

Annexes

Annex I List of contributing authors and organisations

The senior authors gratefully acknowledge the invaluable assistance of these people listed below. They participated during the meetings in the region and also provided valuable material during the production of this report. Most importantly was the extensive experience of the region that they were able to provide, particularly advice on policy options that would be applicable in some cultures but not in others. We wish to thank them for their help and sadly note that two of these have since deceased and will be sorely missed: Achmad Abdullah and Suraphol Sudara.

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Annex II

Detailed scoring tables

I: Freshwater shortage

| Environmental issues | Score | Weight | Environmental concern | Weight averaged score |
|-----------------------------------|-------|--------|-----------------------|-----------------------|
| 1. Modification of stream flow | 2 | N/a | Freshwater shortage | 2 |
| 2. Pollution of existing supplies | 1 | N/a | | |
| 3. Changes in the water table | 2 | N/a | | |

| Criteria for Economics impacts | Raw score | Score | Weight % |
|--|----------------------------|----------|----------|
| Size of economic or public sectors affected | Very small Very large | 2 | N/a |
| Degree of impact (cost, output changes etc.) | Minimum Severe | 2 | N/a |
| Frequency/Duration | Occasion/Short Continuous | 2 | N/a |
| Weight average score for Economic impacts | | 2 | |
| Criteria for Health impacts | Raw score | Score | Weight % |
| Number of people affected | Very small Very large | 1 | N/a |
| Degree of severity | Minimum Severe | 1 | N/a |
| Frequency/Duration | Occasion/Short Continuous | 1 | N/a |
| Weight average score for Health impacts | | 1 | |
| Criteria for Other social and community impacts | Raw score | Score | Weight % |
| Number and/or size of community affected | Very small Very large | 1 | N/a |
| Degree of severity | Minimum Severe | 1 | N/a |
| Frequency/Duration | Occasion/Short Continuous | 1 | N/a |
| Weight average score for Other social and community impacts | | 1 | |

Note: N/a = Not applied

II: Pollution

| Environmental issues | Score | Weight | Environmental concern | Weight averaged score |
|----------------------|-------|--------|-----------------------|-----------------------|
| 4. Microbiological | 2 | N/a | Pollution | 2 |
| 5. Eutrophication | 1 | N/a | | |
| 6. Chemical | 2 | N/a | | |
| 7. Suspended solids | 3 | N/a | | |
| 8. Solid wastes | 2 | N/a | | |
| 9. Thermal | 1 | N/a | | |
| 10. Radionuclides | 0 | N/a | | |
| 11. Spills | 2 | N/a | | |

| Criteria for Economics impacts | Raw score | Score | Weight % |
|--|----------------------------|----------|----------|
| Size of economic or public sectors affected | Very small Very large | 2 | N/a |
| Degree of impact (cost, output changes etc.) | Minimum Severe | 2 | N/a |
| Frequency/Duration | Occasion/Short Continuous | 2 | N/a |
| Weight average score for Economic impacts | | 2 | |
| Criteria for Health impacts | Raw score | Score | Weight % |
| Number of people affected | Very small Very large | 2 | N/a |
| Degree of severity | Minimum Severe | 2 | N/a |
| Frequency/Duration | Occasion/Short Continuous | 2 | N/a |
| Weight average score for Health impacts | | 2 | |
| Criteria for Other social and community impacts | Raw score | Score | Weight % |
| Number and/or size of community affected | Very small Very large | 2 | N/a |
| Degree of severity | Minimum Severe | 2 | N/a |
| Frequency/Duration | Occasion/Short Continuous | 2 | N/a |
| Weight average score for Other social and community impacts | | 2 | |

Note: N/a = Not applied

III: Habitat and community modification

| Environmental issues | Score | Weight | Environmental concern | Weight averaged score |
|--|-------|--------|------------------------------------|-----------------------|
| 12. Loss of ecosystems | 3 | N/a | Habitat and community modification | 3 |
| 13. Modification of ecosystems or ecotones, including community structure and/or species composition | 3 | N/a | | |

| Criteria for Economics impacts | Raw score | Score | Weight % |
|--|----------------------------|----------|----------|
| Size of economic or public sectors affected | Very small Very large | 3 | N/a |
| Degree of impact (cost, output changes etc.) | Minimum Severe | 3 | N/a |
| Frequency/Duration | Occasion/Short Continuous | 3 | N/a |
| Weight average score for Economic impacts | | 3 | |
| Criteria for Health impacts | Raw score | Score | Weight % |
| Number of people affected | Very small Very large | 1 | N/a |
| Degree of severity | Minimum Severe | 1 | N/a |
| Frequency/Duration | Occasion/Short Continuous | 1 | N/a |
| Weight average score for Health impacts | | 1 | |
| Criteria for Other social and community impacts | Raw score | Score | Weight % |
| Number and/or size of community affected | Very small Very large | 3 | N/a |
| Degree of severity | Minimum Severe | 3 | N/a |
| Frequency/Duration | Occasion/Short Continuous | 3 | N/a |
| Weight average score for Other social and community impacts | | 3 | |

Note: N/a = Not applied

IV: Unsustainable exploitation of fish and other living resources

| Environmental issues | Score | Weight % | Environmental concern | Weight averaged score |
|--|-------|----------|------------------------------------|-----------------------|
| 14. Overexploitation | 3 | N/a | Unsustainable exploitation of fish | 3 |
| 15. Excessive by-catch and discards | 3 | N/a | | |
| 16. Destructive fishing practices | 3 | N/a | | |
| 17. Decreased viability of stock through pollution and disease | 0 | N/a | | |
| 18. Impact on biological and genetic diversity | 2 | N/a | | |

| Criteria for Economics impacts | Raw score | Score | Weight % |
|--|----------------------------|----------|----------|
| Size of economic or public sectors affected | Very small Very large | 3 | N/a |
| Degree of impact (cost, output changes etc.) | Minimum Severe | 3 | N/a |
| Frequency/Duration | Occasion/Short Continuous | 3 | N/a |
| Weight average score for Economic impacts | | 3 | |
| Criteria for Health impacts | Raw score | Score | Weight % |
| Number of people affected | Very small Very large | 2 | N/a |
| Degree of severity | Minimum Severe | 2 | N/a |
| Frequency/Duration | Occasion/Short Continuous | 2 | N/a |
| Weight average score for Health impacts | | 2 | |
| Criteria for Other social and community impacts | Raw score | Score | Weight % |
| Number and/or size of community affected | Very small Very large | 3 | N/a |
| Degree of severity | Minimum Severe | 3 | N/a |
| Frequency/Duration | Occasion/Short Continuous | 3 | N/a |
| Weight average score for Other social and community impacts | | 3 | |

Note: N/a = Not applied

V: Global change

| Environmental issues | Score | Weight | Environmental concern | Weight averaged score |
|---|-------|--------|-----------------------|-----------------------|
| 19. Changes in the hydrological cycle | 1 | N/a | Global change | 1 |
| 20. Sea level change | 0 | N/a | | |
| 21. Increased UV-B radiation as a result of ozone depletion | 0 | N/a | | |
| 22. Changes in ocean CO ₂ source/sink function | 0 | N/a | | |
| 23. Changes in sea surface temperature | 1 | N/a | | |

| Criteria for Economics impacts | Raw score | Score | Weight % |
|--|----------------------------|----------|----------|
| Size of economic or public sectors affected | Very small Very large | 1 | N/a |
| Degree of impact (cost, output changes etc.) | Minimum Severe | 1 | N/a |
| Frequency/Duration | Occasion/Short Continuous | 1 | N/a |
| Weight average score for Economic impacts | | 1 | |
| Criteria for Health impacts | Raw score | Score | Weight % |
| Number of people affected | Very small Very large | 1 | N/a |
| Degree of severity | Minimum Severe | 1 | N/a |
| Frequency/Duration | Occasion/Short Continuous | 1 | N/a |
| Weight average score for Health impacts | | 1 | |
| Criteria for Other social and community impacts | Raw score | Score | Weight % |
| Number and/or size of community affected | Very small Very large | 1 | N/a |
| Degree of severity | Minimum Severe | 1 | N/a |
| Frequency/Duration | Occasion/Short Continuous | 1 | N/a |
| Weight average score for Other social and community impacts | | 1 | |

