ANY INNOVATION?

Innovations from the Asia-Pacific toward Sustainable Development

APEIS

Asia Pacific Environmental Innovation Strategy project

Overall Summary

June 2004

1. What is APEIS?

The Asia–Pacific Environmental Innovation Strategy Project (APEIS) is a three-year project that was launched in April 2002 after being proposed and endorsed at the Tenth Environment Congress for Asia and the Pacific (ECO ASIA) Ministerial Meeting in 2001. It comprises three sub-projects, namely, IEM, IEA and RISPO. The objective of APEIS is to develop and promote scientific tools and to provide policy options that will enhance environmental innovations and contribute to sustainable development in the Asia–Pacific region. In particular, APEIS aims:

(i) to provide scientific tools and policy options for policy-makers in the region
(ii) to promote capacity building of experts in the region
(iii) to promote outreach activities to stakeholders and the public in the region

Components of APEIS

APEIS comprises three sub-projects:

(1) Integrated Environmental Monitoring (IEM)
- IEM has been developing an integrated monitoring system to detect/monitor environmental disasters and degradation of natural resources, such as floods, droughts, dust storms, forest fires, air and water pollution, and desertification. It also assesses ecosystem services such as water, heat, and carbon cycling, biodiversity and food production in the Asia-Pacific region.

(2) Integrated Environmental Assessment (IEA)
- IEA has been developing the Asia–Pacific Integrated Model (AIM), which is a set of integrated socioeconomic models to predict future states in the Asia–Pacific region relevant to sustainable development (e.g., energy, CO_2, impacts on water resources, and material balances). IEA has also been developing a strategic database providing data for the AIM models and to RISPO to facilitate policy research.

(3) Research on Innovative and Strategic Policy Options (RISPO)
- RISPO has been developing the *Good Practices Inventory* (GPI), an inventory of local, national and trans-national activities that contribute to sustainable development in the Asia–Pacific region. RISPO has been using the GPI to make *Strategic Policy Options,* packages to help decision-making on sustainable development policy in the region.

Figure 1. Conceptual Image of APEIS

2. What are the Expected Products and Current Progress?

2.1 Integrated Environmental Monitoring (IEM)

The purpose of APEIS-IEM is to accurately describe the present conditions and trends of ecosystem services, as well as the pressures and impacts upon them, for policymaking to promote regional sustainability (Fig. 2).

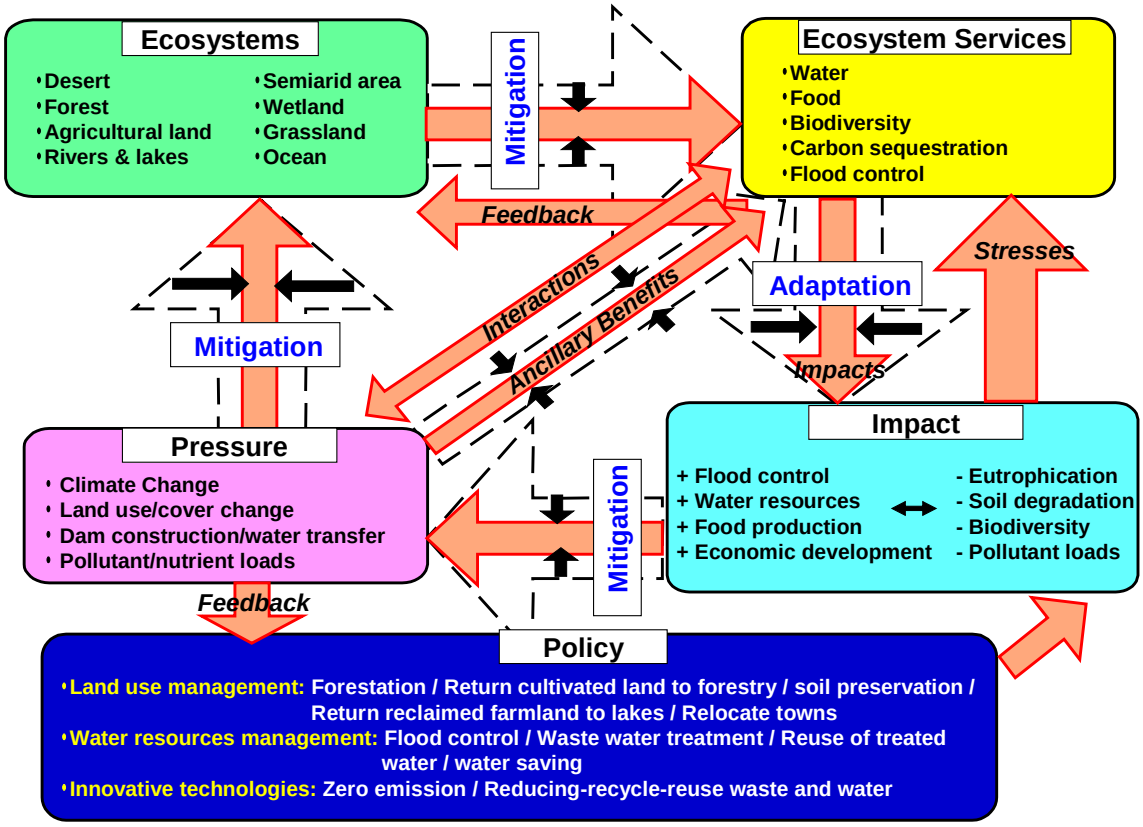

Figure 2. Interactive relationships among policies and ecosystem services

Products IEM can offer

The IEM sub-project has developed an integrated environmental monitoring system that can be used to detect, monitor, and assess environmental disasters and degradation and their impacts in the Asia–Pacific region. The system provides validated remote sensing data and images from MODIS (Moderate Resolution Imaging Spectrometer), and derived ecological indices such as water deficit index, dust storm index, land surface temperature (LST), and net primary productivity (NPP). It has also developed an integrated model to assess the state of and changes in ecological goods

and services, such as fresh water resources, carbon and nitrogen cycles, and food production. With this model, the trade-off between ecosystem services and effectiveness of policies for sustainability can be demonstrated (Fig. 3).

