer use ranging from 0 to 10 t/ha, soil sand components from 2.0% to 80%, and a variety of field rotations: fellow-rice, winter-flooding-rice, wheat-rice, rape-rice-rice and green manure-rice-rice.

The IAP-N model was developed and makes the following improvements over IPCC methodology: nitrogen deposition from residue burning, bio-fixation from rice, NOx and NH_3 emissions from rice paddies and uplands, emissions factors for nine categories of crop lands that vary by region, and three categories of croplands for leaching and runoff.

Still inventory uncertainty is high because most emission factor data is from references and has low measurement frequency, few measurements during the non-growing season, few non-fertilized control measurements, and little inter-annual data collection.

Database improvements were made through survey work in representative counties in each province for nitrogen content in chemical fertilizer and manure. Large variations exist between different region of China, and some survey data appears higher than the statistic data.

CH4 and N2O Emission from Livestock and Manure Management. This sub-task established a livestock database with animal populations in 1994 and 2000 for more than 3000 counties. The database also contains live weight, weight gain per day, characteristics of over 500 feed types for pigs, cattle and sheep, and feed intake data from 116 representative counties.

Data was also collected on the percent utilization for the 10 IPCC default animal manure management systems by survey from 62 representative counties (2 or 3 in each province.) Measurements were made of CH_4 and N_2O emissions from a chicken manure compost box, from a pig manure compost pile, a digester, and from grazing animals.

CH_4 emission measurements for enteric fermentation were made for dairy cattle and yellow cattle by both chamber and tracer methods. The measurements compare well to similar measurements made in other countries. Measurements were also made for several feed types, rough-feed ratios and energy intakes. The results indicate that the impact of feed type is greater than the rough feed ratio, which is greater than that of energy intake.

Models for CH_4 emission from enteric fermentation and animal manure management systems were developed based on IPCC methodologies with some modifications for China-specific feed, energy equation, livestock management and agricultural practice, and manure management systems.

4. PROJECT RESULTS

The inventory of GHG emissions and absorptions (sinks) in China for the year 1994, as presented in the INC, are shown in Table 2 according to the actual emissions of the three gases studied. The relative contributions from each GHG, when converted to CO_2 equivalent using the 100 year global warming potentials, are shown in Table 3.

Table 2: 1994 Inventory of Greenhouse Gases Emissions in China

Sources of Emissions & Absorptions of Greenhouse Gases	Carbon dioxide (10^3 tons)	Methane (10^3 tons)	Nitrous oxide (10^3 tons)
Total net emission (10^3 tons/year)	2,665,990	34,287	850
1. Energy	2,795,489	9,371	50
Burning of fossil fuel	2,795,489		
Burning of biomass (for the purpose of utilizing energy)		2,147	
Emission from oil & gas system		124	
Emission from coal mining		7,100	
2. Industrial processes	277,980		15
3. Agriculture		17,196	786
Animal enteric fermentation		10,182	
Growth of paddy-rice		6,147	
Animal wastes management		867	155
Farmland soil			631

4. Forestry	-407,479		
Changes in the storage of forests and other wood biomass	-431,192		
Transformation of forests & grassland	23,713		
Abandoned farmland	Not estimated		
5. Municipal waste		7,720	

Table 3: Proportions of Emissions in 1994 According to GHG Potential

Greenhouse gas	Emission amount (10^3 tons)	Global warming potential	Carbon dioxide equivalent (10^3 tons)	Proportion (%)
Carbon dioxide	2,665,990	1	2,665,990	73.05
Methane	34,287	21	720,027	19.73
Nitrous oxide	850	310	263,500	7.22
Total			3,649,517	100.00

The tables show that the energy sector accounts for over 76% of all CO_2 emissions and over 82% of all GHG emissions. The industrial sector accounts for about 7.6% of each type of emission, and the agricultural sector, which has no CO_2 emissions, contributed over 16% of the total GHG emissions. The waste sector also has no CO_2 emission and contributes just over 4% of the total GHG emissions. The forestry and land use change sector absorbs about 11% of the CO_2 emissions. These proportions, coupled with their relative uncertainty will help to prioritize the areas which deserve the most attention for future inventory work.

4.1   Relevance of the Project Results to the National Development Priorities

The INC addresses more than the national inventory of GHG emissions. It also identifies current observed impacts of climate change, and it enumerates the policies and measures that the Government of China has implemented to date that have an impact on climate change. As a result of the process of developing the INC, many ministries within the government reviewed programs, policies and goals for economic development, sustainable development, energy conservation and efficiency, renewable energy, aforestation and reforestation, urban sanitation and municipal waste, and comprehensive utilization. It is believed by many of the ministry representatives interviewed that both the process of developing the INC and the final product are highly relevant to the national development priorities and will likely have a strong positive impact.

4.2   Contribution to Formulation of a National Climate Change Strategy

An outline of China National Strategy on Climate Change has been drafted with assistance of the Norwegian Government and UNDP, and its full development is under discussion. It is not clear at this time to what degree the project results will have on the development of a national climate change strategy for China. However, the results are highly relevant to that process. The national emissions inventory provides an official baseline for measuring changes in emissions as a result of possible policies. The climate change related policies and measures are the building blocks for the development of an integrated climate change strategy for China, and the needs for improved education, training and public awareness are highly relevant to the effectiveness of any climate change strategy that is developed. Furthermore, the requirements for research and systematic observation are essential to determining local and regional climate change impacts and to the assessment of vulnerability and adaptation strategies. Therefore, the results of this project are likely to have a significant impact on the formulation of a national climate change strategy.

4.3   Effectiveness Applying IPCC Methodologies and International Best Practices

The methodologies and data used to develop the national GHG inventory for the INC are discussed by sector in Table 4. The project teams were generally quite effective in understanding the IPCC Guidelines and Good Practices, and in most cases, they modified the methodologies and data handling techniques to better represent the actual situation in China. In a few cases they made significant

improvements to the recommended IPCC approaches.

For the energy sector, the most significant improvements over past calculation involved the development of methodology for calculating emissions by vehicle type and fuel; the collection of data on the carbon content and heat value for different categories of coal; and the collection of activity data, emission factors and oxidized fractions by sectors, devices and fossil fuel forms. Data was also collected on emissions of fugitive methane from coal mines and the oil and gas sector. For biomass combustion, CH4 emission factors were developed for cook stoves, but not for kilns.

For the industrial process sector, a significant methodology improvement adjusted CO_2 emissions for the effects of both calcium oxide and magnesium oxide content in the clinker and lime product. In addition, data surveys and some measurements were made of enterprises producing cement, lime, calcium carbide, iron & steel and adipic acid.

For the agricultural sector, significant methodology improvements were made with the development of the CH4MOD model for CH_4 emission from rice parries and the IAP-N model for N_2O emissions from cropland. In addition, models of CH_4 emissions from enteric fermentation and animal manure management systems were developed using the IPCC methodology with some modifications for China-specific data. Survey data was collected from 2-3 counties in each province, and field measurements of CH_4 emission factors were collected from two provincial observation centers.

For the forest and land use change sector, maps were developed of land use patterns and forest resource based on remote sensing Landsat TM images. Preliminary correlations were made of the remote sensing data and biomass stocks, and data was collected on forest type and soil carbon content from about 2500 samples. Measurements were made of shrub land biomass, bamboo stand biomass, litter fall and decomposition rates to develop China-specific emission factors, and field measurements and studies were conducted of carbon cycling in forest soils in four provinces.

For the waste sector, MSW samples were analyzed from only two cities to determine degradable organic contents. Further work is needed in this sector.

