

THE FAO-ESCAP PILOT PROJECT ON NATIONAL WATER VISIONS

Bangkok, December 2004

FROM VISION TO ACTION

**A SYNTHESIS OF EXPERIENCES IN LEAST-DEVELOPED
COUNTRIES IN SOUTHEAST ASIA**

Le Huu Ti

and

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United Nations
ESCAP

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GLOSSARY

ADB	Asian Development Bank
ASEAN	Association of Southeast Asian Nations
FAO	Food and Agriculture Organization
GDP	Gross domestic product
GIS	Geographic Information System
JICA	Japan International Cooperation Agency
LDC	Least-developed country
MOWRAM	Ministry of Water Resources and Meteorology
MW	Megawatt
NGO	Non-governmental organization
R&D	Research and development
RAP	Regional Office for Asia and the Pacific
SLORC	State Law and Order Restoration Council
UNCHS	United Nations Centre for Human Settlements
UNDP	United Nations Development Programme
UNESCAP	United Nations Economic and Social Commission for Asia and the Pacific
UNICEF	United Nations Children's Fund
WHO	World Health Organization
WTO	World Trade Organization

FROM VISION TO ACTION: A SYNTHESIS OF NATIONAL WATER VISIONS IN LEAST-DEVELOPED COUNTRIES IN SOUTHEAST ASIA

1

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1. INTRODUCTION

1.1 Background

Building on the enthusiasm for better management of water resources in the region generated by the World Water Vision development process, a project of cooperation between the Food and Agriculture Organization of the United Nations (FAO) and the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP) was initiated in 1999 with a view to promoting the development of national water visions in Southeast Asia. The joint initiative was conceived of as an anchoring component of a learning process, the aim of which was integrated water resources management in the region. It was planned that the joint project would be a cornerstone of the continuing national water vision building process and would thus help to establish a firm foundation for a regional water vision development programme. In the initial phase of the joint effort, four pilot countries, namely Malaysia, the Philippines, Thailand and Viet Nam, were selected to capitalize on the achievements of the Global Water Partnership for the World Water Vision process. On completion of the initial phase of this joint effort in 2000, the results were disseminated to all the participating countries as well as other countries in the region, posted on the Internet¹ and published by the FAO Regional Office for Asia and the Pacific² for wider dissemination.

In the second phase of the project, further joint efforts were made to assist three least-developed countries (LDCs) in Southeast Asia, namely Cambodia, Lao PDR and the Union of Myanmar, to formulate programmes to transform their national water visions to action.

1.2 Approaches adopted in the national water vision formulation process

“The Vision Exercise’s ultimate purpose is to generate global awareness of the water crisis that women and men face and the possible solutions in addressing it. This awareness will lead to the development of new policies, legislative and institutional frameworks. The world’s freshwater resources will be managed in an integrated

¹ http://www.fao.org/documents/show_cdr.asp?url_file=/DOCREP/004/AB776E/AB776E00.HTM

² Le Huu Ti and Thierry Facon. 2001. From Vision to Action: A Synthesis of Experiences in Southeast Asia. The FAO-ESCAP Pilot Project on National Water Visions. RAP Publication 2001/06, Bangkok.

manner at all levels, from the individual to the international, to serve the interests of humankind and planet earth—effectively, efficiently and equitably.” (Source: **W.J. Cosgrove and F.R. Rijsberman**. 1999. *World Water Vision: Making Water Everybody’s Business*, page 1)

Keeping the above purpose in mind, considerable national efforts have been made to manage water resources sustainably over the past few decades, particularly since the adoption of the Mar del Plata Action Plan by the United Nations in 1977. The National Water Vision to Action programme formulation process introduced a new methodology aimed at developing a more “strategic approach” to the management of the world’s water resources. Within this process and in line with the above purpose of the joint technical cooperation project between FAO and UNESCAP, national expert teams of the three selected countries in Southeast Asia carried out the following tasks:

a. *Reviewing national experiences related to the formulation of national water visions*

The vision process was viewed from the perspective of “a pragmatic programme or framework of action” to respond to the different development needs (short-term, and thus urgent, as well as long-term needs) and to ensure sustainable management of the country’s water resources. Discussions focused on the national formulation processes and related experiences.