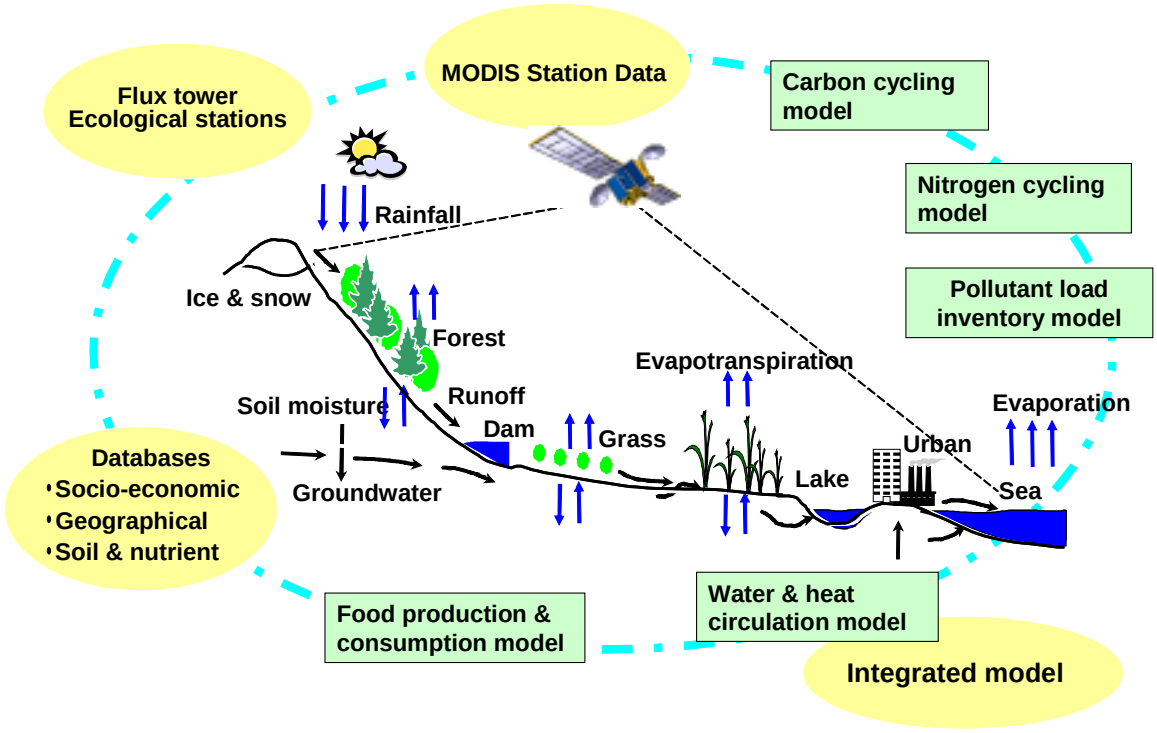

Figure 3 Integrated environmental monitoring system for the Asia–Pacific Region

IEM achievements in 2003

The integrated monitoring network system established by IEM now covers most of the Asia–Pacific region, and continuously provides real-time data of both remote-sensing and ground-based measurements in 2003 (Fig. 4). The MODIS images are publicly released from the APEIS-IEM website, and the original data are planed to be released on the Internet. (Web site: http://www-basin.nies.go.jp/english/project/iem/index.html)

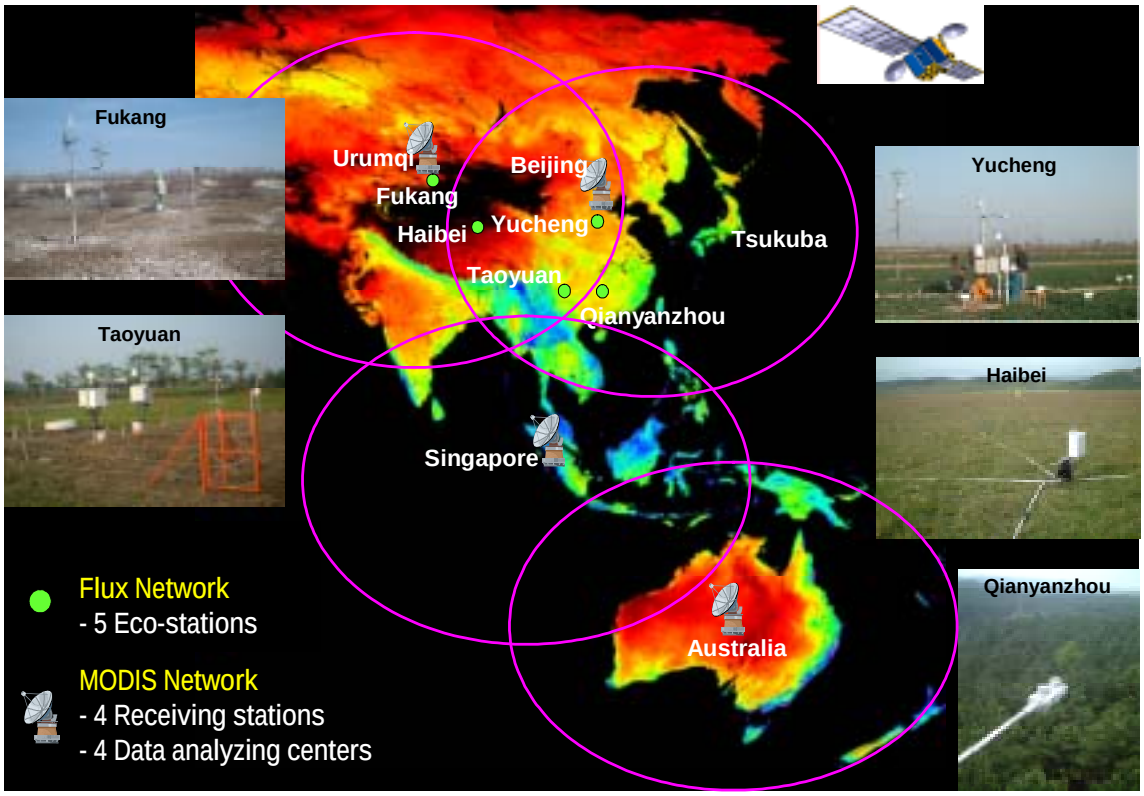

Figure 4. The APEIS integrated monitoring system was established in 2002 under the auspices of the National Institute for Environmental Studies (NIES) in Japan and the Institute for Geographical Sciences and Natural Resources Research (IGSNRR), the Chinese Academy of Science in China, and was expanded with additional participation by the National University of Singapore (NUS) and the Commonwealth Scientific and Industrial Research Organization (CSIRO) in Australia

A network of data-analyzing centers at NIES in Japan, IGSNRR in China, NUS in Singapore, and CSIRO in Australia was formed in 2003 under the umbrella of IEM. These centers store both a wide variety of satellite data and various ground-based measurements. The data processing system for deriving the higher-order MODIS products was also completed (Fig. 5).