Note: N/a = Not applied

Comparative environmental and socio-economic impacts of each GIWA concern

| Concern | Types of impacts | | | | | | | | Overall score | Rank |
|---|---------------------|------------|----------------|------------|--------------------|------------|----------------------------|------------|---------------|------|
| | Environmental score | | Economic score | | Human health score | | Social and community score | | | |
| | Present (a) | Future (b) | Present (a) | Future (b) | Present (a) | Future (b) | Present (a) | Future (b) | | |
| Freshwater shortage | 2 | 2 | 2 | 3 | 1 | 1 | 1 | 2 | 1.8 | 4 |
| Pollution | 2 | 2 | 2 | 3 | 2 | 1 | 2 | 2 | 2.0 | 3 |
| Habitat and community modification | 3 | 3 | 3 | 3 | 1 | 1 | 3 | 3 | 2.5 | 2 |
| Unsustainable exploitation of fish and other living resources | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 3 | 2.8 | 1 |
| Global change | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 1.1 | 5 |

Annex III

List of important water-related programmes and assessments

Major inter-governmental agreements and actors

UN Economic and Social Commission for Asia and the Pacific, ESCAP

Within the Water Resources Programme under its Environment and Natural Resources Development Division, the UN ESCAP organises seminars and workshops on various issues relating to water resources, including: water resources assessment; integrated water resources development and management; protection of water resources, water quality and aquatic ecosystems; river basin development and management; promotion of infrastructure development and investment for drinking water supply and sanitation; water pricing and promotion of private investment in the water sector; water demand management, water saving and economic use of water; and mitigation of water-related natural disasters, particularly flood loss reduction.

Association of Southeast Asian Nations (ASEAN)

ASEAN was established in 1967 and has 10 member countries: Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, Philippines, Singapore, Thailand and Vietnam. The ASEAN Declaration states that the aims and purposes of the Association are: to accelerate the economic growth, social progress and cultural development in the region through joint endeavours in the spirit of equality and partnership in order to strengthen the foundation for a prosperous and peaceful community of Southeast Asian nations, and to promote regional peace and stability through abiding respect for justice and the rule of law in the relationship among countries in the region and adherence to the principles of the United Nations Charter. In 1995, the ASEAN Heads of States and Government re-affirmed that "Cooperative peace and shared prosperity shall be the fundamental goals of ASEAN."

- ASEAN work on water conservation (inclusive ANWRA) and seas and marine environment;
- ASEAN Network of Water Resources Agencies (ANWRA);
- the Strategic Plan of Action for the Environment (see below), adopted by the ASEAN Ministers of Environment;
- ASEAN 1997 Jakarta Declaration on Environment and Development.

UNEP Regional Office for Asia and the Pacific (ROAP)

Working closely with the Division of Regional Co-operation and Representation in UNEP's Nairobi-based headquarters, the Regional Office for Asia and the Pacific (ROAP) looks to adopt global

environmental policy to regional priorities and needs. It acts as a catalyst, coordinator, facilitator and mobiliser of resources. It puts particular emphasis on building partnerships with regional and sub-regional inter-governmental fora, other UN agencies, national governments, NGOs, the private sector, academic and research institutions, and civil society, and the media.

East Asian Seas Regional Coordinating Unit

Information on the UNEP East Asian Seas Programme can be found on the web site of the Coordinating Unit, which is located with ROAP. The Unit is the coordinating body for the East Asian Seas Action Plan (see below).

Financial institutions

Asian Development Bank (ADB)

The Asian Development Bank, a multilateral development finance institution, was founded in 1966 by 31 member governments to promote the social and economic progress of the Asia-Pacific region. It now has 58 member countries - 42 from within the region and 16 non-regional. ADB gives special attention to the needs of the smaller or less-developed countries, and to regional, subregional, and national projects and programs. Promoting sustainable development and environmental protection is a key strategic development objective of the Bank. To fulfill this objective, the Bank: (i) reviews the environmental impacts of its projects, programs, and policies; (ii) encourages DMC governments and executing agencies to incorporate environmental protection measures in their project design and implementation procedures, and provides technical assistance for this purpose; (iii) promotes projects and programs that will protect, rehabilitate, and enhance the environment and the quality of life; and (iv) trains Bank and DMC staff in, and provides documentation on, environmental aspects of economic development. The Asian Development Fund (ADF) is the concessional lending window of the Bank.

Action programmes, strategies and research

Strategic Action Programme for the South China Sea

The Strategic Action plan is based on the findings of the Transboundary Diagnostic Analysis for the South China Sea (see below). The actions proposed are wide-ranging in both context and areas of action. Targets for environmental quality are proposed with regard to habitats (mangroves, coral reefs, seagrass, estuaries and wetlands), fisheries management, and land-based pollution.

ASEAN Strategic Plan of Action on the Environment

The Strategic Plan of Action on the Environment for 1994-1998 has the following five objectives:

- To respond to specific recommendations of Agenda 21 requiring priority action in ASEAN;
- To introduce policy measures and promote institutional development that encourage the integration of environmental factors in all developmental processes both at the national and regional levels;
- To establish long-term goals on environmental quality and work towards harmonised environmental quality standards for the ASEAN region;
- To harmonise policy directions and enhance operational and technical cooperation on environmental matters, and undertake joint actions to address common environmental problems; and
- To study the implications of AFTA on the environment and take steps to integrate sound trade policies with sound environmental policies.

Despite the impacts of the recent economic crisis on the natural resources and environmental conditions, the ASEAN Environment Ministers at their Fifth Informal Meeting in April 2000 discussed the importance of keeping their commitment to environmental protection and sustainable development. Hence, to move forward towards the future goals and directions that the ASEAN leaders expressed in ASEAN Vision 2020 and the Hanoi Plan of Action (adopted in 1997 and 1998 respectively) the Ministers adopted the ASEAN Strategic Plan of Action on the Environment (SPAEE) for 1999-2004. It consists of the key activities to be implemented by ASOEN (ASEAN Senior Officials on the Environment) and its subsidiary bodies over the next five years, including the areas of coastal and marine environment, nature conservation and biodiversity, multilateral environmental agreements, management of land and forest fires and haze, and other environmental activities.

Partnership in Environmental Management for the Seas of East Asia (PEMSEA)

A GEF project, focusing on "building partnerships within and among governments of the region, as well as across public and private sectors of the economy. The goal is to reduce or remove barriers to effective environmental management, including inadequate or inappropriate policies, disparate institutional and technical capabilities and limited investment in environmental facilities and services". PEMSEA is "based on two management frameworks developed and tested in an earlier GEF Project: Integrated coastal management, addressing land-water interactions and the impacts of human activity in coastal areas; and risk assessment/risk management, applying to subregional sea areas and the impacts of human activities on marine ecosystems." PEMSEA web resources include: Virtual ICM; a Legal Information Database Reference

Catalogue; a Directory of Research and Management Institutions in Southeast Asia; and a database of Good Practices. See also the PEMSEA Updates, a free online newsletter.

UNEP Regional Seas Programme

The Regional Seas Programme was initiated in 1974 as a global programme implemented through regional components. The Regional Seas Programme is UNEP's main framework in the field of the coastal and marine environment. It includes 14 regions and three partner seas, involves more than 140 coastal states, and focuses on sustainable development of coastal and marine areas. Each regional action plan is formulated according to the needs and priorities of the region as perceived by the Governments concerned. Regional conventions are in place for several areas. See a map of all regional seas, and go to more information on the Black Sea, Wider Caribbean, Mediterranean, East Asian Seas, South Asian Seas, Eastern Africa, Kuwait Region, North West Pacific, Red Sea And Gulf of Aden, South East Pacific, North East Pacific, South Pacific, Upper South West Atlantic, and West and Central Africa. The UNEP Regional Seas web site also contains information on What's at stake, Major threats, and Actions.