Table 4: Improvements/Impacts of INC and TR Support Projects for GHG Emission Inventory Development

Sector	Sub-sector or Activity	Methodology	Data Collection / Data Quality
Energy	Fossil Fuel Combustion	- The combination of top-down reference approach and bottom-up sector approach useful for climate change policy making, especially for mitigation consideration - Establishment of database for emission inventory	- Data collection and investigation of carbon content and heat value for different categories of coal produced in China - Collection of activity data, emission factors, oxidized fractions by sectors, technical devices and fossil fuel forms in terms of different investigative approaches - Data collection and investigation of efficiency and oxidized fraction for boilers in power, heat, industry and other sub-sectors by capacity, technology and coal type - Recommended improvement to energy balance table to facilitate calculation of the CO_2 emission inventory
	Transportation	- Methodology developed for emission calculations by vehicle type and fuel - Investigated models to develop country-specific emission factors for CH_4 and N_2O	- Data sources developed for vehicle stocks, activity levels, and emission factors by type of vehicle - Recommended improvement to energy balance table to better identify for transportation fuels
	Coal Mining & Post-Mining	- Methodology applied is a hybrid of Tier 2 and Tier 3 IPCC approaches whereby the activity data and emission factors are determined separately for three types of coal mines	- Data collection and investigation of coal production and CH_4 emission factors for state-owned coal mines - No emission factor data for TVE coal mines
	Biomass Combustion	- Methodology applied is a hybrid of Tier 1 and Tier 2 IPCC approaches	- Improvement estimation of data on biomass use - Used expert measurements for CH_4 emission factors for cook stoves with stalk and firewood fuels
	Oil and Natural Gas Systems	- Methodology applied is a hybrid of Tier 1 and Tier 2 IPCC approaches whereby the activity data and emission factors were determined separately for oil and natural gas production processes	- Activity data was developed from industry data and fugitive CH4 emission factors were derived from IPCC default values and international data
Industry	Cement Lime Iron & steel Calcium carbide Adipic acid	- Used clinker production as activity level not cement production - Adjusted CO_2 emissions for the effects of both calcium oxide and magnesium oxide content in the clinker and lime product - Higher tier methods adopted to the extent possible in accordance with China's specific situation in the estimation of emissions from cement, lime and adipic acid production	- Data surveys of enterprises for cement, lime, calcium carbide, iron & steel production - Measurements at all 5 adipic acid plants in China - Measurements on samples of cement clinker to verify the survey results - Database developed for the 5 sub-sectors
Agriculture	Methane emission from rice paddies	- Developed improved CH_4 emission model (CH4MOD) based on IPCC methodology with high spatial resolution (10km x 10km) - CH4MOD model contains four paddy types, various soil types and five crop rotation types - Validated model using about 94 measurement cases	- Collected county-level data on harvest areas, production levels, soil types, climate data, time of rice transplanting, etc. - Collected activity data by survey from 2-5 counties in each province on fertilizer use, residue returns, water regime, etc. - Collected field measurements of CH_4 emission factors from observation centers in Wuxi (Jiangsu) and Yanting (Sichuan) - Developed database and high resolution GIS model for emission calculations

Sector	Sub-sector or Activity	Methodology	Data Collection / Data Quality
	N_2O emission from cropland	- Developed regional scale nitrogen balance model (IAP-N) based on expanded IPCC methodology - Applied IAP-N to six region types using nine cropland-type emission factors and regional-based survey data - Applied Monte Carlo methods to determine the uncertainty in N_2O emission factors - Estimated indirect emission from field burning using IPCC methodology and default emission factors	- Quantified N_2O emission factors from 54 field sites at 12 observation centers covering 9 provinces of China - Collected province-level activity data for harvest area and production of 18 categories of crops, fertilizer use and rural population - Collected survey data for ratio of residues returned to field, ratio of residues field burning, and supplements of manure fertilizer in representative counties in each province
	CH_4 emission from enteric fermentation	- Used IPCC methodology to determine Tier 1 (horses, mules/donkeys, camel and swine) and Tier 2 (dairy cattle, yellow cattle, buffalo, sheep and goat) livestock - Developed three Tier 2 sub-categories (breeding, growing and young) and two management systems (pasture grazing and residue feeding) - Developed a model of enteric CH_4 emissions based on IPCC methodology with modifications for China-specific feed, energy equation, management system and agricultural practice	- Livestock populations were determined from statistical data - Conducted surveys in 2 or 3 representative counties for 28 provinces to determine and animal productivity, feed characteristics and daily feed intake for each Tier 2 livestock type - Measured enteric fermentation emission factors for dairy cattle and yellow cattle for several feed types, rough-feed ratios and energy intakes - Developed a livestock database and spreadsheet calculation model with animal populations, live weight, weight gain per day, feed characteristics and feed intake for 1994 and 2000
	CH_4 and N_2O emission from animal manure management	- Used IPCC methodology to determine Tier 1 (horses, mules, donkeys and camels) and Tier 2 (swine, dairy cattle, yellow cattle, buffalo, goats, sheep and chickens) animals with 10 manure management systems - Calculated methane conversion factors based on annual average temperature by province - Developed a model of CH_4 emissions based on IPCC methodology with modifications for China-specific data	- Collected survey data on average weight gain per day, feeding situation, milk production, work hours, etc. to calculate volatile solids - Collected survey data on utilization of IPCC default animal manure management systems from 62 representative counties. - Measured CH_4 and N_2O emissions from a chicken manure compost box, from a pig manure compost pile, a digester, and from grazing animals. - Nitrogen excretion by animal was taken from literature sources
Forestry	Land use database Soil carbon database Biophysical parameters	- Reported two land use categories only: forestry and forest conversions - Estimated CO_2 emission from burning forest slash - Analyzed remote sensing Landsat TM images for 1995-1996 in eastern China - Decoded images to develop maps of land use patterns and forest resource based on the five land classifications: forest, shrubs, grasslands, fields, and waters (rivers, lakes and wetlands) - Correlated remote sensing data and biomass stocks - Investigated dynamics simulations models to calculate the change in net carbon stocks	- Harmonized the historic statistical data base to determine forested area and land use cover by province - Collected data on forest type and soil carbon content from about 2500 samples of biophysical parameters, such as wood density, biomass density and forest biomass productivity - Measured shrub land biomass, bamboo stand biomass, litter fall and decomposition rates to develop China-specific emission factors - Conducted field measurements and studies of carbon cycling in forest soils in four provinces - Conducted field measurements of GHG emissions by different agricultural soils in one province for three management methods: no-till, residue return and fertilizing

Sector	Sub-sector or Activity	Methodology	Data Collection / Data Quality
Municipal Waste	CH_4 emission from MSW	- Used IPCC Tier 1 approach - Estimated emissions for seven regions in China	- Corrected MSW activity data from statistical yearbook - Analyzed waste sample from two cities (Chongqing and Shenyang) to determine degradable organic contents - Used local and national expert judgment to estimate disposal rates to IPCC waste management types
	CH_4 emission from waste water treatment	- Used IPCC methodology and default emission factors value	- Used national statistics data on municipal and industrial wastewater generation and COD/BOD values

4.4   Adequacy of Steps to Address Vulnerability and Adaptation

Project Document CPR/00/G31, Enabling China to Prepare Its Initial National Communication, did not explicitly state in its overall objectives the performance of vulnerability and adaptation (V&A) assessment. It was subsumed under Immediate Objective 6, which was to develop a description of the general steps to be taken by China to implement the UNFCCC. Therefore, no relevant study activities were carried out under this project regarding actual vulnerability and adaptation assessments.

Chapter 3 of the INC addresses Impacts of Climate Change and Adaptation. This chapter discusses the vulnerability of China to the threats of climate change as demonstrated by the current (observed) and predicted impacts in four of its important economic and resource sectors: agriculture, water resources, coastal resources and terrestrial ecosystem. Information was mostly sourced from existing databases (such as the IPCC Distribution Center) and published literature. This assessment of the impacts is understandably preliminary as no focussed activities were undertaken in this area.