b. *Identifying key components of the national water vision formulation process*

From the experience of the World Water Vision process and subsequent exercises, which involved different levels of consultation and different components, such as subsector visions, regional visions and thematic and regional vision syntheses, it was expected that the key components of the corresponding processes of formulating a national water vision would be identified. As the importance of the subsectors may be different from one country to another, this section was expected to examine how the important subsectors were identified and integrated into the process of formulating a national water vision. In order to ensure active participation of stakeholders it was intended that the relative importance of the components would be viewed from the perspective of the key stakeholders.

c. *Reviewing the framework for the development and management of a national water vision*

In view of the importance of the development and management of a national *shared* water vision, it was expected that a pragmatic framework for such a shared vision would be formulated in order to ensure the feasibility of implementation and management. It was concluded that water resources management is increasingly practiced worldwide at river basin level, meeting both society’s economic and social needs and the needs of nature. Discussions therefore focused on the relative importance of the framework of water resources management at the river basin level, within the water vision formulation process.

d. *Organizing a round-table of national experts from related agencies to discuss the country reports*

A two-day round-table discussion of national experts was organized in each of the three selected countries by the respective supporting national institutions and the national expert teams, with the participation of FAO and UNESCAP officers, to discuss the findings for finalization of the country reports.

1.3 Purpose of this synthesis

This synthesis was prepared as part of the second phase of the project, which has assisted in developing stronger and closer regional cooperation, and in synchronizing regional efforts for better IWRM and more effective contributions to economic and social development in the region. Within this regional context, the synthesis describes how the processes of formulating national water visions were carried out, discusses the findings and recommendations derived from these efforts, and the possible strategies for further strengthening related regional efforts.

2. IMPLEMENTATION OF THE SECOND PHASE OF THE PROJECT

2.1 Selection of countries

The second phase of the project was devoted to assisting the three LDCs in this subregion, namely Cambodia, Lao PDR and the Union of Myanmar. It should be pointed out that a number of studies had been carried out in Cambodia and Lao PDR in previous years in the context of formulating a regional water vision for Southeast Asia, and technical assistance had already been given by the Asian Development Bank and the Global Water Partnership. These studies (together with previous studies undertaken by the relevant authorities in Myanmar) were used as a basis for formulating a national water vision to action programme for each of the three countries. The findings and experience derived from these previous studies were also adopted to improve the way in which the strategic approach was applied to the implementation of the second phase of the project.

2.2 Implementation arrangements

Following the experience of the first phase of this project, and taking into account the limited absorption capacity of the LDCs, the project put greater emphasis on the implementation modalities that would ensure continuity of the efforts and sustainability of the momentum generated by the country case studies. Such modalities would need to build on the central role of the national agency responsible for the formulation of national water resources policies or plans in each of the selected countries. In the implementation of the country case studies, the project received considerable assistance from various national experts and the support of senior officials of the three national governments concerned, especially from the Ministry of Agriculture and Irrigation of Myanmar. The focal points of the country studies are listed below:

- **Cambodia:** Dr Theng Tara, Director, Department of Water Resources Management and Conservation, Ministry of Water Resources and Meteorology, and his colleagues.
- **Lao PDR:** Mr Pholchaleun Nonthaxay, Director, National Water Coordination Committee Secretariat, and his colleagues.
- **Myanmar:** A special working team set up by the government and related agencies headed by Mr Kyaw San Win, Director General, Irrigation Department, Ministry of Agriculture and Irrigation.

The project required substantive contributions from UNESCAP and FAO, not only to coordinate contributions and review the country case studies, but also to provide advisory services, including the organization of seminars and the preparation of technical papers on international experiences and approaches adopted in the formulation of national water visions for integrated water resources management and for agriculture and rural development. This synthesis is also part of the substantive contribution to the project made by the technical staff of UNESCAP and FAO.