East Asian Seas Action Plan

On the initiative of the five States of the East Asian region - Indonesia, Malaysia, Philippines, Singapore and Thailand - the Governing Council of UNEP in 1977 decided that "steps are urgently needed to formulate and establish a scientific programme involving research, prevention and control of marine pollution and monitoring " for a regional action plan in East Asia. An Action Plan for the Protection and Sustainable Development of the Marine Environment and Coastal Areas of the East Asian Region was adopted in 1981, with a decision making body, the Coordinating Body on the Seas of East Asia (COBSEA). A revised Action Plan and a Long-term Strategy for the COBSEA for the 1994-2000 period were developed in 1994 and Australia, Cambodia, China, Korea and Vietnam joined the Action Plan. A new East Asian Seas Action Plan (Leading the EAS Action Plan to the 21st Century) has been elaborated for the period 2000-2009.

State of the regional environment

Transboundary Diagnostic Analysis for the South China Sea

The TDA for the South China Sea and its associated catchment areas was a process that focused on identifying water-related problems and concerns, their socio-economic root causes, and the sectoral implications of actions needed to mitigate them. The chapter on State of the Environment covers modification of habitats, overexploitation of living aquatic resources, and pollution of aquatic environments.

GEO 2000 State of the Environment: Asia and the Pacific

Global Environment Outlook 2000. GEO is:

- A global environmental assessment process, the GEO Process, that is cross-sectoral and participatory. It incorporates regional views and perceptions, and builds consensus on priority issues and actions through dialogue among policy-makers and scientists at regional and global levels.
- GEO outputs, in printed and electronic formats, including the GEO Report series. This series makes periodic reviews of the state of the world's environment, and provides guidance for decision-making processes such as the formulation of environmental policies, action planning and resource allocation. Other outputs include technical reports, a web site and a publication for young people.

GEF Projects in the region

Projects under implementation

UNDP/GEF - International waters: Building Partnerships for the Environmental Protection and Management of the East Asian Seas

The objective of the project is to assist the riparian countries of the East Asian Seas to collectively protect and manage their heavily stressed coastal and marine environments through inter-governmental and inter-sectoral partnerships. These countries include the Republic of Korea which for the first time is a GEF recipient. Building upon the methodologies, approaches, typologies, networks and lessons learned from the pilot phase, the project would enhance and complement national and international efforts by removing or lowering critical barriers regarding policy, investment, capacity, which are having negative effects on the management of the coastal/marine environment in the region. Together with several water body-based projects in the area, these projects constitute GEF's programmatic approach to these coastal and marine waters with globally significant ecosystems that are experiencing severe degradation.

UNDP/GEF - International waters: Prevention and Management of Marine Pollution in the East Asian Seas

Development of policies and plans to control marine pollution from land-based and sea-based sources, upgrading of national and regional infrastructures and technical skills, and establishment of financing instruments for project sustainability. Project will include selection of demonstration sites, establishment of regional monitoring and information network, and involvement of regional association of marine legal experts to improve capacity to implement relevant conventions.

UNEP/GEF - International waters: Reversing Degradation Trends in the South China Sea

Major outcomes will include an approved Strategic Action Programme that will include: a targeted and costed programme of action and a recommended legal framework for improved regional cooperation in the management of the environment of the South China Sea; a series of national and regional management plans for specific habitats and issues; nine demonstration management activities at priority transboundary sites; a regional management plan for maintenance of transboundary fish stocks; and pilot activities relating to alternative remedial actions to address priority pollutants and adopted water quality objectives and standards. Activities include national level analyses and reviews and management of demonstration activities and regional harmonisation and coordination of national level actions.

World Bank - GEF - Biodiversity: Hon Mun Marine Protected Area Pilot Project, Vietnam

This project will support the conservation of critical marine biodiversity values at Hon Mun Island and its surrounding waters, located off Nha Trang in Khanh Hoa Province, south-central Vietnam. This will be achieved through the development of a zoned, multiple-use marine protected area (MPA) that protects globally important examples of Vietnam's best remaining coral reef, mangrove and seagrass ecosystems. This project will establish Hon Mun as an MPA pilot site, developing methodologies for MPA establishment and management that can be replicated in other areas as part of a national MPA system.

Project concepts in the pipeline

UNEP/GEF - International waters: Formulation of a Transboundary Diagnostic Analysis and Preliminary Framework of a Strategic Action Programme for the South China Sea

The primary objective of this project is to undertake an extensive transboundary diagnostic analysis for the South China Sea and the watershed draining into it. The transboundary diagnostic analysis will form the basis for formulating a framework for a SAP.

UNDP - GEF - Biodiversity/International waters: Biodiversity Management in the Coastal Area of China's South Sea

The project aims at protecting globally significant marine and coastal biodiversity along China's sub-tropical and tropical southeast.

Other actors, initiatives and resources

WorldFish Center (formerly ICLARM)

An international research organisation "devoted to improving the productivity, management and conservation of aquatic resources for the benefit of users and consumers in developing countries".

ICLARM is one of the research centres of CGIAR, Consultative Group on International Agricultural Research. ICLARM, in collaboration with the the Food and Agriculture Organization of the United Nations (FAO) and other partners, and with support from the European Commission, has developed FishBase, a global information system on fishes for research scientists, fisheries managers, zoologists and many more. FishBase contains full information on 23 500 species. ICLARM has also developed similar systems on coral reefs and their resources (ReefBase) and management of fish stocks in Asia (TrawlBase).

International Coral Reef Initiative (ICRI)

An environmental partnership that brings stakeholders together with the objective of sustainable use and conservation of coral reefs for future generations. ICRI is an informal mechanism that allows representatives of over 80 developing countries with coral reefs to sit in equal partnership with major donor countries and development banks, international environmental and development agencies, scientific associations, the private sector and NGOs to decide on the best strategies to conserve the world's coral reef resources.

Coral Health and Monitoring Programme (NOAA)

The mission of the NOAA Coral Health and Monitoring Program is to provide services to help improve and sustain coral reef health throughout the world. Long term goals: Establish an international network of coral reef researchers for the purpose of sharing knowledge and information on coral health and monitoring. Provide near real-time data products derived from satellite images and monitoring stations at coral reef areas. Provide a data repository for historical data collected from coral reef areas. Add to the general fund of coral reef knowledge. See also Global Coral Reef Monitoring Network, GCRMN.

The International Coral Reef Initiative (ICRI) launched the GCRMN in 1996 to improve management and sustainable conservation of coral reefs for people by assessing the status and trends in the reefs and how people use and value the resources. The GCRMN links existing organisations such as Reef Check, CORDIO, CARICOMP, AGRRA and ReefBase to promote ecological and social, cultural and economic monitoring of coral reefs. The GCRMN produces the 'Status of Coral Reefs of the World' reports every 2 years and activities in the South China Sea are coordinated from the WorldFish Center in Penang Malaysia (www.gcrmn.org & www.reefbase.org).

Annex IV

List of institutions that affect water use

Institutional Environment Water Sector

China

The main institutions involved in water resources management are:

- Ministry of Water Resources (MWR), responsible for water resources survey and assessment, rural water planning and development, and management and protection of water resources. The Ministry of Water Resources directly supervises the Water Resources and Hydroelectric Power Construction Corporation, and administers 13 higher education institutions and 7 regional basin commissions.
- Local Water Resources Management Department, responsible for water administration at provincial level. Each province has a Water Resource Bureau responsible for planning, survey, design, construction, operation and management of irrigation, drainage, flood control works, and rural hydroelectricity. Water resources bureaux at the prefecture and county levels are directly responsible for the construction and maintenance of main and secondary canals, associated irrigation and flood control structures, and medium-sized reservoirs. Townships and villages share responsibility for constructing and maintaining branch canals, ancillary works, and small reservoirs.
- Ministry of Geology and Mineral Resources cooperates with the MWR in the management of groundwater resources.
- State Environmental Protection Bureau deals with the protection of water resources.
- Ministry of Agriculture is responsible for state farm water conservation, construction and management.
- Ministry of Construction is responsible for urban water conservancy including groundwater exploitation and protection.

China's water law was enacted in 1988 and establishes principles, general guidelines, and technical standards for water resources management.