This chapter of the INC involves mostly effects on biophysical systems, with less consideration of the impacts in the human dimensions such as water needs, risk assessment, settlements, health and food supply, among others. Climate scenarios specify changes in means in temperature and precipitation, and do not assess changes in extremes, in relation to the climate variability part of climate change. Relative to future needs for adaptation assessment, the use of climate scenarios can be limiting unless they are used to explore sensitivities.

Because V&A assessment was not a part of either the INC Project or the TR Project, what was presented is an *ad-hoc* list of possible adaptations without evaluating and prioritizing them. In the future, a strategic adaptation framework of policy interventions should be developed in the national context of social, environmental and economic circumstances. A key challenge will be the prioritization, harmonization and integration of adaptation to climate change within the normal business of sustainable economic development[1].

4.5   Capacity Building

4.5.1   The National Coordination Committee on Climate Change

Representatives of the Members of the NCCCC interviewed for this evaluation consistently expressed a high degree of satisfaction with the results of these projects and the process undertaken to prepare and submit the INC. Specifically, those members that participated in the drafting and review of the document expressed appreciation for the capabilities, expertise and knowledge developed by the various national participants.

The China Meteorological Administration, which was responsible for drafting Chapter 5, Research and Systematic Observation, expressed a deepened appreciation for the complexities and need for better understanding of climate change issues. These projects helped them to better formulate the requirements for a China Climate Observation System (CCOS) and understand the need for an Integrated Assessment Model to better assess vulnerability and adaptation strategies. They further recognized that these strategies needed to be coordinated and integrated with mitigation, environmental protection and sustainable development strategies.

The Ministry of Civil Affairs leads the China National Committee for Disaster Reduction, and they would like to see regional case studies based on CCOS and vulnerability and adaptation modelling. Such analyses and strategies would directly support the national disaster alleviation center they recently established.

The Ministry of Finance noted that the review process for the INC helped to enhance the understanding of government policy makers and support improved cooperation between various governments ministries involved in various aspects of climate change.

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[1] See Preliminary Report of the Consultative Group of Experts on National Communications from Parties not included in Annex I to the Convention (FCCC/SBI/2001/8, July, 2001).

The Ministry of Foreign Affairs expressed the belief that the information developed by the INC will help in the process of formulating a national climate change strategy, and will also help shape policy on mitigation, adaptation and sustainable development.

The Ministry of Science and Technology noted that the review of the INC was the first time that all elements of the government interacted on climate change policy and activities, and the process has clearly raised the level of awareness.

4.5.2 Relevant Government Agencies

More that 100 institutions and 400 experts were directly and indirectly involved in the process of preparing the INC. The institutions reviewed and assessed the methodologies used by the previous inventory studies; studied the recommended methodologies from the IPCC Guidelines for National GHG Inventories; held training workshop on IPCC Guidelines, Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories; and finally, they developed methodologies for China's GHG emission inventory.

These institutions and experts collected data from the national statistical systems; conducted surveys of activity data and emission factors for energy, industrial processes, agricultural and waste sectors; performed field measurements of emission factors and parameters for determining emission factors; consulted with international experts on activity data and emission factors; assessed data quality; and designed models and databases.

The two projects (especially the INC Project) held a large variety of workshops (about 80) for project inception; training on methodology issues, data collection and public awareness; and government and expert reviews. The total number of participants was over 1750. In addition, national experts attended international training workshops, international study tours, and international conferences.

As a result of all this capacity building, expert working teams were established in each sector with experience, expertise and international contacts and exposure. Several China-specific methodologies were developed, more accurate activity data and emission factors were collected, and databases and calculation tools were created.

4.6 Impacts

4.6.1 To Achieving the Millennium Development Goals and the "Xiaokang" Society

In China, the goal of "Xiaokang", or building a relatively prosperous society, conforms to both the objectives of the MDGs and that of increasing the capacity of the people to adapt to the adverse impacts of climate change. In Chapter 3, the Initial National Communication presents a preliminary assessment of climate change vulnerabilities to four major economic and environmental sectors of China. In Chapter 4, the INC discussed policies and measures related to climate change. These chapters address two important areas: the environmental protection and sustainable development, which are exactly part of the MDGs and Xiaokong.

In the longer term, V&A assessment is very relevant in the pursuit of the Millennium Development Goals (MDGs), especially those directly concerning about responding to the vulnerabilities of the human and ecological systems. For adaptation measures and strategies to be mainstreamed into the development pathway, policies must support their implementation. The MDGs in the national context must also have the institutional and policy infrastructure to sustain the commitment to achieving them.

4.6.2 On Other UNDP/GEF National Climate Change Projects

These projects, even take together, are relatively small compared to other GEF climate change related projects in China. However, the synergies between these projects and others in China, national, GEF and bilateral, have been significant. These projects benefited from more than 30 nationally-funded thematic research projects. These GEF projects also had important impacts on the nationally-funded projects, because they made many different researchers and research organizations work together in a coordinated manner.

The other GEF-funded climate change projects provided input to the preparation of the INC, specifically to the Chapter 4, Policies and Measures Related to Climate Change Mitigation. Other

potential impacts will be the use by the ongoing projects of the GHG inventory and other information in the INC.

4.6.3   Informing the International Community about China's Climate Change Mitigate Efforts

Representatives of the NCCCC presented the contents of the Initial National Communication during a side event at COP-10 in December 2004.   Based upon the comments received at that time, the ministry representatives interviewed believe that the INC made a strongly positive impression on the members of the international community.

4.6.4   Raising China's National Awareness of Environmental Issues

Specific awareness on climate change in China is weak. Based on the survey work performed, the INC project concluded that there is a general concern, but it is not built on a clear understanding of the causes and consequences of climate change. Training materials on climate change were prepared and a training workshop held in Beijing.   A comprehensive book on global climate change was written and published, and the official China Climate Change website was built.   While these are important tools, the projects were only able to scratch the surface of the problem of raising national awareness of climate change specifically and the environment generally.

A workshop to prepare a Long-term Strategy for Public Awareness Raising on Climate Change helped to increase understanding of climate change issues with a broad range of policy makers in Beijing, and the preparation of the INC resulted in a significant increase at the national government level in climate change awareness. At the national level, there is also awareness of the role that the GEF plays in addressing climate change issues. However, it would appear that these projects have done little to raise the level of awareness in provincial and local leaders, or in the public as a whole.

4.7   Sustainability of the Expertise and Capabilities Developed

The development of a national GHG inventory is a complicated and continuous activity requiring special scientific knowledge in a wide variety of fields. Sustaining the personnel and organizations engaged in the various aspects of this activity requires that they have continuity and stability for their mission and the funding support to carry it out.

Through these projects, a significant number of experts and institutions have become knowledgeable regarding the process of preparing a national communication and a national GHG inventory.   In addition, they have become acquainted with leading international experts in their fields, and several of them have been given lead author positions in the development of future IPCC guidelines.

Sustaining this individual and institutional expertise will not happen by itself, and the specific actions are needed to support the maintenance and further development of the expertise and capabilities developed by these projects. The following actions for accomplishing this are envisioned:

1. The NCCCC should designate a single institution with coordination responsibility regarding the further development, maintenance and quality control of the national GHG inventory. Other institutions with specific expertise should continue to manage and maintain the various databases that have been developed through these projects, and thereby support and develop their experts.   The coordination organization would have overall responsibility for quality assurance and maintenance funding.

2. Funding support should be provided to facilitate continued international collaboration on the part of the Chinese experts that have been chosen for lead positions in the development of new IPCC guidelines.