2.3 Organization of national round-table discussions of the country case studies

Following the review of the draft reports on the country case studies by the UNESCAP and FAO officers concerned, a two-day round-table workshop of national experts was organized in each of the countries by the respective supporting national institutions and experts according to the following schedule:

- **Lao PDR:** 18-19 December 2002 in Vientiane – attended by 32 participants from the various government agencies constituting the National Water Resources Coordination Committee and representatives of international organizations, including FAO and ADB.
- **Cambodia:** 7-8 January 2003 in Phnom Penh – attended by 39 participants (including several senior officials) representing different government agencies and international organizations, including the Mekong River Commission Secretariat and Japan International Cooperation Agency.
- **Myanmar:** 23-24 June 2003 in Yangon – attended by 36 participants from the various water-related government agencies. Apart from the 36 participants, about 30 invited guests took part in the opening ceremony, which was presided over by the Deputy Minister of Agriculture and Irrigation, Mr Ohn Myint.

In all these round-table workshops, FAO and UNESCAP officers presented their findings on recent studies related to the formulation of a national water vision to action programme and took part in subsequent detailed discussions.

2.4 Preparation and submission of the final country reports

After the completion of the round-table workshops, the country study reports were revised jointly by the national experts and UNESCAP and FAO officers to incorporate the findings and recommendations of the round-table discussions. In the chapters following this synthesis the main findings and recommendations of these country reports are summarized and examined in the context of a regional cooperation project, taking into account any developments that have occurred since the round-table discussions. The country case study reports and other relevant reports are listed in the bibliography at the end of this synthesis.

3. IMPORTANT FINDINGS AND RECOMMENDATIONS

3.1 A comparative analysis of achievements in the least-developed countries before the studies

The three countries, Cambodia, Lao PDR and Myanmar, provide an interesting picture of LDCs with different political and socio-economic conditions within the region. As can be seen from Table 1.1, extracted from the Report on the Asian Development Outlook 2004 of the Asian Development Bank (ADB), Cambodia and the Lao PDR recorded similar economic growth rates between 2001 and 2004. Over the next few years, the Lao economy is expected to grow faster than that of Cambodia because of the increase in foreign direct investment, particularly in the hydropower subsector, e.g. the Nam Theun 2 project³. With respect to the Union of Myanmar, the economy recorded higher rates of growth for the same period than those of the other two countries. However, according to ADB:

³ According to the ADB, the Electricity Generating Authority of Thailand (EGAT) has agreed to buy electricity from the Nam Theun 2 plant over a period of 25 years.

Table 1.1 GDP growth of LDCs in Southeast Asia (in percent)

Country	2001	2002	2003	2004	2005 (Projected)
Cambodia	5.7	5.5	5.0	5.4	5.4
Lao PDR	5.8	5.9	5.9	6.0	6.2
Myanmar	8.1	>10	>10	--	--

Source: *Asian Development Outlook 2004*, Asian Development Bank, Oxford University Press, 2004.

“[i]n view of the very limited reform agenda apparent at this time, growth prospects of Myanmar in the medium term are limited. International sanctions look likely to continue curbing exports and foreign direct investment. Insufficient investment in social areas and the slowdown in fixed investment suggest less than satisfactory reductions in poverty. The longer-term prospects for sustained growth are good, but only if the Government moves toward policies that reduce the macroeconomic imbalances and structural distortions.”

As agriculture accounts for the main share of the gross domestic product (GDP) and represents the most important sector in terms of the use of water resources, the solid growth of this primary sector is expected to make an important contribution to poverty reduction.

3.2 Findings related to the formulation and implementation of national water visions in the least-developed countries of Southeast Asia

The “strategic approach” referred to in Section 1.2 emphasized the formulation and implementation of a national water vision to action programme, especially for the priority components (sectors or areas) of integrated water resources management in each of the three countries.

a. National water vision statements

Cambodia

- *Access for all to safe, adequate and affordable drinking water, hygiene and sanitation.*
- *Freedom for all from the threat of loss of life and livelihood as a result of floods and droughts.*
- *Sufficient water where it is needed, to provide for food security, people’s livelihoods, and economic activity.*
- *A water environment that is unpolluted and supports healthy fisheries and aquatic ecosystems.*

Lao PDR

- *The coordinated development and management of water and water resources for the health, wealth and happiness of the people.*
- *A national programme of poverty alleviation and the socio-economic development objective of liberating the country from the status of least-developed country.*

Myanmar

Sustainability of water resources by the year 2030 to ensure sufficient water quantity of acceptable quality to meet the needs of the people in terms of health, food security, economy and the environment.