Vietnam

The Ministry of Water Resources (MWR) is the main body charged with setting policy, and responsible for the planning, management and allocation of water resources at the central level. The MWR is responsible for constructing headworks and canals for schemes larger than 150 ha, while the provinces are responsible for developing smaller schemes. Several divisions of the MWR are particularly important for agricultural water control. The Institute of Water Resources Planning prepares

national plans, policies, objectives and strategies for water resources management and development which are used as guidelines by the provinces. It also prepares prioritised lists of investment projects for consideration by the state planning committees.

The Office of Irrigation and Drainage Management oversees the management of irrigation and drainage structures, develops policy guidance, produces operations and maintenance guidelines and collects data. It operates one national irrigation scheme in Dau Tieng, and interacts with other schemes through provincial or regional Irrigation and Drainage Management Committees and Provincial Peoples Committees.

The Vietnamese Hydraulic Investigation and Design Company is the technical design arm of the MWR. The Construction Management Department, financially autonomous since 1994, develops procurement and construction management policies and guidelines for the water resources sector and monitors the activities of construction enterprises building MWR schemes. Other institutions involved with irrigation planning and management include the Ministry of Science, Technology and Environment, which formulates environmental policies, which may include water related issues. The General Department for Meteorology and Hydrology undertakes surveying and hydrographic data collection and monitoring. The Ministry of Energy manages electricity generation, transmission, and distribution for uses including irrigation pumping.

The World Bank irrigation rehabilitation project, being implemented since 1995, is funding the rehabilitation and completion of seven irrigation schemes comprising a total area of 130 000 ha, at a total investment cost estimated at 40 million USD. The Red Delta water resources sector project provided 75 million USD, financed by the Asian Development Bank, to rehabilitate or upgrade 20-30 small to medium-scale irrigation schemes in the Red Delta. The project was implemented by the MARD and was completed recently.

Thailand

Some 38 ministerial departments under 10 ministries, one independent agency and six national committees are involved in water resources development, with responsibilities for water policy, irrigation, domestic and/or industrial water supply, fisheries, flood alleviation, hydropower generation, navigation or water quality. The National Water Resources Committee (NWRC), under the Office of the Prime Minister, is responsible for setting a policy to develop water resources throughout the country. The National Economic and Social Development Board is responsible for economic planning. The Department of Mineral Resources, under the Ministry of Industry, monitors groundwater resources, while surface

water monitoring is mainly carried out by the Department of Energy Development and Promotion under the Ministry of Science, Technology and Environment, and the RID, which has its own network.

Many departments or agencies are involved in water supply for domestic or industrial purposes. The main one is the Metropolitan (or Provincial, outside Bangkok) Waterworks Authority. Wastewater treatment and water quality are mainly the responsibility of the Ministry of Science, Technology and Environment. Large dams are operated either by the RID or by the EGAT, while small dams have been developed by the Land Development Department or the Office of Accelerated Rural Development (under the Ministry of Interior). The Harbour Department is in charge of protecting inland waterways, and of issuing licenses for navigation. Irrigation is managed by the RID for public schemes, or by the Department of Energy Development and Promotion for the electric pumped schemes. The RID is the supervising agency for private irrigation.

A groundwater act adopted in 1987 defines the responsibilities, rights and duties of each of the various parties involved. In May 1998, a national water resources act was awaiting cabinet approval. This act should establish the NWRC as the coordinating agency for water resources development. Although work began some years ago on a national water resources master plan for water resources development in the 25 river basins, this work has come to a standstill due to lack of funds.

Philippines

The NWRB coordinates the activities of the different agencies involved in the water sector (irrigation, hydropower, flood control, navigation, pollution, water supply, waste disposal, watershed management, etc.). The other main agencies involved in water resources management are:

(i) In water supply and wastewater:

- Metropolitan Waterworks and Sewerage System (MWSS) of the Department of Public Works and Highways (DPWH), which is responsible for water supply, storage, treatment, research, design, construction and maintenance of water supply and sewage systems in the national capital region and outlying service areas in nearby provinces.
- Local Water Utilities Administration (LWUA) of the Department of Public Works and Highways (DPWH), which is responsible for the development and improvement of water and sewerage systems in areas not covered by the MWSS.

(ii) In water resources monitoring and development:

- Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA), which conducts monitoring, data

gathering and maintenance of information on rainfall and evaporation.

- Bureau of Research and Standards (BRS) of the DPWH, which is engaged in monitoring and studies of water resources as well as water research and quality standards. The DPWH is also responsible for flood control.
- NPC, which conducts water resources monitoring, research and hydropower generation.

(iii) In irrigation:

- NIA of the Department of Agriculture, which was created in 1974 with the mandate to initiate an 'irrigation age'. Its tasks include the development, operation and maintenance of irrigation systems throughout the country. In particular, it has been responsible for the construction of NIS schemes, and is now responsible for the recovery of irrigation fees.
- Bureau of Soils and Water Management (BSWM) of the Department of Agriculture, which handles, through its Project Management Office (PMO), the construction and maintenance of SWIM projects.

The SWIM projects have been implemented by the Government to mitigate damage brought about by insufficient water supply during the dry season and the frequent floods during the rainy season. The objectives might differ from one project to another, and the following agencies are involved:

- DPWH, for water supply, inland fishing and mini-hydropower;
- NIA, for irrigation;
- Forest Management Bureau (FMB), for watershed management with an incidental purpose of flood control;
- National Electrification Administration (NEA), for mini-hydropower generation.

The 1976 Water Code of the Philippines revised and consolidated the laws governing the ownership, appropriation, utilisation, exploitation, development, conservation and protection of water resources which are subject to government control and regulation through the NWRB.

Malaysia

The responsibility for water resources planning and development is shared by various government agencies. Malaysia has no single water resources authority for an overall coordinated planning and integrated river management approach.

The Department of Irrigation and Drainage (DID), under the Ministry of Agriculture, is responsible for the planning, implementing

and operation of irrigation, drainage and flood control projects throughout the country. The Department of Agriculture (DOA) is responsible for providing advice and extension services to the farmers. In the water supply sector, the Public Works Department (PWD), under the Ministry of Public Works, is responsible for the planning, implementation and operation of urban water supply projects. However, in line with the Government's privatisation policy, many water supply projects have already been taken over by water supply companies or privatised.

The Ministry of Health (MOH) provides untreated but drinkable water to rural communities not served by the local water authorities. The MOH also monitors water quality at water treatment plant intakes as well as the quality of water within the distribution system for compliance with national drinking water standards.

The control of water pollution is the responsibility of the Department of Environment (DOE), which is empowered to enforce compliance with effluent standards for point sources of pollution. The Ministry of Housing and Local Government is responsible for compliance with regulations and standards on sewerage works which have been privatised to a national sewerage company. Although either directly or indirectly much legislation touches on water resources, most of the existing laws are considered outdated. The Water Act of 1920 is inadequate for dealing with the current complex issues related to water abstraction, pollution and river basin management.

Indonesia

The 1945 constitution declared national water and land resources to be controlled by the State and that they should be utilised in an equitable manner for the benefit of the people. The responsibilities for the development and management of water resources and irrigation schemes are specified in laws, presidential instructions and government regulations. The most important are:

- Presidential Instruction No. 1 (1969), on the management of irrigation water and maintenance of irrigation networks;
- Law on water resources development No. 11 (1974);
- Government regulations on:
 - Beneficiaries contribution for maintenance cost of water resources facilities No. 6 (1981),
 - Water management No. 6 (1982),
 - Irrigation, No. 23 (1982),
 - Rivers (1991) and swamps (1991);
 - Decree of the Minister of Mining and Energy concerning underground water resources management (1983).

Numerous institutions are presently involved in water resources management. Their tasks and responsibilities are clearly stated in national legislation:

- The Ministry of Public Works, with its Directorate General of Water Resources Development, is responsible for planning, design, construction, equipment, O&M, and guidance in water resources development.
- The Ministry of Forestry is responsible for catchment area development.
- The Ministry of Environment is responsible for environmental quality development and management.
- The Environmental Impact Management Agency is responsible for environmental impact control.