3. As much as possible, the processes of data collection and quality control should be regularized through improvements and additions to the national statistical system and index. These projects made recommendations to the National Bureau of Statistics (NBS) for such improvements, which provides a starting point for this work.

4. Funds and technical support from the international community are very necessary to provide the equipment and improve the capability of performing scientific measurements to determine

emission factors and other related parameters, such as device-related biomass combustion characteristics, soil types and fertilizer use in rice paddies, animal feed characteristics, forest biomass quantities, soil carbon contents, etc.

5. CONCLUSIONS

5.1 Improvement of National Capacity to Measure and Monitor China's GHG Emissions

As addressed in more detail in Section 4.5, these projects have made a significant contribution to capacity building for establishing the methodology and database framework for developing a national GHG inventory.   Expert working teams have been established in each sector of the inventory with experience, expertise and international contacts and exposure, and several China-specific methodologies were developed that have broad applicability to other developing countries.   Finally, three Chinese experts have been selected as lead authors for portions of the 2000 IPCC guidelines, and five Chinese experts have been selected as lead authors for portions for the 2006 IPCC guidelines.

In addition, measurement and monitoring systems have been established or expanded at research centers for several of the lead institutes, and this capacity to perform measurements of emission factors and other related parameters provides a solid basis for continued measurement and monitoring work.   Finally, databases have been developed in all sectors that provide a starting point for performing future inventory calculations and for regularizing the inventory development process.

The TR Project made important contributions to the development of the national inventory in the INC, especially in the agriculture sector. However, this project's primary role was strengthening capacity in support of future national GHG inventory work.

5.2 Adequacy of the Methodologies Adopted for the INC

5.2.1 National GHG Inventory

As discussed in more detail in Section 4.4, the projects were quite effective in applying the IPCC guidelines and methodologies and in incorporating international best practices to develop the 1994 national GHG inventory for the INC.   In summary, all the methodologies met the minimum requirements of the IPCC Guidelines and Good Practices, and in many cases, the methodologies and data collection techniques were significant improvements over the IPCC recommendations.

5.2.2 Public Awareness

The INC project made an effective start on expanding public awareness of climate change, but the survey work indicated that the current level of awareness is low and that a significant and sustained program will be required to developing broad public understanding of climate change, its potential impacts, government-related policies, international programs and potential personal choices.   The training materials, book and website are valuable tools that will need to be further utilized and expanded upon in the future.

5.2.3 Vulnerability and Adaptation

As stated in Section 4.5.2, the general steps to be taken by China to implement the Convention in terms of describing the vulnerability to climate change is not sufficient and the strategies to be taken for its adaptation unstructured. These gaps need to be filled in the Second National Communication.

Climate change, though a global phenomenon has very localized impacts. China is a big country with distinct regional differences.   As such, detailed vulnerability assessment, for example either by geographical location or by sectors, needs to be done for adaptation strategies to be meaningful. Current and future vulnerabilities have to be considered, not only biophysical impacts but also on socio-economic considerations. It is important to provide a synthesis of the current state of knowledge, and to stress that vulnerability and adaptation assessment is an ongoing process. The information provided should be relevant to China's needs and priorities with respect to adapting to current and

future climate variability and change. In relation to this, vulnerabilities to current climate variability and future climate change on specific human systems, areas or sectors that are most critical, must be presented. A review or assessment of the difficulties or barriers to adaptation in critical areas or sectors, together with opportunities and priorities for adaptation should be set.

There are many opportunities in China where adaptation to climate changes can be successfully linked or integrated. China's Agenda 21 on Sustainable Development presents itself as the launching pad of many programs and policies where adaptation to climate change can be integrated. China has many environmental and energy laws, policies and regulations that have direct or indirect bearing to increasing the adaptive capacity of the human and natural systems. In as much as uncertainties cannot be totally eliminated, identified adaptation strategies and measures should always follow the precautionary approach.

5.3   Effectiveness of the PMOs and Project Steering/Advisory Committees

The impression of the review team is that the PMOs for both projects were well organized and performed their functions adequately. This impression is based on the quality of the project deliverables as presented to the team, the quality of the sub-project reports prepared for the evaluation process, and the overall efficiency with which the evaluation process was managed and coordinated.

This impression was confirmed in the discussions with the various government ministries that participated in the review of the INC. All of these organizations expressed satisfaction with both the process of preparing the INC and with the final result. They also expressed appreciation for the open and efficient manner in which the PMOs managed the process.

As best the review team can tell from reviewing meeting notes and from discussions with the project managers, the Project Steering Committees were quite helpful in review and guidance to the project teams on management measures, progress reviews of the interim results by each subcontract team, and a discussion of the draft INC report before it was submitted to the NCCCC.

6.   RECOMMENDATIONS

Two sets of recommendations are provided. The first set of recommendations (contained in Sections 6.1 to 6.3) pertain to work needed in support of preparing China's Second National Communication. The second set of recommendations (contained in Section 6.4) pertain to future-looking target research aimed at helping China improve its capabilities to develop effective climate change strategies that will address mitigation, V&A and sustainable development.

6.1   Capacity Building for Inventory Compilation

For developing the national GHG inventory for the Second National Communication, two aspects of capacity building should be considered: research study and routine work. Research study mainly includes development and improvement of methodologies and models, data surveys and field measurements, model verification, quantifying uncertainties, etc. This aspect of capacity building should be structured to coincide with the recommendations below under Improvements to Methodology and Data Quality.

The routine work mainly includes data collection and processing, periodic checks of field measurements, maintenance of databases, compilation of inventory, quality assurance and quality control, reporting validation and verification, etc. For the preparation of the national inventory for the Second national Communication, a high priority should be given to capacity building to convert the process into a systematic and routine activity.

To accomplish this goal, two elements of should be incorporated into the project design. First would be to institutionalize the further development, maintenance and quality control of the various databases that have been developed through these projects. While the sectoral databases may be maintained by separate institutions with specialized expertise, one organization should have overall responsibility for coordination and quality assurance.

Second, the national statistical system and index should be improved to support the compilation of the national GHG inventory. These projects have already made recommendations to the National Bureau of Statistics (NBS) for improvements to the national statistical system, and these should form a starting point for this work. However, active involvement of the NBS in the project for the Second National Communication should be considered as essential to development of the capacity for routine compilation of future national GHG inventories. Specialized data collections systems should be established where using the national statistical system is not appropriate.

6.2 Improvements to Inventory Methodology and Data Quality

6.2.1 Energy

China's energy statistics system does not include the activities index related to fuel combustion by device in the end users sub-sectors, which would be the essential factors to the CO_2 emissions and be meaningful to policy study. The current categorizing of sectors is in terms of the enterprise dominant economic activities. But the economic activity sectors often mismatch the energy sector category. For example, iron and steel making is a significant economic activity category. But, the energy consumption of iron and steel making enterprises includes their transport activities and in many cases fuel use for co-generation of heat and power. To properly develop the GHG emissions inventory and to support proper planning of GHG mitigation strategies, the transport and fuel consumption activities within the iron and steel making enterprises should be accounted in the transport and energy conversion sectors, respectively. The national energy balance table should be reformed to make the appropriate match between energy sector categories and economic activity categories.

For the GHG emissions inventory related to road transport activities, the Tier 1 approach based mainly on apparent transport fuel consumption provides a simple and direct method for accounting the CO_2 emission. But in the current energy balance table, the apparent transport fuel consumption only accounts for transport service enterprises and does not include other transport fuel consumption such as that related to industrial activities. The national energy balance table should capture all transport fuel consumption under one category.

The TR Project focussed on the Tier 2 approach, which is more meaningful for policy making and scenario development, and is needed for accounting for CH_4 and N_2O emissions from vehicles. However, this approach is very complex and depends on data collection of activities levels and vehicle emission factors that have large uncertainty, especially for CO_2 emission accounting. While it is important that this effort be continued for the second national communication, high priority should be given to the accurate and regularized calculation of apparent transport fuel consumption.