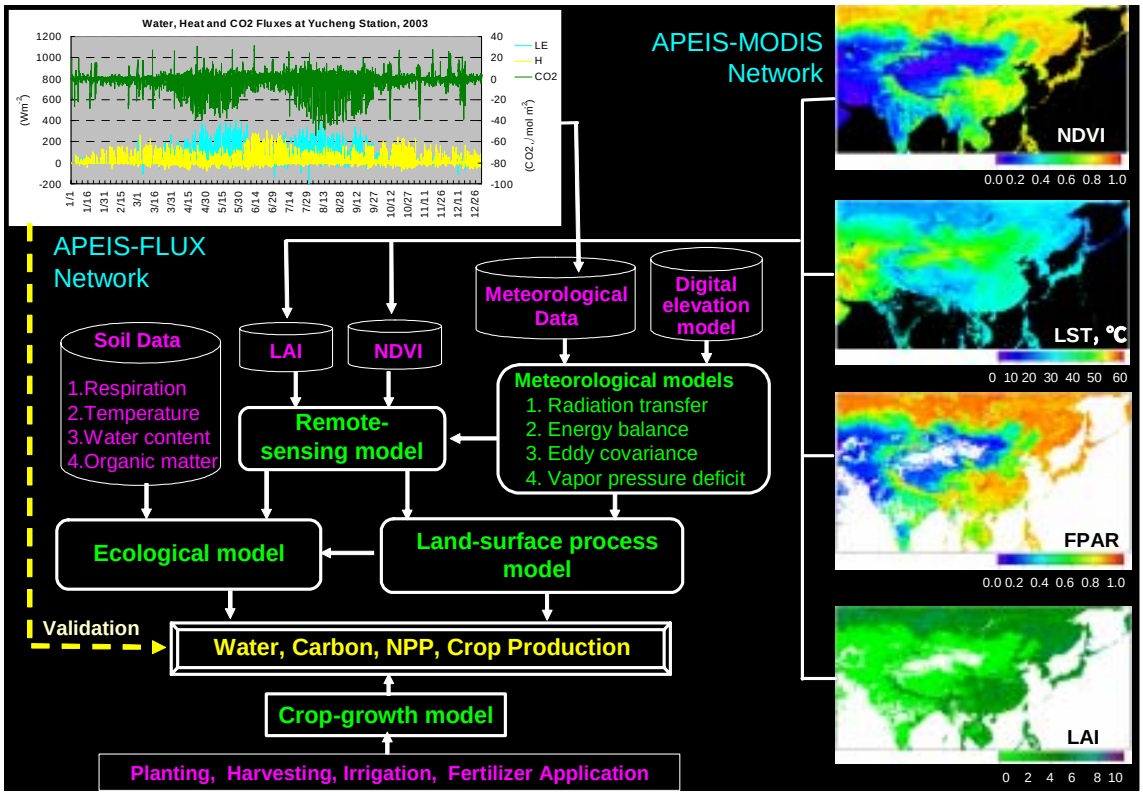

Figure 5 Flowchart of APEIS data processing

Although numerous satellite-derived indices in the Asia–Pacific region have already been produced by other projects and organizations, most have yet to be calibrated or validated by ground-truth data and they might contain significant uncertainties. IEM has established five validation sites in a variety of ecosystems in China (grassland, crop land, paddy field, forest, and semi-arid area) at which ground-truth data—including information related to radiation, meteorology, soil, and vegetation—is continuously measured. Using these consistent and quality-assured datasets, IEM can produce accurate and reliable information specific to the region (Fig. 6).

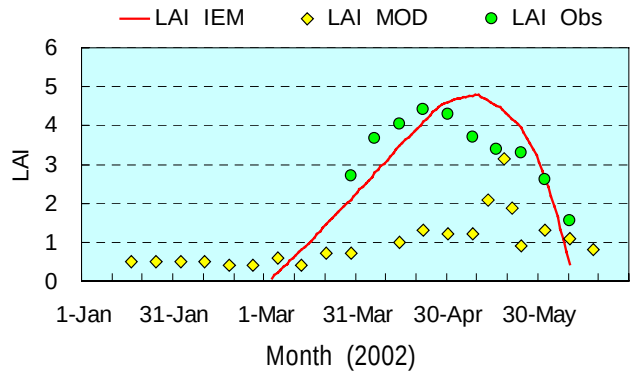

Figure 6. Comparison between IEM product of MOD15 (LAI IEM) and that of NASA products of MOD15 (LAI MOD) in 2002. This shows LAI MOD has poor agreement with observations (LAI Obs). One of the reasons is that misclassification of land lover leads to errors in NASA products.

IEM data can help create scenarios for realizing sustainable development. As one of the most important drivers of both ecological change and economic development, changes in land use and land cover have been dynamically monitored by IEM (Fig. 7).

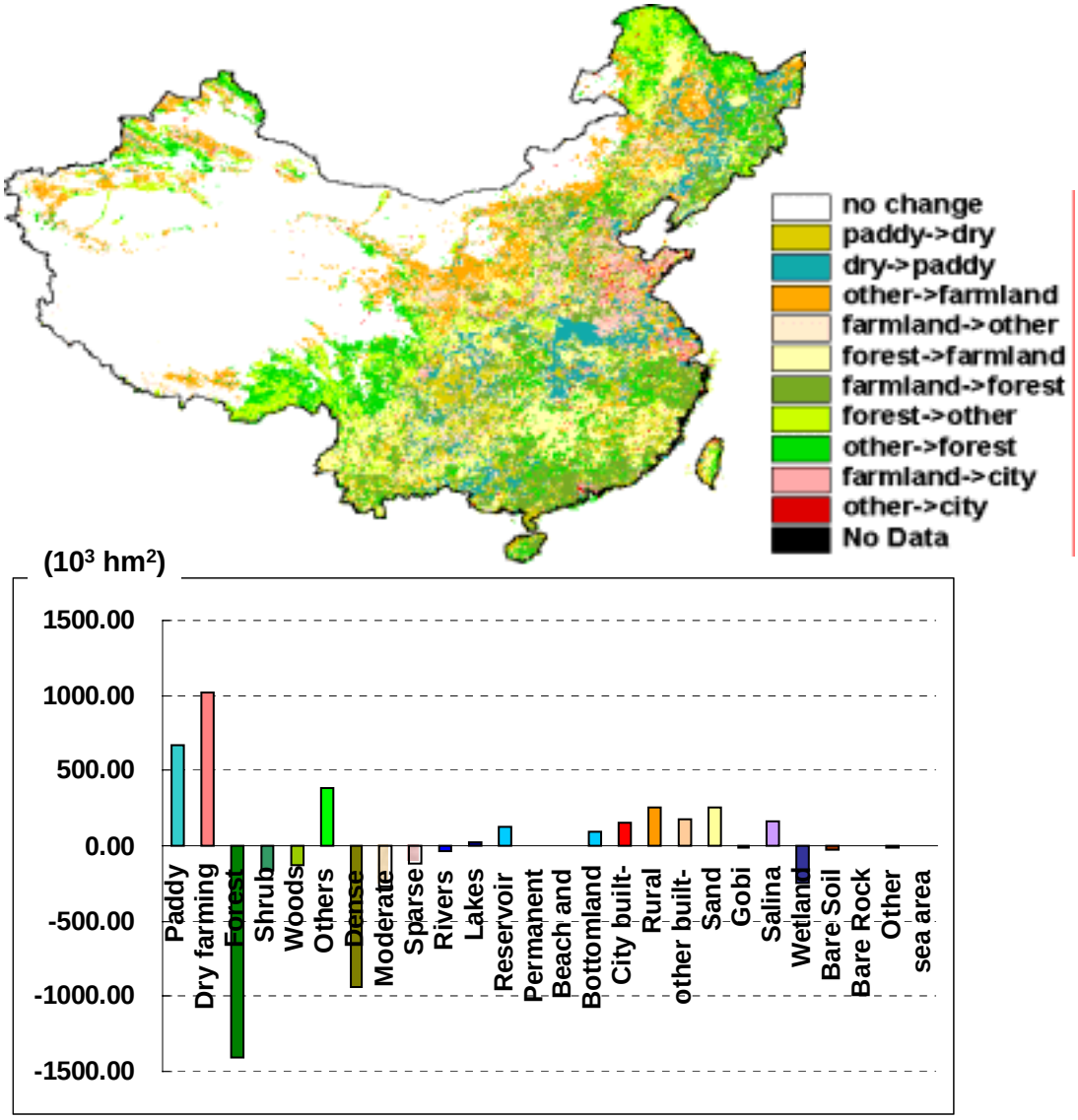

Figure 7 Land-use changes from 1990 to 2000 in China. Areas of cropland, towns, rural residences, and water bodies increased in both eastern and western parts; the area of cropland increased at a higher rate in the western part. Areas of woodland and grassland decreased in both eastern and western parts; the rate of decrease was higher in the eastern part. The area of unused land in the eastern part decreased; however, that in the western part increased.