Cambodia

The public institutions involved in the water sector are:

- General Directorate of Irrigation, Meteorology and Hydrology of the Ministry of Agriculture, Forestry and Fisheries, with:
 - Department of Water Management, which is responsible for the O&M of all irrigation infrastructure in Cambodia, including the operation and repair of pumps. The office also undertakes rural water supply, including well drilling;
 - Department of Engineering, which is responsible for the design and construction of hydraulic structures;
 - Department of Hydrology, which carries out the installation and maintenance of a network of hydrological stations, and collects and processes data;
 - Department of Meteorology, which is in charge of meteorological data collection and forecasting;
 - Department of Research, Training and Extension;
 - The Mekong Secretariat.

An informal 'water resources law task force' has been established through the Irrigation Sector Meeting of the interested parties. As part of this process, an adviser to the Ministry of Agriculture, Forestry and Fisheries (MAFF) has compiled a draft law on the water resources of Cambodia, which was due to be submitted in 1996. Domestic water supply is the responsibility of several institutions: the Department of Hydrology, the Ministry of Public Works and the Ministry of Rural Development.

Annex V

Criteria for scoring environmental impacts

| Issue 23: Changes in ocean surface temperature | |
|--|---|
| This refers to the impact on populations, species, and communities from changes in Sea Surface Temperature as a result of global change. | |
| Score 0 = No known impact | No measurable or assessed effects of SST increase. |
| Score 1 = Slight | Slight impact is determined when one or more of the following criteria are met or exceeded: Measured assessed effects of SST are causing a behavioral change in some species without affecting the viability of the population |
| Score 2 = Moderate | Moderate impact is determined when one or more of the following criteria are met or exceeded: Community structure is measurably altered as a consequence of changes in SST. Populations are declining. |
| Score 3 = Severe | Severe impact is determined when one or more of the following criteria are met or exceeded: Measured/assessed effects of changed SST are leading to massive loss of communities or a change in biological diversity. |

Annex VI

The South China Sea Large Marine Ecosystem

(Excerpted from LME 2004)

Brief description

The South China Sea Large Marine Ecosystem is bounded by the coasts of Vietnam, China, Taiwan, the Philippines, Malaysia, Thailand, Indonesia and Cambodia. It is separated from the Gulf of Thailand, to the West, by a shallow sill (Piyakarnchana 1989, Eiamsa-Ard & Amornchairojkul 1997). The South China Sea contains many biological sub-systems and a variety of habitats. These include mangrove forests, seagrass beds, coral reefs and soft-bottom communities. The 50 m depth contour largely follows the coast, with the widest shelves occurring along the eastern edge of the LME. Much of the South China Sea is below 200 m. Small coralline areas can be found south of Cambodia, between Borneo (Malaysia) and Sumatra (Indonesia), and off Palawan Island (Philippines) in waters deeper than 200 m (Pauly & Christensen 1993).

Productivity

The South China Sea is a biologically diverse marine ecosystem. It is considered a Class II, moderately high productivity (150-300 gC/m²/year) ecosystem based on SeaWiFS global primary productivity estimates. High productivity levels are found in gulfs, along the coast, and in reef and seagrass areas, common in the Philippines portion of the LME (Pauly & Christensen 1993). Production decreases with depth. For a study of productivity in the Southwestern South China Sea (eastern peninsula of Malaysia and southeastern Sumatra), see FAO (1981). Oceanic waters ranging in depth from 200 to 4 000 m cover nearly one-half of the South China Sea. Pauly and Christensen (1993) have developed a static, stratified model of the South China Sea ecosystem that accounts for consumption, exportation by fishing and migration, predation, and other mortality.

Fish and fisheries

The Pauly and Christensen (1993) fisheries model incorporates data from several regions. The coastal and estuarine areas off of Vietnam, China and Cambodia are very productive. In the past, a substantial fraction of the Vietnamese catch was taken by artisanal, non-mechanised boats. South Vietnam's demersal resources were exploited primarily by Taiwanese vessels. The Northwestern coast of the Philippines is a soft-bottom area fished intensively by trawlers (Silvestre et al. 1989). The deep shelf area of South China Sea is predominantly fished by Taiwanese vessels (Yeh 1981). There are no catch or biomass data for shrimp or crabs, and information

on catches of demersal fish is sparse. In deep oceanic waters (200 to 4 000 m), fisheries are limited to large pelagic fishes, mainly tuna (Pauly & Christensen 1993). Other species harvested are billfish, swordfish, shark, porpoise, mackerel, flying fish, anglerfish and shrimp. The total fish harvest is approximately 5 million tonnes per year. This is about 13% of the area's total fish production, the rest being eaten by predators. Five of the countries are among the top 8 shrimp producers of the world. Fishermen sometimes use small-meshed nets and practice destructive fishing methods, such as cyanide and dynamite fishing. While 2/3 of the major fish species are overexploited, carefully constructed fishing regimes could result in increased catches (Pauly & Christensen 1993). The Vietnam/China area was lightly exploited from the mid-1970s to the mid-1980s. By now much of this potential has probably been realised. The deeper coralline areas and those situated in the central portion of the LME are only slightly exploited, leaving room for an increase in production there (Alcala 1981, White 1989). The potential areas for an increase lie in the deeper areas of the LME, but these are areas difficult to fish. The University of British Columbia Fisheries Center has detailed fish statistics for this LME.

Pollution and ecosystem health

The health of the South China Sea Large Marine Ecosystem is in serious decline due mainly to coastal development. Presently, 270 million people (5% of the world's population) live in the coastal areas of the South China Sea LME, and this population is expected to double in the next three decades. This population explosion is driven by world trade, tourism, industrialisation, fisheries, and oil exploration and exploitation. The area's rapid economic development and population growth are the cause of significant ecological damage in coastal and marine areas. The primary environmental threats by humans in the South China Sea are the destruction of mangrove forests, sewage pollution, exploitative fishing practices and overfishing, coral reef degradation, and damage to seagrasses and wetlands. Only a third of the region's mangrove forests remain. 65% of mangrove forests have been lost or converted into shrimp farms, industrial areas or tourist resorts. The mangroves are chopped up for wood chips or firewood. Their disappearance on such a large-scale has led to sediment erosion, water pollution, loss of biodiversity and a critical loss of nursery habitat for young fish. Sewage-laden water causes disease downstream. Sewage pollution affects biodiversity and fisheries. 2/3 of major fish species are overfished. 80% of the coral reefs are at risk from pollution, overexploitation and cyanide and dynamite fishing for reef fish. Other pollution problems are increased river sedimentation and the effects of climate change, which affect the corals. 125 major rivers flow into the South China Sea. The effects of increased sedimentation and nutrients, plus destructive fishing practices, are being felt in the region's other

major habitat, seagrass communities, of which 20 to 50% were found to be degraded. Many fish nursery areas and breeding grounds are being degraded. UNEP has undertaken the COMEMIS project (Coastal Marine Environment Management Information System), to help improve the region's capacity to make sound environmental assessments through GIS.

Socio-economics

The South China Sea LME contributes to the livelihood of millions of people engaged in world trade, tourism, industry, fisheries and oil exploitation. However, the ongoing depletion of the sea's marine resources is likely to adversely affect the region's economy. The South China Sea is the world's second busiest international sea lane.