Other areas where better data collection is needed are: 1) measurements of CH4 emission factors from small and medium coal mines, 2) measurements of biomass use for energy, and development of CH_4 emission factors from kilns and cook stoves.

6.2.2 Industrial processes

These projects lead to a significant improvement in emissions accounting from the major industrial processes. Through verification and comparison between the Tier 1 approach and disaggregated enterprise sampling, the Tier 1 approach based on national production amounts appears suitable to accounting CO_2 emission with acceptable uncertainty. For the second national communication, it should not be necessary to calculate CO_2 emissions from these five industrial processes by disaggregated enterprises sampling.

However, more industry sub-sectors, for example nitric acid, non-ferrous metals, and building materials, should be included, and additional industrial gases (HFCs, PFCs and SF6) should be included as encouraged by the new UNFCCC guidelines. The industrial processes inventory is the sector that will be most affected. Specific capacity building efforts will be needed to obtain activity data and emission factors for the new sectors and gases.

6.2.3 Agriculture

These projects have made significant contributions to the determination of agricultural GHG emissions through development of sub-sector models. Future efforts should focus on expanded field

measurements of data underlying these models.

For CH_4 emissions from paddy rice fields, more measurements of emission factors of winter-flood paddy fields are needed to better represent the different climatic regions, cropland types and field management practices. In addition, more data is needed to better characterize soil types, chemical fertilizer use, supplemental manure fertilizer additions, as well as water management practices and different rice varieties.

For N_2O emissions from cropland, additional data is needed to better represent different climatic regions, cropland types and field management practices. In addition, longer-term measurements of direct emission factor from the various cropland types are needed. In addition, measurements of the indirect emissions from croplands and from residue burning are warranted.

While the IAP-N model is a significant improvement to the IPCC emissions calculation process, it is a balance model that operates on a regional basis using average process characteristics for each region. Converting IAP-N to process model would provide greater spatial resolution and allow temperature and precipitation impacts to be directly modeled.

Regarding CH_4 emissions from enteric fermentation in livestock, more data collection and analysis is needed to better characterize feed quality and quantity, and both lab tests and field measurements are needed to develop China-specific CH_4 conversion rates and emission factors. This data should be collected on a regional basis to assess the impact of China-specific feed technologies and livestock practice.

Regarding CH_4 and N_2O emissions from animal manure management systems, more work is needed to define and determine the usage of China-specific manure management systems and to measure the methane emission factors from these systems by climate zone. This work will support improvements to the current models for livestock and manure management systems.

The livestock populations as well as livestock feed quality and quantity are important components to the GHG calculation in the agricultural sector. Useful improvements to the China Statistics Yearbook would be to include new statistical indices that provide livestock population data according to the size categories used in the inventory. The long-term objective would be to support the generation of these parameters, which would be periodically verified by sampling measurements, through routine statistics work.

6.2.4   Forestry

Improvements are needed in this sector in three specific areas: 1) monitoring the forest area and land use change, and 2) estimating the forest biomass and carbon stock above ground, and 3) measuring soil carbon contents in relation to land use changes.

The TR Project demonstrated the value of using remote sensing data to recognize forest and land use types and their changes. The remote sensing methodology should be combined with the National Land Use Pattern Monitoring System to develop a feasible and reasonable tool for routine work of accounting changes in forests and land use. One of the important support requirements for preparation of the SNC will be to defray the high cost of purchasing remote sensing Landsat TM images.

Utilization of the remote sensing image data was not very good detecting forest biomass stocks because it only reads superficial information. Therefore, it will be necessary to conduct more field research surveys in a few representative provinces to develop better correlations with forest biomass data. In addition, models that perform dynamics simulations of the change in net carbon stocks should be investigated further and used in coordination with the field measurements and remote sensing data.

Additional work to determine soil carbon contents is critical given the large amount carbon deposited in many soils. In order to support the national CO_2 emission inventory it will be necessary to expand the number of field research centers to include soil carbon from croplands, develop provincial activity data for forest conversion, and develop more China-specific emission factors, particular soil carbon related factors.

Additional capacity building will be needed in this sector to support adoption of the new GPG-LULUCF methodology, which increases the number of land use categories to six and requires the collection of a lot more land use inter-conversion activity data. In addition, more emission factors will be required, which will require a large amount of field work.

6.2.5 Municipal waste

Regarding CH_4 emissions from MSW disposal, significant work is needed to improve the MSW sampling analysis. Waste samples from at least two representative cities (one large and one small-medium) should be taken and analyzed in each of the 7 regions. In addition 3 to 5 landfills should be chosen for monitoring methane emission over a several-year period, and using the Tier 2 methodology these results should be compared with the results generated by the Tier 1 approach.

For CH_4 emissions from wastewater, improvements to the database should be made through sampling analysis of wastewater and COD/BOD by region and industry type. Measurements of conversion factors for different disposal methods should be considered in a following phase.

The national statistics survey should be upgraded to include an index for MSW generation, management systems and composition in support of the national accounting of GHG emissions.

6.3 Public awareness

Public awareness of climate change issues in China is weak, and while the INC project developed valuable tools for raising the level of awareness, a significant and sustained program is required to develop broad public understanding of climate change, its potential impacts, government-related policies, international programs and potential personal choices. Some of the remaining funds in the INC Project should be used to continue public awareness activities. These should highlight the INC submittal and its importance to China's climate change strategy and sustainable development needs.

In particular, the SNC support project should have the goal of developing programs that can be sustained after that project is completed. These programs should focus on three specific sectors of the general public:

1. Communication to the general public of the central government's climate change strategy and the synergies of this policy to the countries strategies for sustainable economic development. One of the foundations of this synergy is comprehensive utilization, the scientific theory for how China will achieve more economic output with less material inputs. This is essential to meeting the government's goal of quadrupling GDP by 2020. Part of the message to the public should be how individuals can contribute through their own actions to achieving this goal.

2. Raising the awareness of provincial and local leaders of the potential regional and local impacts of climate change and the need for their full cooperation and support of the central government policies for mitigation and adaptation. The results of an expanded V&A assessment will be central to this program.

3. Generating awareness of China's growing business community of the economic benefits of being on the "right" side of the climate change issue. As public awareness grows, and as climate change impacts become more apparent, being a "climate leader" can be promoted as being good for business.

6.4 Projections of Future GHG Emissions

The Government of China needs to understand the likely impacts of a broad range of social and technological policies on potential emissions of GHGs in the future. A focussed capacity building activity is needed to support the development of methodologies and models for forecasting energy demand and GHG emissions that would allow the evaluation of possible policies for sustainable economic development and climate change mitigation and would provide input to the V&A assessment.

6.5 Targeted Research for Vulnerability and Adaptation Assessment

China has significant potential vulnerabilities to climate change. In conjunction with the preparation

of the Second National Communication, a targeted research project should be pursued to increase capacity to better assess the impacts of climate change on the key vulnerable sectors/areas and its possible effects of non-climatic changes (e.g. human health, human settlement, socio-economic disruption, and the environment). The information developed would provide a basis for the initial development of adaptation strategies that would build on and strengthen activities that are already ongoing. The project should include capacity building and institutional strengthening and a component regarding public awareness, education and information dissemination. The priority research topics should be to:

a) Support for the design of a China Climate Observation System (CCOS) that can provide regional specific data on climate changes.

b) Develop a database of high-resolution climate change scenarios that can be linked directly with integrated assessment models without the need for transformation through a weather generation model.

c) Support development of an integrated assessment model that can link to CCOS and the climate change scenarios and can assess both the impacts of climate change at the regional level and the vulnerability of regional social, health, economic and environmental systems. These assessments should include cost-effectiveness analyses to provide policymakers and stakeholders with the information needed to take actions for adaptation.

d) Strengthen the understanding of extreme climate events and their impacts and coordinate these results with the national committee for disaster reduction to support disaster preparedness and development of possible warning systems.

e) Link long-term adaptation options with likely near-term climate variations to develop adaptation strategies that can be incorporated into national, regional, and local sustainable development plans.