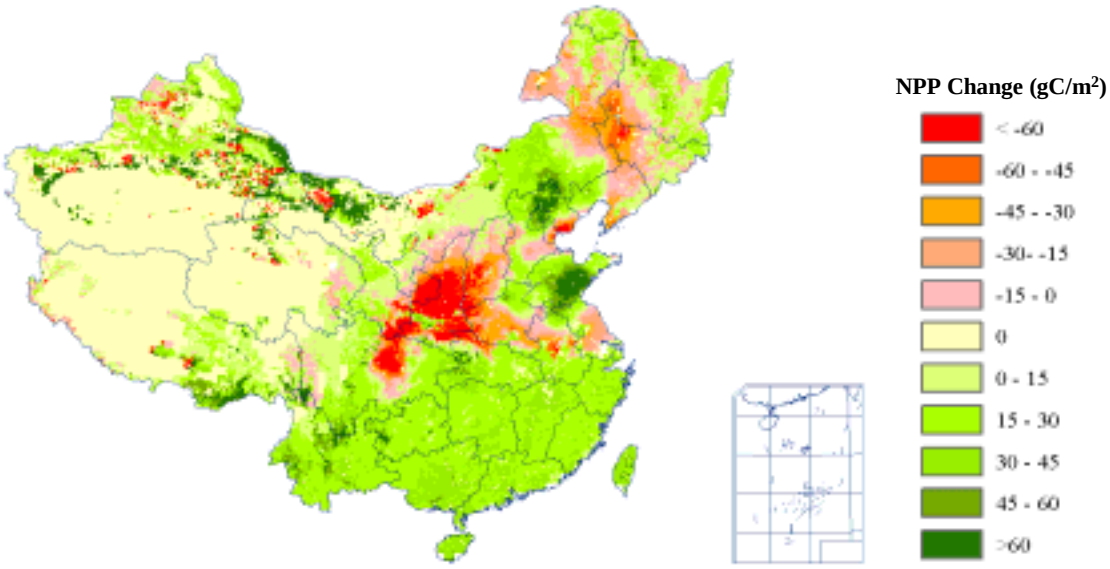

Figure 8 Changes in NPP due to land-use/land-cover changes in China were estimated by using ecological modeling. NPP increased in most parts of China, but decreased in the Loess Plateau and the western part of northeastern China. Provisioning services, measured by food production, also increased.

Water resource management is one of the most important issues that we are currently facing. IEM developed an integrated watershed management model that simulates ecological functions, such as water, heat, carbon and nitrogen cycles, and sediment transport, as well as agricultural production.

We used the model to simulate sediment loads under different land-use change scenarios over the whole of the Jialingjiang catchment (160 000 km^2), located in the upper reaches of the Changjiang basin), to evaluate how sediment loads from the catchment would be affected. One of the main flood-prevention policies adopted by the Chinese Government is conversion of farmland to forest on steeply sloped areas. Simulations of this scenario showed that the volume of sediment erosion in this catchment will obviously decreased according to the recovery of forest area on sloped areas (Fig. 9).

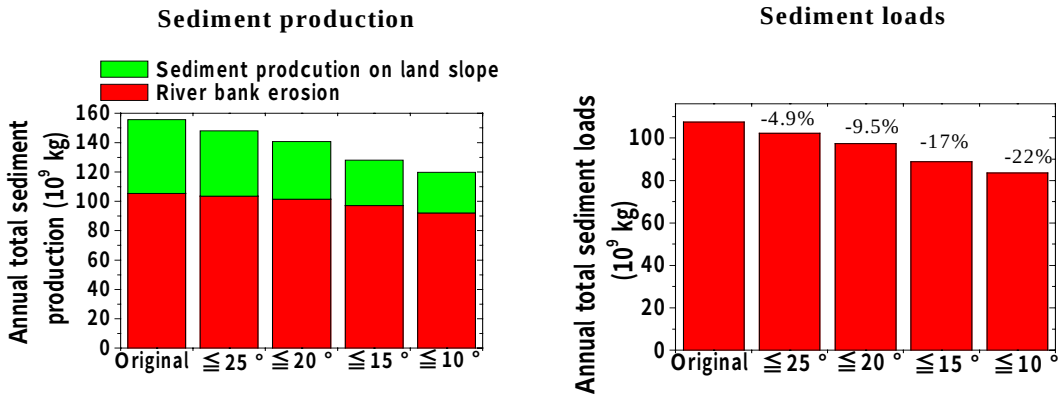

Figure 9. Effects of policy of returning farmland to forest on prevention of both sediment production and sediment loads

2.2 Integrated Environmental Assessment (IEA)

The contexts of environmental policymaking have become complex owing to multiple inter-related factors affecting the outcomes and multiple trade-offs involved; for instance, between economic growth and environmental protection. Integrated assessment models can provide useful frameworks for analysis in such contexts.

Problems/issues to be addressed

The Integrated Environmental Assessment (IEA) sub-project aims to apply a set of integrated assessment models and a strategic database to:

- Assess country-level policies and their impacts on local air pollution, wastes, greenhouse gas (GHG) emissions, health, land-use, and water resource depletion. The models will consider:
  - innovative technologies and practices
  - regulatory constraints and market-based policies
- Assess the impacts on economies and ecosystems of global and regional policies for GHG stabilization. The models will consider:
  - trade agreement regimes and bilateral technology transfer agreements
  - scenarios for natural and social environments

Products IEA can offer

IEA is providing a set of integrated modeling and database tools during the first phase (FY2002-2004) of APEIS (Fig. 10). These include (i) the Strategic Database (SDB), used for storing data relating to socioeconomic scenarios and innovative options, and assessment of those innovations; (ii) the AIM/Energy model, used for local- and country-level assessment of technologies and emission mitigation options; (iii) the AIM/Material model, used for country-level assessment of environmental investments and recycling; (iv) the AIM/Trend model, used for regional- and global-scale projections of future socioeconomic and environmental trends; (v) the set of AIM/Ecosystem models, used for assessment of impacts on water, agriculture, vegetation, and health; (vi) the AIM/Top-down model, used for regional- and global-scale assessment of economy–environment dynamics; and (vii) the AIM/Bottom-up model, used for assessment of technologies and land-use dynamics in the Asia–Pacific region.

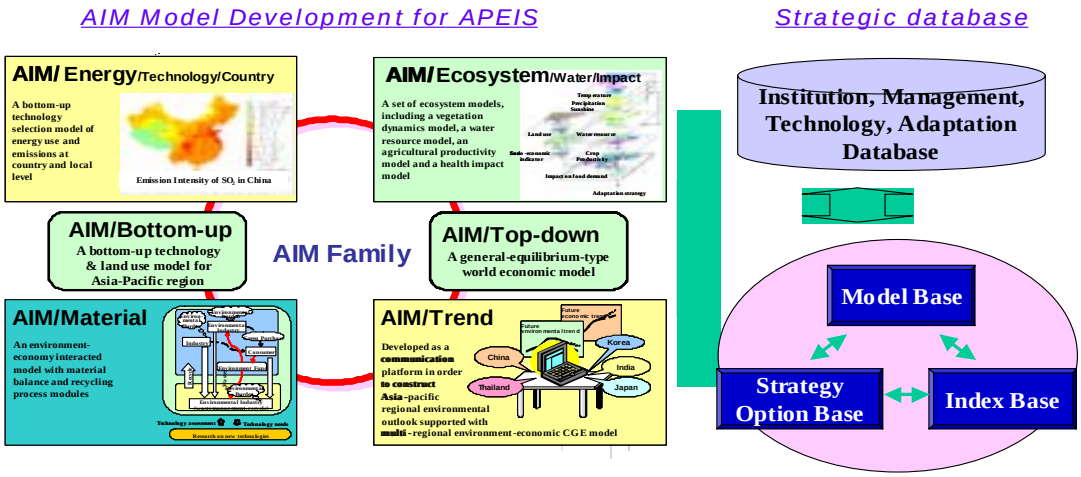

Figure 10. AIM models and Strategic Database (SDB) for APEIS

These models and the database can be used either independently or together to systemically analyze complex environmental policy situations. Relevant information is exchanged among different models to ensure consistency. These tools are being used for environmental assessment in Japan, China, India, Thailand, and Korea.