Governance

Seven nations are involved in the governance of the South China Sea LME. The countries are Cambodia, China, Indonesia, Malaysia, Philippines, Thailand and Vietnam. The region, in experiencing a phase of rapid economic development and population growth, did not account for the environmental consequences: the degradation of its resources and water quality. Until now, narrow state interests and power politics have characterised the interaction between countries, and the influence of environmental groups has remained inconsequential. Rapid economic growth has also sharpened conflicts between the various sectors within governments. This was especially true of China in the past decade. Governments of the South China Sea region are now coming to see that the marine environment in the region is under threat. Environmental ministries are now in place, and environmental laws and regulations are being formulated. The Chinese government has asked for help from UNDP to implement integrated coastal management through the establishment of demonstration zones. This project was initiated in 1997, with an investment of 1.1 million USD from UNDP, and 18 million yuan (2.2 million USD) from China. The United Nations Environment Program (UNEP) has unveiled a regional plan to try to reverse the degradation of the South China Sea by starting 9 pilot projects for sustainable development at priority transboundary sites in the region. UNEP's Strategic Action Plan for the South China Sea has been endorsed by all ASEAN members as well as by the People's Republic of China. This is the first time the seven countries have agreed to collaborate around the marine biology of the region. Several of the countries have contending claims to large areas of the South China Sea, leading to political tensions among them. The claims are about the status of the Paracel Islands and the Spratly Islands, which are said to contain minerals, oil and gas resources. In 2001, these Asian nations agreed to set aside their quarrels in order to save the South China Sea, and signed a joint agreement to the UNEP project. They will cooperate

on a 32 million USD plan to protect the marine environment. The Global Environment Facility (GEF) is contributing 16 million USD to this plan. As knowledge of environmental hazard is spread through the region, the impetus for conflict resolution will grow. GEF funding will secure a comprehensive package of marine environmental research and projects that will build human and institutional capacity. Through their concern for the environment the countries of the South China Sea can be brought closer together as they discover their common heritage and the importance of the Sea as a source of protein for the growing coastal populations. For a map of the area and information on managing potential conflicts in the South China Sea LME, on the status of conventions, and for a transboundary diagnostic analysis for this LME, go to the University of Oslo web site (<http://sum.uio.no/southchinasea/links/recommend.html>).

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Annex VII

Irrigation, water withdrawal, and drainage development

(Excerpted from FAO Aquastat 2004)

China

Since the founding of the People's Republic of China in 1949, irrigation and drainage have experienced a period of vigorous development. From 1958 to 1985, about 64 368 million yuan were spent on irrigation and drainage projects. The irrigated area for farmland increased from 16 million ha in 1949 to 51 million ha in 1996. After 1949, in order to promote agricultural production, pump irrigation and drainage were developed rapidly. The total area equipped for irrigation, including farmland, orchards and pastures, was 52 943 200 ha in 1996, representing 55% of the total cultivated area. Surface irrigation is the method practised (mainly for rice, wheat, millet, vegetables, corn and cotton) on about 99% of the total equipped irrigated area. The remaining 1% is under sprinkler and localised irrigation. The total water withdrawal was 525.5 km³ in 1993, of which 385 km³ for irrigation, 22.66 km³ for rural domestic uses and livestock, 25.17 km³ for urban domestic and public uses, and 92.55 km³ for industrial water use. The total water demand for 2000 was estimated at 593 km³, with 7% for domestic and municipal use, 21% for industry, and 72% for irrigation. In 1995, the total amount of wastewater produced was 37.29 km³, of which 23.33 km³ was treated. The re-used treated volume was 13.39 km³. The Ministry of Water Resources estimates the maximum possible area which might be brought under irrigation in the first half of the 21st century at 64 million ha. Nevertheless, as much of the land proposed for irrigation is located in arid and semi-arid zones, a long-term viable strategy has to be formulated as to how to provide additional water resources to irrigate these lands.

Vietnam

Modern irrigation development stagnated until the reunification of the country in 1975. Early post-1975 growth was in small and medium irrigation schemes, while in the period 1985-1990, growth was concentrated in large irrigation and multipurpose schemes. The total irrigated area expanded at a rate of 2.9%/year in the period 1980-1987, while between 1988 and 1994 it was 4.58%/year. The total annual water withdrawal for agriculture, industries and domestic purposes was estimated at 54.3 km³ in 1990. The total domestic demand in 1990 was estimated at 2.0 km³/year for both urban and rural consumers. This volume for domestic water use was estimated at 1.3 km³ in 1980 and is expected to reach 2.9 km³ by 2000. National industrial demand

was 1.5 km³ in 1980, rising to 5.3 km³ in 1990. It is expected to reach 16.0 km³ in 2000. In 1980, agriculture used 35.0 km³ of water. In 1990, agricultural water withdrawal was estimated at 47.0 km³, or 86.5% of the total water demand, of which some 6.5 million m³ were for livestock. The estimated water demand for agricultural purposes for 2000 is 60.5 km³. Approximately 1.46% of Vietnam's water demand is met by groundwater. The balance comes from surface water sources such as rivers, lakes and reservoirs. Groundwater is mainly used for domestic water supply in urban areas. With rehabilitation of existing infrastructures in the Red and Mekong deltas, there is the potential to expand irrigation to some 700 000 ha. The overall irrigation potential in Vietnam is estimated at 6 million ha. In 1994, the actual irrigation capacity was just 70% of the three million ha of equipped area. Two-thirds of this area were in the two large deltas (37% in the Red Delta, and 27% in the Mekong Delta). In 1994, about 49% of the cultivated area was irrigated. In 1990, there were 5 071 irrigation schemes in operation. The drainage system covers over 1 million ha, mostly in the northern and central parts of the country, particularly the Red Delta.

Thailand

In modern times, canal construction for irrigation started at the beginning of the 20th century. The aim was to maintain water in canals for irrigation and navigation, and to drain paddy fields during periods of flooding. Irrigation has traditionally been supplementary irrigation for the wet season. It is only recently that schemes have been designed for dry season irrigation. The area equipped for wet season irrigation was estimated at 5 003 724 ha in 1995. Thailand develops 120 000 ha of irrigation each year (2% of the equipped area). In 1988, the area actually irrigated was estimated at 91% of the equipped area. All schemes are irrigated by surface irrigation: sprinkler and drip irrigation are at an experimental stage only on fruit trees. The irrigation potential for the wet season can be roughly estimated at 12 million ha, considering both soil and water availability but excluding basin transfers. The total area suitable for irrigation is estimated at 16 million ha. The total water withdrawal in 1990 was estimated at 33.13 km³, of which 91% was for agricultural purposes. Domestic and industrial water withdrawals are increasing substantially every year.

Philippines

The major irrigation investment periods have been the 1920s, the post-second world war period and the 1970s and early 1980s when public involvement in the irrigation subsector was at its maximum. In this respect, the creation of the National Irrigation Agency (NIA) in 1964 has been decisive. The irrigation potential was estimated at 3.1 million ha in 1990. It corresponds to the area where irrigation facilities can easily be provided by the Department of Agriculture

or the NIA. A World Bank survey has proposed the reassessment of irrigation potential as the figure of 3.1 million ha was obtained without considering new settlement on agricultural lands, water resources availability, water resources development cost, need of flood control and drainage facilities, etc. In 1992, the area of land equipped for full/partial control irrigation was estimated at 1 532 751 ha. Irrigation water is generally supplied by river diversion. The total water withdrawal was estimated on the basis of the water rights issued by the National Water Resources Board (NWRB) to 55 422 million m³ in 1995, of which 88% is for agricultural purposes, 8% for domestic and 4% for industry. Other water withdrawal (non-consumptive use of water) included hydropower (89 000 million m³), fisheries (498 million m³) and recreation (93 million m³). Production of wastewater in the national capital region and nearby provinces is estimated at 74 million m³, while the volume of treated wastewater reached 10 million m³ in 1994 at the Ayala and Dagat-Dagatan pond. Disposal of wastewater is expected to increase as new sewer lines are being built every year.

Malaysia

Since the formation of the Department of Irrigation and Drainage in 1932, irrigated areas for paddy cultivation have progressively increased. By 1960, about 200 000 ha had been developed, the emphasis then being on supplementing rainfall for single crop cultivation. During the 1960s and early 1970s, the introduction of double cropping of rice cultivation required the development of adequate water resources for the second cropping season. During the 1980s, the priority for irrigation took on a new dimension with the need to rationalise rice cultivation and increase its productivity. Malaysia has over 932 irrigation schemes covering an area of 340 633 ha. In addition, there are 21 967 ha which are inundation and control drainage schemes (1994 estimates). The current irrigation efficiency is around 35-45%. In 1994, the total drained area was 940 633 ha. About 600 000 ha were drained for oil palm cultivation, using public funding for smallholders. The issues of salinity, waterlogging and water-borne diseases are not reported as being significant. The annual internal renewable water resources are estimated at 630 km³. As surface water is readily available throughout the year, it is abstracted mainly for irrigation and domestic uses. The groundwater potential is limited to some pockets of the coastal region and is generally exploited by rural people to supplement their piped water supply. Surface water represents 97% of the total water use, while groundwater represents 3%. About 60-65% of groundwater utilisation is for domestic and/or municipal purposes, 5% for irrigation and 30-35% for industry. The total water demand increased from 8.7 km³ in 1980 to 12.7 km³ in 1995, and was projected to increase to 15.2 km³ by 2000. Irrigation currently accounts for about 9.7 km³ or about 76% of the total water consumption. However, irrigation demand is expected to taper

off as no further expansion in irrigated paddy cultivation is envisaged. The potential irrigable area is approximately 413 700 ha.