Adaptations are not only the responses to specific effects (e.g. building sea walls) but may also include general policies and development priorities, such as population planning, economic development planning, land-use policies, etc. Specific requirements include adaptations to effects identified in the vulnerability assessment. These adaptation strategies/measures must be evaluated in terms of costs, practicability, and environmental and cultural appropriateness.

7. LESSONS LEARNED AND BEST PRACTICES

The key lessons from these projects are that: 1) a developing country like China was able to prepare a high-quality INC with funding support and capacity building from the international community, 2) that many of the IPCC methodologies were based on the situation and data of industrialized countries, and modification to a developing country situation were needed, and 3) while many of the methodologies developed in these project can be applicable to other developing countries, each country situation is unique and must be assess as such.

The objectives, outputs and implementation approaches used in these projects were sound and well executed. The oversight provided by the NCCCC, the inputs from the Project Steering Committees and the PMOs' coordination of the many sub-contractors, national and international experts, training workshops and international training and study tours contributed to the successful results.

UNDP should promote the results of these projects with other developing countries and encourage effective transfer of the methodologies and modelling approaches for use in the preparation of their NCs.

ANNEX A - Evaluation Team Terms of Reference

Introduction

Background of the Two Projects

China's annual energy consumption exceeds 1.3 billion tce. China has recently surpassed Japan to become the second largest energy consumer in the world. Fossil fuels constitute the bulk of China's consumption, with coal to be at 66.1% and the oil at 24.6% (China Year Statistics Book 2003) of total primary energy consumption. The energy structure of the country has a direct impact on greenhouse gas (GHG) emission. The average energy consumption and income per capita of China still remains at a low level. However, over the past 20 years, annual GDP growth has consistently exceeded the 7% mark. By the year 2020; the GDP should be double the size of the GDP in 2000 according to the Chinese government's development plan, referred to as "Xiaokang". This sets a great challenge as how to maintain the economic growth while protect the environment and long-term benefit.

GHG emissions contribute to the global climate change, which is one of the major environment concerns of the world. In 1992, the international community developed the United Nations Framework Convention on Climate Change (UNFCCC) to address the issue. China was to one of the first countries to join the convention. The convention sets out general obligations of parties to the Convention. According to the convention, both developed and developing countries are required to submit a National Communication which outlines the state of their own environment, industry, and contribution to global GHG emissions. To support the countries in developing the document, the Global Environment Facility (GEF) through UNDP provided assistance to China for the preparation of its Initial National Communication. Following this, In July 2001, the UNDP/GEF project document CPR/00/G31 - Enabling China to Prepare its Initial National Communication was signed.

Preparation of the National Communication is a challenging task that requires specific expertise in many areas. The greenhouse gas (GHG) inventory, in particular, requires expertise for data collection, measurement, modeling, and estimation methodologies of the main emission sectors. In addition, some sectors or sub-sectors require special research to deal with the complexities presented in obtaining accurate estimates of GHG emission and sinks so as to describe the situation to its most possible accuracy. In relation to support the preparation of China Initial National Communication, another UNDP/GEF project "CPR/00/G33 – Targeted Research Related to Climate Change was approved in Jan. 2002".

These projects are both nationally managed by the Office of China National Coordination Committee on Climate Change Policies under the NDRC.

Intended Project Results

CPR/00/G31 - Enabling China to Prepare its Initial National Communication

The main objective of this project is to enable China to fulfill its commitments under the UNFCCC to communicate the following to the Conference of Parties to the Convention:

(1) A national inventory of emissions and sinks (Year 1994) of greenhouse gases in the energy, industrial, agriculture, forestry and municipal solid waste sectors.

(2) China Initial National Communication to be submitted to the UNFCCC. It should include a general description of steps taken by China to implement the Convention; and

(3) Actions taken to increase public and political awareness on climate change.

CPR/00/G33 – Targeted Research Related to Climate Change

The main objectives of the project are to accurately estimate the GHG emissions for building the inventories of road transport, land use change and forestry, and agriculture sectors. Specifically, the project aims to:

(1) Strengthen the capacity for estimation in relevant agencies of the GHG emission and for building the high quality of the GHG inventories.

(2) Improve the methodologies for estimating the emission factors, and modeling of road transport, land use and forestry, and agriculture; This is to be accomplished though the development of techniques for estimation and model of emissions and removals. The project aims to accomplishing this though making use both of existing knowledge in China and best established international methodologies.

Project Strategies

The overall strategy of the two projects is to adhere to the following principles: (1) build on existing knowledge and expertise and avoid duplication of existing research or development of existing methodologies, thus achieving both cost effectiveness and efficient use of the limited time available to complete the GHG inventory for the Initial National Communication; (2) emphasize integration of technology, policy, and public awareness; (3) use internationally established methodologies and make use of previous experiences from abroad; and (4) establish the national capacity to submit high quality National Communication Report as required by the UNFCCC and to address climate change issues for sustainable development in China.

Objectives of the Evaluation

Both projects are subject to a final evaluation at the end of the implementation. CPR/00/G31 will be completed by the first quarter of 2005 and CPR/00/G33 by the mid of 2005. Since the two projects are closely linked, to evaluate the projects together will be cost effective and benefit both projects.

The objectives of the evaluation are to assess the effectiveness of the both projects in building national capacity to measure and monitor changes in China's emissions scenario. This includes how the project has contributed to building capacity in specialized institutions. It should measure how the project has strengthened the ability of the China Office of National Coordination Committee on Climate Change Policy to monitor emissions within the country both in terms of its relations with relevant institutions and in its understanding of up-to-date research methodology. The evaluation should review which methodologies were adopted in taking the 1994 baseline in order to identify where there were limitations (i.e., the most recent or appropriate methodology were not necessarily used) and provide recommendations for specific areas where gaps occurred and improvements should be made. In addition, the mission will review how these gaps and needs should be addressed by the Second National Communication, particularly in regards to vulnerability and adaptation to climate change. Finally, the evaluation should measure the effectiveness of public outreach during the course of the evaluation.

Specific Tasks for the Evaluation

The evaluation team will review documents/reports and meet with relevant ministries, academic institutions and agencies of the industrial and business sectors, to evaluate and discuss issues related to National Communication and Targeted Research Projects. The mission will cover the following areas:

1) Whether the project results have been achieved with regards to the immediate objectives and outputs measured by their success criteria as specified:

   a) Review the relevance of the project results in line with the national development priorities and objectives as well as sector policies.

   b) Specify the contribution of thee UNDP/GEF projects to the preparation of National Communication and the related research activities in terms of the achievements of the projects immediate objectives and outputs within the set timeframe.

   c) Evaluate the contribution of the targeted research project to improving the research methodology and accuracy of the measurements in the areas of road transport, agriculture, and forestry. Assess how these three sectors contributed to the overall strength of the national communication and how the process of preparing initial national communication has influenced the government in its formulation of national a strategy to address climate change issues.

d) Review how the targeted research project and the initial national communication has assist: a) other UNDP/GEF national climate change projects in understanding how to achieve their goals in terms of reduced GHG emissions, and b) help to inform the international community about China's research capacity and efforts to mitigate climate change and how this information has assisted in building a unified, global strategy for GHG reductions.

e) Evaluate the project impact in terms of achieving the Millennium Development Goals (MDGs) and recommend links between actions in addressing climate change issues and the MDGs achievement/ the sustainable development.

f) Evaluate the impacts of the two projects on strengthening the capacities the relevant government agencies, and particularly in terms of the strengthening the ability of China Office of National Coordination Committee on Climate Change Policy to build contacts and knowledge in order to be able to collect information and disseminate the most recent and or relevant climate change research methodology. The project should also evaluate the impact of climate change on companies that were directly involved in the project, and that benefited in the development of the national communications.

g) Evaluate as to what extent the two projects have contributed to raising China's national awareness of environmental issues and of the GEF's role in address these issues. The evaluation should include an assessment of these projects' contribution to advocacy activities and cooperation among the target groups in each project.