Current progress

During the 2003 financial year, IEA completed advanced versions of AIM/Energy, AIM/Material, AIM/Top-down, and AIM/Water, and a preliminary version of the integrated AIM/Ecosystem models. It also completed a 1st version of the SDB with indicators focusing on environmental efficiency. It projected environmental trends and assessed innovative options for selected countries. IEA held its second capacity building workshop at the Asian Institute of Technology, Thailand, in June 2003. The IEA models and database have been used for addressing various environmental issues in selected countries through collaboration with experts in each country. Teams in each country have collected existing data, projected future years' data, designed socioeconomic scenarios, and identified abatement options for each country, in consultation with various experts and policymakers.

AIM/Energy results for China indicate that the potential for CO_2 mitigation in the industrial sector is high, especially in the power, steel, and cement industries. The analysis shows that reduction of over 60 Mt C can be achieved in the market-driven case alone (Fig. 11). Also at mitigation costs of less than US$50/t C, a reduction of over 200 Mt C can be achieved. The major sectors that contribute to CO_2 emissions in China are the industrial and the residential sectors concentrated in the South Eastern part of the country (Fig. 12a). This region contributes to majority of the emissions. Strong mitigation policy scenario results in a shift away from coal to natural gas in the power sector.

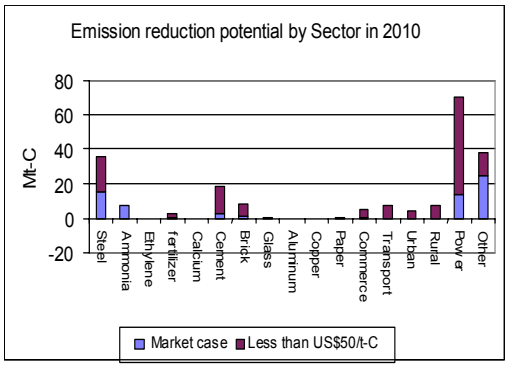

Figure 11. CO_2 mitigation potential in China

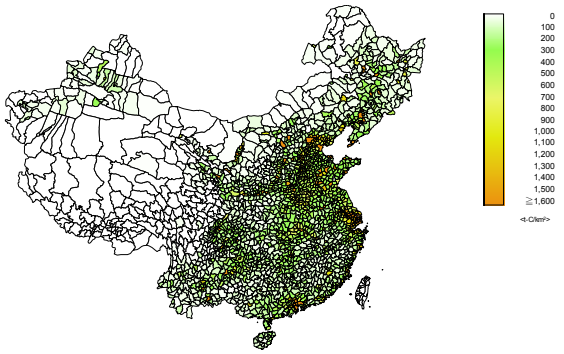

Figure *12a. CO_2 emission intensity in China in 2010*

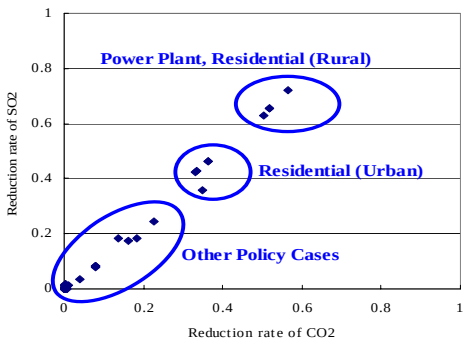

Figure 12b. Co-benefits of CO_2 reduction in China in different sectors

In the rural residential sector there is a switch from traditional biomass to cleaner fuels like LPG. The groupings in Figure 12b indicate CO_2 reductions in specific sectors corresponding to different levels of carbon tax. Though policy options aim to reduce CO_2, a reduction in SO_2 also occurs. This leads to the added benefit of reduction in local air pollution caused by SO_2 emissions. The main insight is that the GHG and the local pollutant emissions move in sync.

AIM/Energy results for India show that the "550 ppmv stabilization scenario" for CO_2 will be characterized by a significant switch from coal- to gas-based power generation, especially in the coastal areas (Fig. 13).

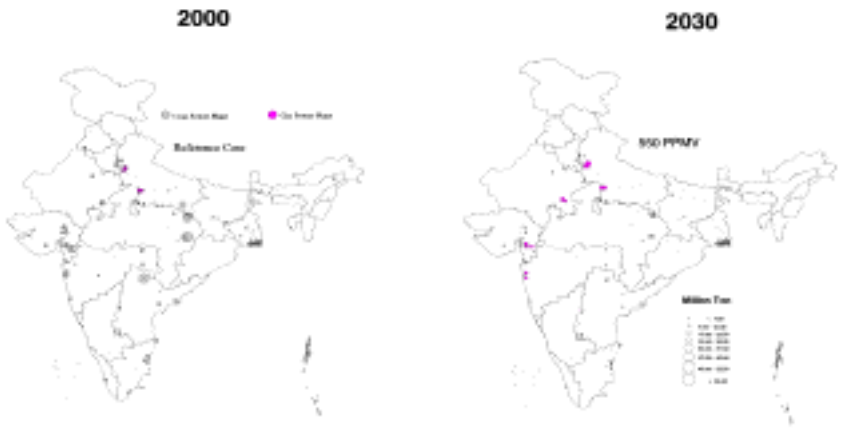

Figure 13. CO_2 emissions from large power plants in India under the reference scenario in 2000 (left) and the 550 ppmv stabilization scenario in 2030 (right)

Effects of CO_2 emission constraints (increase in emissions restricted to 2% per year) and policies promoting recycled biomass goods and technology innovations coupled with CO_2 constraint were analyzed with the AIM/Material model for India. The GDP loss in 2030 under CO_2 emissions constraint is about 2% of the total GDP in the reference scenario.

The introduction of recycling in the carbon constraint scenario helps reduce GDP loss by about 9% in 2030. In the case of the innovation plus carbon constraint scenario the GDP loss is even lower. About 25% or USD 20 Billion loss over the reference case is mitigated in 2030. (Fig. 14)

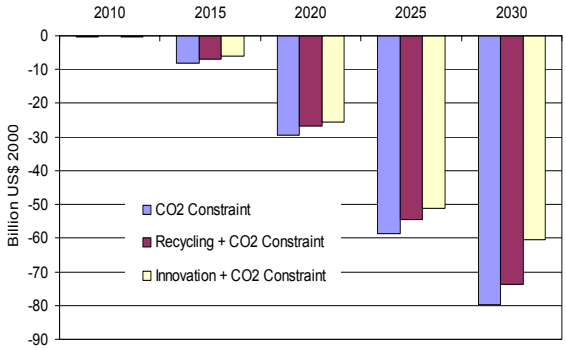

Figure 14. GDP change in India under 'CO_2 emissions constraint', 'Recycling and emission constraint', and 'Innovation and emission constraint

The scenario of a free trade agreement among Asian countries, analyzed using AIM/Top-down, shows a significant change in both GDP and emissions relative to the reference scenario in 2010. Free trade will increase GDP as well as SO_2 emissions in Korea and the ASEAN countries owing to the rise in production from energy-intensive industries. However, free trade may induce a decline in SO_2 emissions in other countries, due to ancillary benefit of CO_2 reduction for Kyoto target (Japan) or a drop in production from energy intensive-industries (India) (Fig. 15).