Indonesia

Modern irrigation systems were introduced in the middle of the 19th century. In 1969, with the launching of the five year development plan (Repelita), the Government started a major program in irrigation development which included:

- Rehabilitation of existing irrigation works;
- Expansion of service areas in existing schemes;
- Construction of new irrigation systems;
- Upgrading of semi-technical irrigation systems to technical level;
- Introduction of special maintenance to upgrade the physical infrastructure;
- Implementation of efficient operation and maintenance procedures for launching sustainable Operation and Maintenance (O&M) programmes;
- A credit programme;
- Among other initiatives.

In the first 25 years of development, spanning five Repelitas (1969-1993), water resources policies were directed to support the development of different sectors with the primary emphasis being on agriculture. The success of this development is demonstrated by the country having achieved food self-sufficiency, particularly in rice, since 1984. Another result of Indonesia's development was the reduction of poverty from 44% of the population (54 million people) in 1969 to 13% (26 million people) in 1993. Indonesia has now embarked on the second 25-year development period (1994-2019), with emphasis on sustainable development and management of water resources. Water resources have now been elevated to a full sector level and policies are directed to promoting a more effective and efficient management of water resources in an integrated manner. Greater emphasis is placed on sustaining self-sufficiency in rice and on the O&M of water resources infrastructure. In addition, the Government is implementing a crash programme in Repelita VI to improve 1 million ha of village irrigation systems and to develop a 600 000 ha rice estate by swamp reclamation in central Kalimantan. In 1990, water withdrawals were 69.24 km³ for agriculture, 4.73 km³ for domestic and municipal water supply and 0.38 km³ for industrial use.

Cambodia

Modern irrigation systems were first developed in the period 1950-1953. Many of the structures built during that period functioned until 1975. Most of these structures, such as the 'colmatage' canals, have become non-functional as a result of the network of irrigation/drainage

systems built during the period 1975-1979. Since then, most attempts to rehabilitate these newer schemes have failed. Irrigation potential has never been estimated in terms of physical area which could be irrigated considering water and land resources. A recent FAO survey indicates that a number of areas appear suitable for groundwater exploitation, though there are still uncertainties about water quantity and quality. The lack of data, particularly on water quality, is a cause for concern as there are reports on iron toxicity from Svay Rieng province, close to the border with Vietnam, as well as increased tidal saline incursion from the Mekong River in May-June. Water withdrawal was estimated at 520 million m³ in 1987, of which 94% is used for agricultural purposes.

Brunei

Urban water supply is entirely from surface water. The major use of water in industrial processes is for the liquefied natural gas industry which abstracts and treats its own water from the Sungai Belait River. Other industrial uses are on a smaller scale for timber/sawmills, dairy farms, soft-drink manufacture and workshops which account for an estimated 25% of overall water demand. In 1994, the total water withdrawal was estimated at 91.59 million m³. Initially, groundwater abstraction was undertaken in the 1950s for use by the oil and gas industries. This has been replaced by surface water sources. Groundwater abstraction, which accounts for 0.5% of the total water supply, is currently limited to the local bottled water industry. All irrigation facilities were equipped in 1980. There are only minor irrigation schemes (up to 0.9 ha). Irrigated agriculture represents 1 000 ha, and all irrigation is surface irrigation. The existing infrastructure and facilities are being upgraded in rural areas, but the irrigated area has remained unchanged since 1980. The major irrigated crops are rice, vegetables and fruits. The figures for rice show that the country is able to meet only 3.6% of the total demand of 27 500 tonnes/year. Lack of labour is the main constraint on agricultural development in the country.

Socio-economic costs

In Thailand, early irrigation systems were designed to operate at full capacity only in the wet season. The canal capacities and control regulators are inadequate for the increasing demand for dry season irrigation. Furthermore, irrigation water demand has to compete with demand from other sectors. This becomes a sensitive issue during the dry season. A certain flow of water must be maintained for navigation, to prevent saltwater intrusion, and to supply water for domestic and industrial purposes in the Bangkok area. In the dry season, water resources can no longer meet the increasing water demand from all sectors, and particularly for the irrigation subsector which needs to withdraw more and more water because of the development of dry season irrigation (FAO 1999). This water competition has led to poor agricultural performance in recent dry seasons.

On average, the Government of Thailand spends 45 USD/ha/year for O&M. In the northeast, 10% of the irrigated land is affected by salt (FAO 1999). The salt bearing nature of the soil parent material has been identified as the primary cause for this. Other activities such as irrigation could be classed as secondary causes for accelerating this locally. Many programmes have been launched in order to correctly manage cash crops and paddy on saline soils. Salinisation is now reported to be affecting large areas in the coastal parts of Thailand's central plain.

In China, most irrigation projects constructed in the 1950s and 1960s can no longer be operated effectively. The development of sprinkler irrigation, initiated since the early 1950s, increased until 1980, when large areas were abandoned due to the poor quality of equipment and poor management. This has resulted in a continuous decline in irrigation benefits and has had a direct impact on the stability of agricultural development and on the economy. In principle, all water users must pay water charges. FAO (1999) report that since 1985, the water charge has been calculated on the basis of the cost of the water supply. The water charge for agriculture is usually lower than that for industry. Where shortages occur, a rational water allocation system is practised and dissuasive charges are applied to extra volumes of water. On average, water charges for irrigation varied between 150 and 300 yuan/ha (17.96 and 35.92 USD/ha) in 1995.

In Cambodia by comparison, a recent FAO survey has estimated that the development of 1 ha irrigated by pumping would require an investment cost of 2 800 USD, and 85 USD/year for operation and maintenance (O&M), placing considerable strain on the economy. In Indonesia in 1992, the average cost of developing a surface irrigation scheme was 3 645 USD/ha while the average O&M cost of a surface irrigation system was 8.4 USD/ha/year. In Vietnam, irrigation fees were first established in 1984 in some provinces (e.g. Vinh Long). The fee for irrigation and drainage services represents from four to 8% of the total crop output.

In the Philippines, under the National Irrigation System (NIS) schemes, the average cost of irrigation development is estimated at 3 800-7 600 USD/ha for new schemes, while the cost for the rehabilitation of existing schemes varies from 1 000-1 600 USD/ha. On all National Irrigation System schemes in the Philippines, the fees collected by the National Irrigation Agency should cover the costs for operation, maintenance and even the investment cost within a reasonable period of time to an extent consistent with government policy. However, in practice, capital cost recovery is confined to the communal sector and the fees collected covered only 80% of O&M expenditure in 1989.

In Malaysia, water supply is undertaken by government agencies and privatised water companies. The coverage for water supply is 99% for urban areas but 77% in the rural areas. Farmers pay nominal irrigation charges which vary from 3-15 USD/ha/year. It is estimated that fees collected from farmers cover only 10-12% of the actual operational cost. The Government does not seek full cost recovery because the farming community is considered a low income group. About 32% of the water produced is lost in the distribution system due to several factors such as pipe leakage, under-metering, and other unaccounted water losses.

Trends in water resources management

China

The whole country is facing increasing water shortages. The policy of low water fees and free water delivery services practised in irrigation and drainage projects in the past has led to a situation where the funds needed for their regular maintenance and rehabilitation have not been available. In order to achieve the goals stipulated by the Government in the 9th Five Year Plan, irrigation should increase by 3.3 million ha and grain production capacity should increase by 40-50 million tonnes in the period 1995-2000. To achieve these objectives, the Government has decided to allocate part of the basic national construction fund for agriculture to the rehabilitation of the irrigation works. In 1985, the Government issued a new rule requiring water charges to be collected according to the cost of water delivery. At present, water charges are on average between a half to two-thirds of the water delivery costs. It is expected that cost recovery will be accelerated in the near future, with regional variations to take account of farmers' ability to pay.