2) How to maintain and utilize the skills and expertise in preparation of the future emission inventories and other climate change studies and reports and where the significant gaps were discovered:

a) Review how the project assisted the national capacity building for the GHG emission assessment and the inventory set-up by applying methodologies suggested by IPCC and incorporating international best practices from other sources. The evaluation should also determine to what extent those scientific practices and methodologies have been incorporated into the every day operations of the relevant research institutions.

b) Assess sustainability of the capabilities developed in terms of documenting and recording the project results, and in terms of maintaining the expertise and consultation mechanisms for GHG inventory updating and for effectively dissemination of the project results on climate change.

c) Review the degree of change in awareness for both the policy-makers and the public as a result of the public awareness raising activities on climate change by this project and other relevant activities as well.

d) Identify where difficulties occurred in the preparation of the first national communication. Identify which areas did not receive sufficient support, or were not successful on adopting international methods. Identify how the quality of data collection and measurement can be improved for the second national communication and how international assistance can assist this process in a way that improves upon the initial national communication.

3) Summarize lessons that can help improve the future activities related to climate change. How operational experiences from these 2 projects can be used or modified to ensure a cost-effective planning and implementation of China's Second National Communications (SNC) Project:

Provide recommendations to help UNDP-Beijing, the GOC and project partners improve operational and support activities for the SNC in line with the UNFCCC and GEF guidelines. The recommendations would aim to ensure that:

a) Executing agencies and partners do a better job to address operational lapses and gaps;

b) Work of the PMOs and Project Steering/Advisory Committee/s is strengthened;

c) Enable UNDP-Beijing to provide effective support;

d) Improve ways to draw, share and document lessons learned and best practices to the various stakeholders are used;

e) Identify areas and needs in regards to vulnerability and adaptation to climate change to be given special attention under the SNC; and

f) Effective operational guidance for effective implementation of the SNC and any future project prospect/s.

Findings and recommendations of the evaluation will be shared with the government and the relevant institutions of the project.

Products Expected from the Evaluation

The evaluation mission should complete and submit the draft <u>Project Evaluation Report</u> (PER) before departure, and the finalized PER in both electronic and hard copies within 7 days after departure from Beijing. The report should be in conformity with the format set forth in the UNDP Guidelines for Evaluators (December 1998). See the annex for the outline of the Guidelines.

Composition of the Evaluation Team

The mission will consist of three experts: two international and one national. The two international experts will be identified and recruited by UNDP and the national expert by the project institute. The international team leader and the national expert should have broad knowledge of greenhouse gas emission and climate change as well as policies and efforts to address the issue. The other international expert will focus on vulnerability and adaptation and the special requirements of the SNC. All the experts should hold degrees of advanced studies relevant to the subject and at least 7 years working experience in the area of climate change.

The experts will work as team on the evaluations, dividing tasks in order to maximize the usefulness of each party's respective strengths in research backgrounds and languages. The team leader is responsible for the completion and submission of the final evaluation report while each team member will contribute in writing the report to cover both projects. In addition, an interpreter will be recruited to facilitate the dialogue and discussion of the team with agencies concerned during the evaluation.

Roles and Responsibilities

The UNDP-GEF Regional Coordinator for Climate Change for Asia and the Pacific will assist the UNDP CO and members of the evaluation team in preparing for the final evaluation of the project. The executing agency (EA) shall provide in advance copies of the necessary documents needed by the expert/s during the evaluation period. Likewise, the EA shall provide the list of contact persons representing the various stakeholders of the project, which will be the basis for the tentative itinerary/schedule of activities. The EA will finalize the schedule of activities in consultation with all parties concerned. The EA and UNDP-Beijing will coordinate the logistical arrangements for the evaluation.

Schedule of the Mission and Budget

The evaluation mission is scheduled to start in 15 February 2005, lasting for 21 days for the whole team (including arrival and departure. This time will include 18 days in China, and three days for pre- and post-mission preparation). The duration of the international V & A expert will be one week for the mission. An itinerary for the mission is proposed as follows and shall be finalized by the PMOs in consultation with UNDP. The evaluation report will be begun on the mission, but not finalized after consultants have finished evaluation process and left China.

Support to the Evaluation Team

UNDP will provide policy guidance to the mission, and the two PMOs will arrange relevant briefing and meetings, and for airport pickup and other logistic support.

The following documents and reports shall be prepared or collected to assist the team to conduct the

evaluation:

1. Project documents (UNDP)
2. Evaluation Guideline (UNDP)
3. Project Implementation Reports/Terminal Reports (the PMOs)
4. China Initial National Communication Report, draft English version (the PMO)
5. Financial Reports (CICETE)
6. MDG China Report (UNDP)
7. Other supporting documents, technical reports, proceedings, etc (the PMOs)

Revised on 10 January 2005

ANNEX B - Evaluation Itinerary

Date	Activity	Location	Participants
16 Feb	Arrival in Beijing and stay in Landmark Hotel. Pick up by the PMO	NC PMO	International experts Xu Huaqing
17 Feb 8:30-10:30	Joint briefing at the UNDP office	UNDP	Evaluation team, NPD, PM, NPCs
17 Feb 2:00	Evaluation team meet and review of the documents		Evaluation team
18 Feb 9:00-10:00 10:00-12:00	Introduction by the National Climate Change Office Report on Initial National Communication (NC) Project by the PMO and discussion	NC PMO	Evaluation team and relevant project officers
18 Feb 13:30-16:00	NC Project: Subcontract 1 report by ERI and discussion	NC PMO	Evaluation team, national institutes, relevant officers
19 Feb 9:30-12:00	NC Project: Subcontract 2 report by ERI and discussion	NC PMO	Evaluation team, national institutes, relevant officers
19 Feb 13:30-16:00	NC Project: Subcontract 3 report and V&A report by AMI and discussion	NC PMO	Evaluation team, national institutes, relevant officers
20 Feb	Drafting the evaluation report		Evaluation team
21 Feb 9:30-12:00	NC Project: Subcontract 4 report by CAF and discussion	NC PMO	Evaluation team, national institutes, relevant officers
21 Feb 13:30-16:30	NC Project: Subcontracts 5 and 6 reports by AMI and CAAC and discussion	NC PMO	Evaluation team
22 Feb 9:30-11:00	Meeting with State Meteorological Administration and the Ministry of Civil Affairs	SMA Office	Evaluation team, national institutes, relevant officers
22 Feb 11:00	Draft report ready by the V & A expert and departure of the expert		Rosa Perez, the V & A expert
22 Feb 14:00-16:00	Report on the Targeted Research (TR) Project by the PMO and discussion	TR PMO	Evaluation team and relevant officers
23 Feb 9:00-11:00	TR Project: Subcontract 1 report by ERI and discussion	TR PMO	Evaluation team, national institutes, relevant officers
23 Feb 11:00-14:00	TR Project: Subcontract 2 report by CAAS and discussion	TR PMO	Evaluation team, national institutes, relevant officers
23 Feb 14:00-16:00	TR Project: Subcontract 3 report by CAF and discussion	TR PMO	Evaluation team, national institutes, relevant officers
24 Feb 14:00-15:00 15:30-16:30	Visit to Ministry of Finance Visit to China GEF Secretariat	MOF and China GEF Offices	Evaluation team
25 Feb 9:30-10:30 14:00-15:00	Visit to Ministry of Foreign Affairs Visit to Ministry of Science and Technology	MOFA and MOST Offices	Evaluation team
26 - 28 Feb	Drafting the evaluation report		Evaluation team
1 March 10:00	Draft evaluation report distributed Meeting RR	UNDP	
2 March 14:00-17:00	Debriefing to report on the findings and recommendations of the evaluation mission at the UNDP office	UNDP	Evaluation team, NPD, NPCs, national institutes and relevant officers
3-4 March 9:30-16:00	Discussions and revisions to the evaluation report	UNDP and PMOs	Evaluation team, NPCs
5 March	Team Leader departure from Beijing Revised draft report to be distributed		UNDP and NPCs
18 March	Written comments of draft report submitted		UNDP and NPCs
25 March	Finalized evaluation report submitted to UNDP		Evaluation team