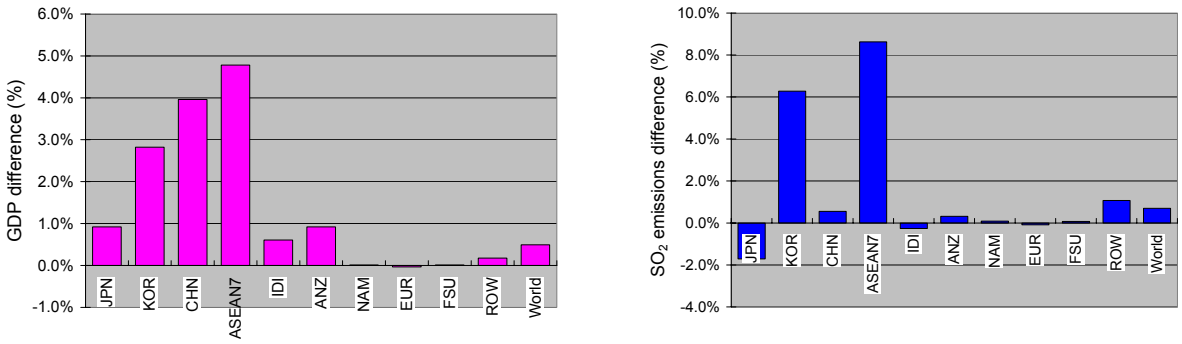

Figure15. Impact of free trade agreement among Asian countries relative to the reference scenario in 2010

The SDB is designed to analyze strategies for innovations required for a shift to environmentally sound industries and lifestyles. Various innovative technologies in the fields of nanotechnology, biotechnology, and information technology, and innovative social systems, such as environmental funds and awareness campaigns, can be analyzed for their impacts on soil/water preservation, waste reduction, and climate change. Descriptive information on innovative strategies and socioeconomic scenarios are quantified, and the impacts of the innovations under different scenarios are analyzed (Fig. 16).

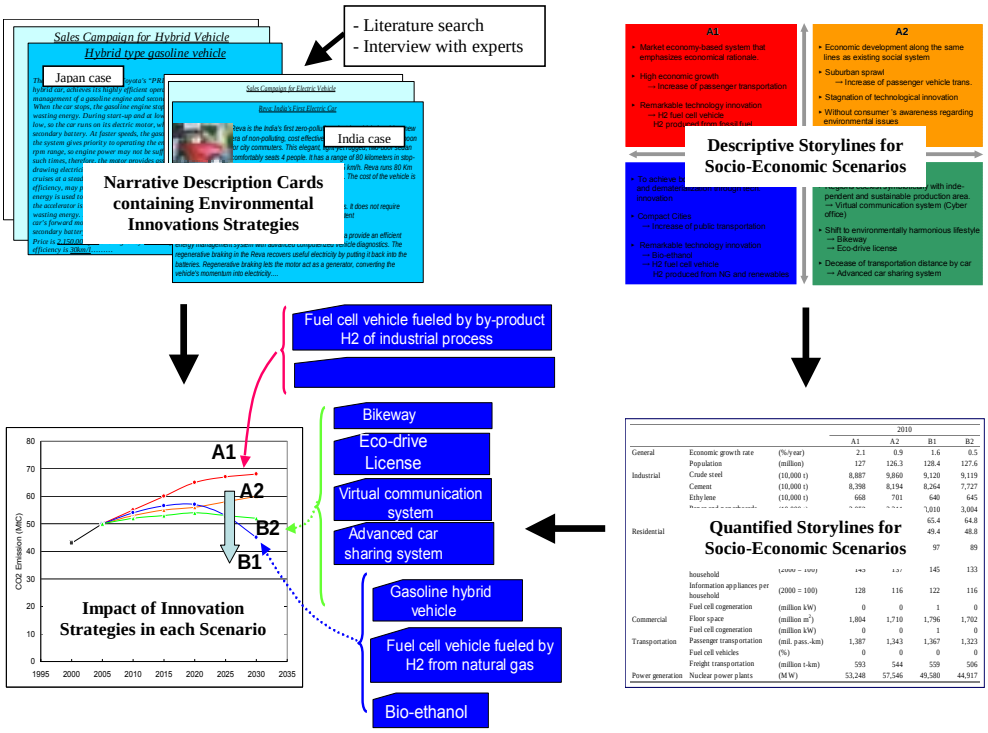

Figure 16. Framework of the Strategic Database (SDB)

IEA is currently collaborating with RISPO on exchange of data relating to the transport and biomass sectors. Earlier it collaborated with IEM to acquire spatial data. IEA is also collaborating with external projects like the Millennium Ecosystem Assessment (MA), Global Environment Facility (GEF), and Globally-Integrated Environmental Assessment Modeling (GLEAM) by the National Institute for Public Health and the Environment (RIVM, the Netherlands) and United Nations University (UNU). IEA products have contributed to quantifying the MA's long-term global scenarios of natural and social environments.

Possible applications of IEA products to policymaking

IEA products have a wide range of applications to policy making, as highlighted in Table 1. They can address a variety of environmental policy concerns at the levels of:

- city, country, region, and world
- sector, economy, and ecosystem
- short term (5–10 years), medium term (10–50 years), and long term (50–200 years)
- technology innovations, management and institutional innovations, command and control interventions, and market-based interventions

Proposals from IEA to better meet policy makers' needs

Integrated analysis with the IEA models and database suggests that (i) the potentials of technological innovations for the environment are large but differ among countries, indicating immense opportunities for regional collaboration; (ii) technological innovations are most effective if integrated with social innovations; (iii) policy options effective for the global environment can reduce local environmental burdens as well; (iv) investments in the recycling industry and in technological innovations can partly mitigate the loss of GDP due to environment constraints; (v) globalization would introduce innovations mainly in emission reduction while adversely affecting the incentives to sustain ecosystems; and (vi) free trade agreements will have varied economic and environmental impacts in different Asian countries.

2.3 Research on Innovative and Strategic Policy Options (RISPO)

Problems/issues to be addressed

One of the most serious obstacles to promotion of environmentally sound policies in developing countries is that of their implementation. Therefore, the RISPO sub-project aims to support policy makers in the Asia–Pacific region to overcome this obstacle by identifying policy options for sustainable development.

To support policy implementation for sustainable development, RISPO focuses on innovative and critical instruments to make the policies successful. RISPO specifically focuses on three kinds of instrument: economic instruments, social instruments, and physical instruments. Under this framework, eight research themes as listed in Table 1 have been identified by international teams of researchers in the Asia–Pacific region.

Table 1 : Instruments and sub-themes

Focus	Sub-theme	
Economic Instruments		Innovative financing for renewable energy development
		Creation of inter-boundary markets for recyclable materials
		Improving environmental performance of small and medium-sized enterprises (SMEs)
Social Instruments		Facilitating community-based tourism in protected areas
		Promoting environmental education by NGOs
		Promoting local/indigenous knowledge-based sustainable resource management
Physical Instruments		Development of environmentally sustainable transport systems in urban areas
		Promotion of biomass energy

RISPO's approach focuses on ground-based field studies of successful examples of sustainable development practices. By taking a field-based approach RISPO intends to complement the other two sub-projects of APEIS and develop a sound understanding of factors that promote or hinder sustainable development in various settings and to describe lessons thus learned.

Example of field studies: Interviewing villagers in Chingra Kheli, Bangladesh

A RISPO research team visited Chingra Kheli village to interview local people to find out their perceptions on the impacts of current climate change (including that of sea-level rise), local coping strategies, and short- and long-term needs to be addressed by local and national governments and by international organizations.