Vietnam

Government plans indicate an accelerated growth rate of 4.5-5% for the agriculture sector. Other targets include:

- Reducing the number of very poor people by 50%;
- Reducing malnutrition among children to less than 30%;
- Providing clean drinking water to all the urban population and 80% of the rural population.

About 40% of the investment needed is projected to come from the Government, 15% from state enterprise and the rest from the private sector. The main items in the public investment program are transport and water supply (33%), and irrigation and agriculture (24%). The Ministry of Agriculture and Rural Development (MARD) has prepared a programme for rural development, which complements and builds on the strategy for the agriculture sector. The major objectives are to raise incomes and living standards in rural areas; diversify the rural economy

through increased production of high value crops; and conserve the natural resource base, particularly land and water.

For 2010, the main targets are to:

- Raise GDP per capita in the rural areas to 1 000 USD;
- Irrigate 80% of all cultivated land;
- Increase forested areas;
- Raise food production to 40-45 million tonnes.

Thailand

A lot of sites for dams have been identified in order to supply more water to the Chao Phraya River. However, nearly all the suitable sites for large-scale projects have been already exploited. The remaining undeveloped potential sites are either in heavily populated areas or in national park reserves. The resettlement of population and environmental issues are so sensitive that no decision has been taken concerning such dams, even though detailed design studies have been ready for more than 15 years in some cases. The Kaeng Sua Then and the Nam Choan projects have been a cause of conflict between developers and conservationists. It seems increasingly clear that there will be less scope for the development of such large-scale projects in the future.

There is a great need for water in the central region for both irrigation and urban water supply. Most of the water used in the central region comes from the northern region. This follows a set of rules established when the main needs were in the central region. In the last few years, there has been an increasing demand for water, especially in the irrigation sector, in the northern region. If the observed trend continues, and if all projects are implemented, a point will be reached in the near future where water released from the northern region, after satisfying requirements there, will not be sufficient to meet the irrigation water demand in the central region. To address this problem, the Government has launched many programmes to both reduce demand and increase the resources available. The ongoing national economic and social development stresses the need for a more efficient use of water, and in particular the importance of collecting water fees in irrigated agriculture to avoid wastage. Agricultural water fees should cover only O&M costs, while for the other sectors (domestic and industrial) the fees should also take account of the construction and maintenance costs of water distribution systems. To increase the available resources, inter-basins transfer projects are being studied and implemented. One such project already exists, diverting water from the Mae Klong River to the Chao Phraya central plain. Other projects, such as diversion of water from the Mekong, Mae Kok and Mae Ing rivers to the Yom and Nan rivers, are more politically sensitive. Desalination or re-use of treated wastewater have still not been envisaged.

Philippines

The majority of the population depends on agriculture for its livelihood and irrigation is considered a crucial element in agricultural production. With the potential irrigable area of 3.1 million ha, irrigation development is only at the halfway stage. Self-sufficiency in food has been set as a target by the Government. Agricultural development through irrigation, therefore, still remains a priority on the Government's agenda. The Irrigation Crisis Act (Republic Act No. 6978) signed into law in January 1991, mandated the National Irrigation Agency to develop the remaining 1.5 million ha of irrigable lands within ten years through the construction of irrigation projects including other related project components. Irrigation, soil and water management have been set as a priority on the agenda of the Department of Agriculture. The Medium Term Philippine Development Plan (1994-1998) also envisages a fast pace in irrigation development.

Malaysia

Agriculture will remain the main user of water in the future. However, its importance was projected to decline from approximately 76% to about 70% of total water consumption by 2000. In the irrigation sector, future efforts will focus on demand management through improved water management rather than on supply management. In the water resources sector, there is a need to review the planning and development of dams. Most of the existing dams were generally designed for one single purpose by various government agencies and privatised utility companies. Future dams will be designed with consideration for multipurpose usage through improved coordination and the optimisation of resources. There is also an urgent need to address the issue of water pollution, which could have a serious economic impact if left unchecked. The Government is studying the feasibility of setting up a national body to manage the rivers as well as the creation of a national water council to improve federal-state government cooperation in water resources management.

Indonesia

The Ministry of Public Works through its Directorate General of Water Resources Development (DGWRD) identified four main missions in water resources sector programming as part of Repelita VI (1994-1999):

- Maintenance of self-sufficiency in rice production to achieve long-term food security. Although Indonesia achieved self-sufficiency in rice production in 1984, demographic growth, land use changes, variations in rainfall, climatic changes, drought, flooding, drainage problems in low-lying areas and urbanisation have resulted in rice shortages requiring the importing of rice and the building up of costly rice buffer stocks. The DGWRD directs its programming

towards activities which support the continued increase in rice production to maintain self-sufficiency.

- Provision of water to meet increasing water supply demands. Rapid industrialisation, increasing urbanisation and the need to supply the nation's population with safe drinking water have necessitated the development and maintenance of adequate water sources and supplies of proper quality water in many regions of the country. Often, the water needs are at locations far away from good quality water sources, so requiring large capital investments for conveyance infrastructures. The water sources are continuously subjected to water quality degradation due to urban, industrial and upper watershed pollution. The DGWRD directs its programming to develop sources of good quality water and supply to demand centres to meet the needs for water supply.
- Flood alleviation and river management. Many of Indonesia's agricultural and urban areas are located in the lowlands. The majority of rivers flood frequently due to the high intensity rainfall in the watersheds and influx of sediment, particularly in lowland areas. In addition, the river morphology and carrying capacities are continuously changing due to sediment problems, large variations in flow, and human encroachment. To protect investment and economic activity as well as to ensure the availability of surface water resources close to demand centres, the DGWRD direct its programming to continuously improve flood protection and drainage, through both structural and non-structural measures, and to manage water bodies such as ponds, lakes and reservoirs.
- Water resources development, conservation and management. The archipelago nature of the country, variations in rainfall, large fluctuations in river flows and lack of proper storage sites have hindered the nation's ability to meet the increasing water demands. The gradual degradation of upper watersheds, poor groundwater resources, increasing water quality problems in the lower reaches of the rivers, and the inefficient use of water require a greater focus on water resources, conservation and prevention. Thus, to ensure the continued availability of water resources, the DGWRD direct its programming towards steps to improve water resources availability through appropriate conservation and management measures.

The four missions directed by the DGWRD are being implemented through a number of major and support programmes. The water resources sector now has two major subsectors:

- Water resources development, with three major programmes:
 - Water resources development and conservation,
 - Supply and management of water,
 - Management of rivers, lakes and other water resources;

- irrigation with, two major programmes:
 - Development and management of irrigation networks,
 - Development and management of swamp areas.

Cambodia

Under the National Socio-Economic Development Plan, 1996-2000, water supply and wastewater treatment have been set as priorities by the Government. As new irrigation scheme development has a low economic internal rate of return (1-6%), the rehabilitation of existing schemes has been set as a priority by the Government. Priority is given to small-scale schemes, as large-scale schemes have serious operation and maintenance problems. The estimated potential of irrigated agriculture production is high for small-scale irrigation schemes with active community participation and in combination with other agricultural technology packages, especially balanced fertiliser use. Indeed, soil fertility is a major problem in Cambodia and production increase with irrigation alone would remain relatively limited. Priorities include:

- The development of well-designed flood control devices in conjunction with irrigation facilities to enable drainage in times of flooding, and irrigation in the dry season;
- Construction of several dams, mainly for hydropower purposes.

Brunei

The water demand for 2000 was estimated at 105 million m³, depending on the growth of the population and expected increase in per capita consumption as a result of increased urbanisation. Efforts are being made to diversify the economy away from a heavy dependence on oil and gas towards a more independent agriculture sector. The first of the Government's four major objectives in agriculture is to enhance domestic production of paddy, vegetables, poultry and livestock. The Government is trying to stimulate greater interest in agriculture through the establishment of model farms, and by providing training, advice and support.