ANNEX C - List of Persons Interviewed

Name	Institution	Task
Sun Cuihua	Office of the National Coordination Committee on Climate Change	PMO
Ma Amin	Office of the National Coordination Committee on Climate Change	PMO
Xu Huaqing	Energy Research Institute, NDRC	INC PMO
Hu Xiulian	Energy Research Institute, NDRC	INC Sub-contractor Energy
Zhu Songli	Energy Research Institute, NDRC	INC Sub-contractor Energy
Liu Xueyi	Energy Research Institute, NDRC	INC Sub-contractor Energy
Zhu Xiaojie	Energy Research Institute, NDRC	INC Sub-contractor Energy
Yu Shengmin	Energy Research Institute, NDRC	INC Sub-contractor Energy
Yang Hongwei	Energy Research Institute, NDRC	INC Sub-contractor Industry, Interpreter
Hu Xiaoqiang	Energy Research Institute, NDRC	INC Sub-contractor Industry
Zhang Jianmin	Energy Research Institute, NDRC	INC Sub-contractor Industry
Lu Chuanyi	Energy Research Institute, NDRC	INC Sub-contractor Industry
Han Shenghui	Institute of Atmospheric Physics, Chinese Academy of Sciences	INC Sub-contractor Agriculture
Zhang Wen	Institute of Atmospheric Physics, Chinese Academy of Sciences	INC Sub-contractor Agriculture
Li Yue	Institute for Agricultural Environment and Sustainable Development, Chinese Academy of Agricultural Sciences	INC Sub-contractor Agriculture
Dong Hongmin	Institute for Agricultural Environment and Sustainable Development, Chinese Academy of Agricultural Sciences	INC Sub-contractor Agriculture
Xu Deying	Forest Ecology & Environment Institute, Chinese Academy of Forestry	INC Sub-contractor Forestry & Land Use
Zhang Xiaoquan	Forest Ecology & Environment Institute, Chinese Academy of Forestry	INC Sub-contractor Forestry & Land Use
Gao Qingxian	Center for Climate Impact Research, Chinese Academy of Environmental Sciences	INC Sub-contractor Waste
Huang Jing	The Administration Center for China's Agenda 21	INC Sub-contractor Public Awareness
Chang Ying	The Administration Center for China's Agenda 21	INC Sub-contractor Public Awareness
Wang Kejian	CEInet Data Co. Ltd.	INC Sub-contractor Public Awareness
Xu Yinlong	Agro-meteorological Institute, Chinese Academy of Agricultural Sciences	Expert Author for INC Chapter 3
Lin Erda	Chinese Research Academy of Agricultural Sciences	TR PMO
Zhu Songli	Center for Energy, Environment and Climate Change, Energy Research Institute	TR Sub-contractor Transport
Xu Deying	Forest Ecology & Environment Institute, Chinese Academy of Forestry	TR Sub-contractor Forestry & Land Use
Yan Hong	Research Institute of Forestry, Chinese Academy of Forestry	TR Sub-contractor Forestry & Land use
Han Shenghui	Institute of Atmospheric Physics, Chinese Academy of Sciences	TR Sub-contractor Agriculture
Li Yue	Institute for Agricultural Environment and Sustainable Development, Chinese Academy of Agricultural Sciences	TR Sub-contractor Agriculture
Dong Hongmin	Institute for Agricultural Environment and Sustainable Development, Chinese Academy of Agricultural Sciences	TR Sub-contractor Agriculture
Chao Qingchen	China Meteorological Administration	
Dai Xiaosu	China Meteorological Administration	
Gao Yun	China Meteorological Administration	
Liu Jiandong	Chinese Academy of Meteorological Science	
Qian Xiaoying	Ministry of Civil Affairs	
Ren Guoyu	National Climate Center, Beijing	
Xu Ying	National Climate Center, Beijing	

Li Rui	Ministry of Finance	
Wen Gang	China GEF Secretariat	
Sun Guoshun	Ministry of Foreign Affairs	
Kong Xiangwen	Ministry of Foreign Affairs	
Duan Maosheng	Ministry of Science and Technology	
Fu Ping	Ministry of Science and Technology	
Maria Suokko	UNDP	
Miao Hongjun	UNDP	
Xiang Yingling	CICETE	
Li Bin	CICETE	
Zheng Shuang	Energy Research Institute, NDRC	Interpreter

ANNEX D - List of Documents Reviewed

The People's Republic of China, Initial National Communication on Climate Change, Presentation at COP10 Side Event December 10, 2004.

Millennium Development Goals: China's Progress, An Assessment by the UN Country Team in China.

Project Document: Enabling China to Prepare Its Initial National Communication (ECPINC), CPR/00/G31/A/1G/99, signed July 2001.

Project Document: Targeted Research Related to Climate Change, CPR/00/G33/A/1G/99, signed June 2002.

Annual Project Report (APR) for UNDP/GEF Projects, Enabling China to Prepare Its Initial National Communication, December 2004.

Annual Project Report (APR) for UNDP/GEF Projects, Targeted Research Related to Climate Change, February 2005.

Initial National Communication on Climate Change: The People's Republic of China, Executive Summary, Beijing, October 2004.

Initial National Communication on Climate Change: The People's Republic of China, (Zero Draft) English Translation, Chapters 1-7, Beijing, February 2005.

Terminal Report (Draft): Enabling China to Prepare Its Initial National Communication (ECPINC), February 2005.

Terminal Report: Targeted Research Related to Climate Change, February 2005.

Self-Evaluation Report: Targeted Research Related to Climate Change, February 2005.

Project Implementation Report (2001-2004), Enabling China to Prepare Its Initial National Communication, PMO, NDRC, December 2004.

China's National Climate Change Strategy Outline

China's Climate Change Info-Net, www.ccchina.gov.cn, Office of the National Coordination Committee on Climate Change.

National Report on Sustainable Development, The People's Republic of China, Executive Summary, China Environmental Science Press, Beijing, 2002.

Ten Years of Entry into Force of the UNFCCC, Efforts of China, Office of the National Coordination Committee on Climate Change, December 2004.

Meteorological Service in China, China Meteorological Administration, Beijing, July 2004.

Project Presentations: Enabling China to Prepare Its Initial National Communication, Overview and 10 Sub-Project Reports (Energy, Industrial processes, Agriculture-CH4, Agriculture-N2O, Livestock Enteric Fermentation, Animal Manure Management, Waste, V&S, Forestry & Land Use, and Public Awareness)

Project Presentations: Targeted Research Related to Climate Change, Overview and 4 Sub-Project Reports (Road Transport, Agriculture, Livestock &, Animal Manure Management, and Forestry & Land Use)