Products RISPO can offer

RISPO offers the *Good Practices Inventory* and packages of *Strategic Policy Options* as tools to assist policy makers in pursuing sustainable development. The *Good Practices Inventory* is a database of experiences that are rich in lessons and potential for application. The *Strategic Policy Options* are innovative policies extracted from analysis of the *Good Practices Inventory* and other past experiences. Those tools are intended to be used by both policy makers and a wider audience to promote discourse for sustainable development. Figure 17 shows the steps taken to develop the *Good Practices Inventory* and *Strategic Policy Options.*

A preliminary version of the *Good Practices Inventory* is available on the RISPO website. The *Strategic Policy Options* database will become available on the web by March 2005.

Figure 17. Steps to develop Good Practices Inventory and Strategic Policy Options

Good Practices Inventory (GPI)

The *Good Practices Inventory* is designed to help overcome the lack of information on such practices in the region. It serves as a storehouse of accumulated experience and a platform for information sharing and discussion. The inventory is provided in the form of an easily searchable database on the RISPO website. Information on each good practice includes the critical and innovative instruments leading to successful practices, lessons learned, and potential for application.

Approximately 100 examples of good practices in the Asia–Pacific and other regions of the world have been collected during the first two years and are being uploaded into the *Good Practices Inventory* (http://www.iges.or.jp/APEIS/RISPO/inventory/). The geographical distribution of the good practices is shown in Figure 18.

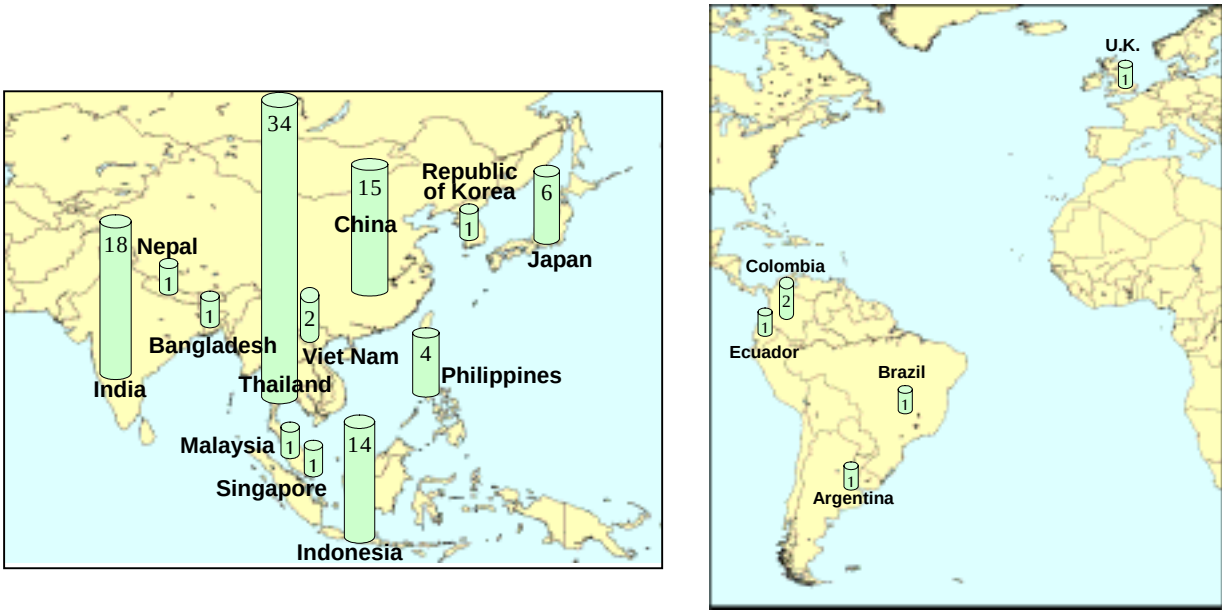

Figure 18. Distribution of cases being compiled in the Good Practices Inventory

Strategic Policy Options (SPO)

Strategic Policy Options are packages of innovative policy options for sustainable development covering selected sub-themes and strategies. Figure 19 shows the structure of *Strategic Policy Options*. These packages will highlight the critical instruments used in each of the strategic options, the expected and observed impacts, evaluation, implementation issues, and applicability and limitations.

Strategic Policy Options mainly targets policy makers at local, national, and regional/international levels. *Strategic Policy Options* will provide a basis upon which practical policy options are developed, taking into account the geographical, social, cultural, and economic differences among countries in the Asia–Pacific region.

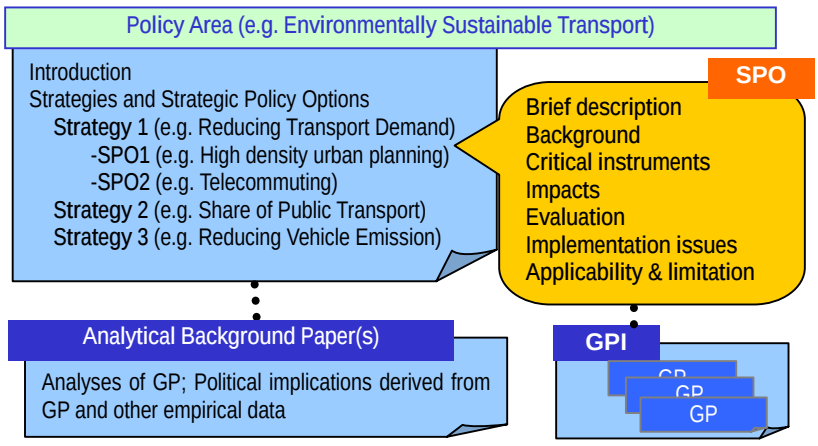

Figure 19 Structure of Strategic Policy Options

Current Progress

Current progress of RISPO includes:

- Research collaboration network with research institutes, universities, and NGOs in the Asia–Pacific region
- Preliminary version of *Good Practices Inventory* on Internet with approximately 100 cases
- Collaboration with the IEA to assess the impacts of *Strategic Policy Options*

Framework of strategies and *Strategic Policy Options* database will become available on the web by March 2005.

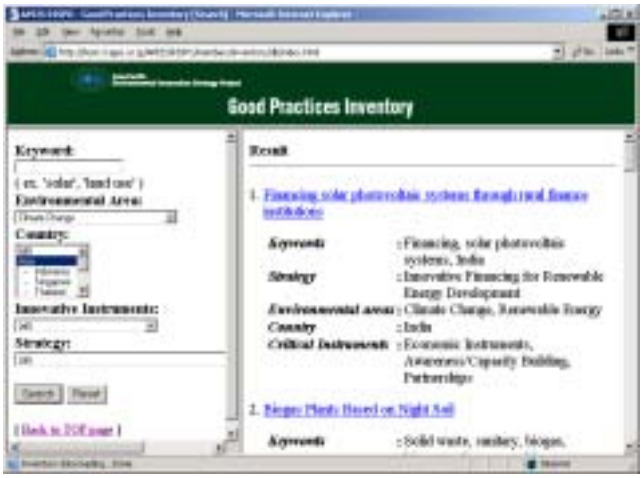

Figure 20. Preliminary version of the Good Practices Inventory

Possible application of RISPO products to policy making

RISPO products provide policy makers with a database of past experiences and policy options. The *Good Practices Inventory* helps policy makers to learn from past experiences. The packages of *Strategic Policy Options* guide the policy makers in examining strategies for sustainable development and offer options for creating policies to move toward sustainable strategies.

Proposals from RISPO to better meet policymakers' needs

RISPO recognizes the importance of interaction with policy makers. RISPO researchers have had interactions with policy makers through local workshops, international conferences, and Research Coordination Committee meetings. In the final year of the project, it is planned to hold several workshops with policy makers. Specifically, in November 2004, the RISPO Workshop is planned to be held in conjunction with the GEF/SEFII Workshop[1], with sequential meetings with policy makers.

The 2nd Plenary Workshop for RISPO, February 2004, Hayama, Japan

Local workshop with policymakers in Thailand on sustainable transport, March 2004

[1] GEF/SEF II Workshop — workshop of the Global Environment Facility (GEF) and Strategic Environment Framework in the Greater Mekong Subregion (SEF II)"

3. Interaction with International Groups

APEIS partnerships

APEIS was registered as a Type II Partnership Initiative at the World Summit on Sustainable Development (WSSD, Johannesburg, South Africa, 2002), and as an "action" under the Portfolio of Water Actions at the Third World Water Forum (Kyoto, Japan, 2003). APEIS also has a variety of partnerships, such as with the Millennium Ecosystem Assessment (MA), the Asia–Pacific Network for Global Change Research (APN), and the National Performance Assessment and Subregional Strategic Environment Framework in the Greater Mekong Subregion (GMS).

3.1 IEM

Contributions to Policymaking and Millennium Ecosystem Assessment

The Second APEIS Capacity Building Workshop on Integrated Environmental Monitoring of the Asia–Pacific Region was held in Sydney, Australia, on 27 and 28 November 2003 (Fig. 20). Participants from the Philippines, Malaysia, Australia, Pakistan, Nepal, Japan, Singapore, and China attended the workshop. The workshop presented the importance of capacity building in the MODIS Network and the APEIS-FLUX tower measurement, and the regional integrated models and their applications to the Asia–Pacific region. Presentations also focused on cooperative studies of land-use/land-cover change, the carbon cycle, and MODIS validation in different countries of the region.

APEIS-IEM research results have been published in a special issue of the *Journal of Geographical Sciences* (Vol. 59, No. 1, 2004), and the APEIS-FLUX sites have become important training centers for the Chinese Ecological Research Network, and have been visited by many scientists, students, and policymakers.

Participants of the second APEIS-IEM capacity building workshop in Australia. Major suggestions: Strengthen the cooperation and data exchange among stations; improve the quality of tower site data, especially in regard to the effects of topographic variations and horizontal advection; improve scaling methodologies that enable flux data to be used to validate MODIS products and integrated models.

The activity of APEIS-IEM is closely linked with the Millennium Ecosystem Assessment (MA) through the participation in the China MA, one of the sub-global assessment projects. The outcomes of APEIS-IEM are contributing to Chapter 7 in the sub-global assessment as a core scientific method for assessing conditions and trends of ecosystem services.

3.2 Collaboration between APEIS-IEA and MA

IEA products have contributed to the MA's quantification of long-term, global scenarios of natural and social environments. Four long-term scenarios of natural and social environments were analyzed using the AIM/Ecosystem models. The simulations indicate that forest area will decrease at the beginning of the 21st century in all regions under all scenarios. While regional scenarios (AM [2] and OS [3])—scenarios characterized by food demand pressures—show this decline to continue until 2050 for Asia, global scenarios (GO[4] and TG[5]) show recovery of forest area in later periods due to pressures of globalization (Fig.21).

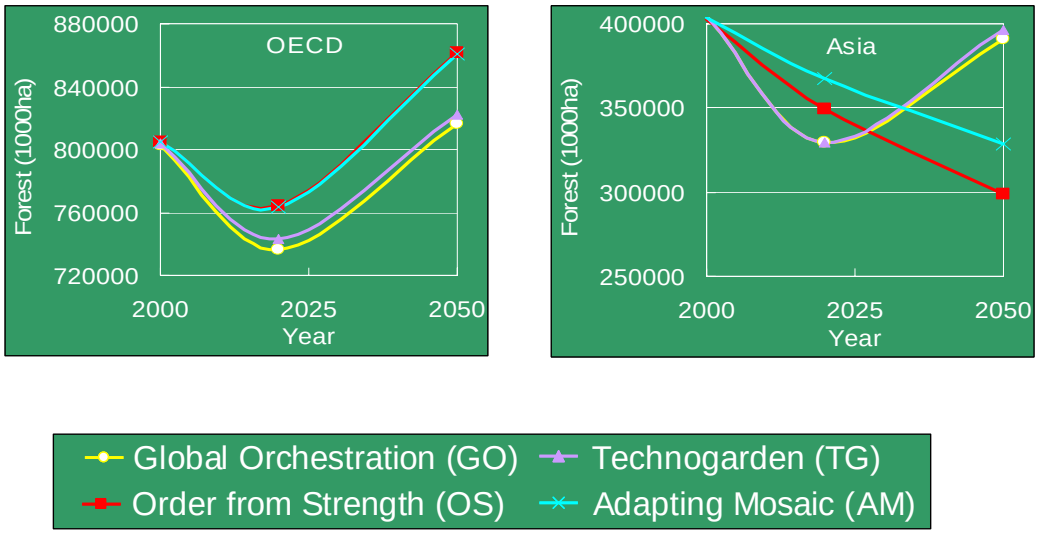

Figure 21. Estimation of forest area under different long-term scenarios of natural and social environment

3.3 RISPO partnership activities

RISPO is currently collaborating with the "National Performance Assessment and Subregional Strategic Environment Framework in the Greater Mekong Subregion (GMS)" project under the Asian Development Bank's technical assistance for Strategic Environment Framework for GMS (SEF II) and Global Environment Facility (GEF).

The primary objectives of the project are to facilitate:

(1) Informed decision making through better understanding of the state of the environment and the impacts resulting from sustainable development policies

(2) Effective and efficient management of national environmental programs and improved public accountability for results on environmental issues, biological diversity, climate change, use of water, air and water pollution, and solid waste disposal

[2] Adapting Mosaic- a name of scenario for ecosystem assessment, characterized by regionally decentralized and environmentally conscious societies

[3] Order from Strength- a name of scenario for ecosystem assessment, characterized by regional consolidation

[4] Global Orchestration- a name of scenario for ecosystem assessment, characterized by high degree of globalization and economic growth

[5] Technogarden- a name of scenario for ecosystem assessment, characterized by rapid increase in environmental industries supported by globalization

(3) Response to national, subregional, and international demands for information and performance assessment related to the environment in the region

The collaboration between APEIS and the GEF/SEF II project is expected to yield mutual benefits for both projects. The outputs of APEIS research can be used by policy makers in the GMS when implementing projects and APEIS is able to produce more user-friendly products in response to the needs of policymakers.

Working together with the GMS national governments and international organizations—such as the United Nations Environmental Programme (UNEP) and the Asian Development Bank (ADB)—the National Institute for Environmental Studies (NIES) and the Institute for Global Environmental Strategies (IGES) provide expertise to the GEF/SEF II project through exchange of views and discussion with the involved parties. Specifically, NIES (IEA) takes part in the development of "Decision Support Systems", and the IGES (RISPO) contributes to "Needs Assessment and Gap Analysis", as well as to "Development and Implementation of Environmental Performance Assessment Systems" at a subregional level.

The First Expert Group Meeting for the National Performance Assessment and Subregional Strategic Environment Framework in the Greater Mekong Subregion (GMS). At this meeting, experts discussed a draft implementation plan of the project, suggesting the importance of including institution analysis and capacity building. UNEP Regional Resource Centre for Asia and the Pacific, Thailand, 8–9 July 2003

APEIS Web sites :

APEIS:
http://www.ecoasia.org/APEIS

APEIS-IEM :
http://www-basin.nies.go.jp/english/project/iem/index.html

APEIS-IEA :
http://www.nies.go.jp/social/aim/apeis/

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