The process of formulating the national water visions varied among the three countries. For example, the Cambodian national water vision was derived from the policy formulation process and thus was much more detailed than that of Lao PDR or Myanmar. However, in the process of developing an overall framework for action on IWRM for the three countries, a consolidated and integrated vision was adopted to guide the formulation of targets in each country. Therefore, the frameworks for action developed in the three countries are more or less similar in terms of the linkage between the national water visions and the various programmes of action. However, the details of the various subsectors were different as the priorities in each country depended on the potential and opportunities available to it. Further details can be found in the country study reports.

b. Fundamental features of the national water vision to action programmes

All representatives of line ministries and related agencies recognized the importance of the national water vision as a guide for integrated water resources management in all sector activities and at all levels of water resources management in the country. It was also recognized that enhancing awareness and acceptance of the national water vision would facilitate coordination of activities among all relevant sectors and at all management levels.

Cambodia

All representatives of line ministries and related agencies agreed that the Ministry of Water Resources and Meteorology (MOWRAM) should be the key agency responsible for the implementation and realization of the national water vision. In this connection, they identified various aspects and key activities required to create an effective framework for turning the vision into reality. These activities include those related to the water law, policies and regulations as well as the mobilization of resources and the participation of the key stakeholders in the management and development of the country's water resources. The participants recognized the importance of successful implementation of the national water vision in different sectors and for different priorities of the national development process. Of these, the participants focused on four themes suggested by MOWRAM: poverty reduction and rural development; economic development and nature conservation; pilot basin management for the Prek Thnot river basin; and the establishment of a framework to turn the national water vision into reality. The participants identified indicators and targets as well as the expected role of MOWRAM in facilitating efforts to achieve the proposed targets. These initial efforts identified a number of challenges to MOWRAM as leader of the water sector, especially with respect to the mobilization and allocation of financial resources to the water sector. Responses to these challenges would therefore need to be included in the strategy and programme of work of MOWRAM. The participants therefore expected the support of UNESCAP and FAO, as well as other international organizations, to continue. These findings suggest the need for a systematic and coordinated approach to the introduction of integrated water resources management in Cambodia. This systematic approach is centred on the key role of MOWRAM. This is the most important and fundamental difference when compared to the previous findings related to the implementation of the national water vision. Efforts should be made to identify the core activities that MOWRAM would undertake to build on the confidence entrusted to it by the representatives of the line ministries and related agencies.

In the above context, efforts should be made to introduce a dual approach to realizing the national water vision:

1. Overall approach: MOWRAM is to undertake the programmes related to the framework of turning the national water vision into reality and to the implementation of the pilot river basin management project.
2. Sectoral approach: Related subsector agencies are to undertake priority activities related to the programmes on poverty mitigation and rural development, and economic development and nature conservation.

Lao PDR

During the past three years, important progress in the improvement of water resources management in the Lao PDR has been made, especially following the establishment of the Water Resources Coordination Committee. The most important achievements were related to the coordination of activities and the increase of interest and attention by the government and the donor community in the management of water resources. Among these achievements was the development of the national water vision and the related change in perception of key water resources stakeholders on the need for better coordination. These changes enabled the round-table workshop on turning a national water vision into action to introduce a more centralized approach to coordination in the realization of the national water vision. All participants recognized the importance of the coordinating role of the Water Resources Coordination Committee in the promotion of integrated water resources management at the national and river-basin levels. This change in perception made it possible to introduce a two-pronged approach in the programme of action for the realization of the national water vision:

1. Overall approach: The Water Resources Coordination Committee is to undertake the programmes related to the framework of turning the national water vision into reality and the implementation of the pilot river basin management project.
2. Sectoral approach: Related subsectoral agencies are to undertake priority activities related to the programmes on poverty mitigation and rural development, and economic development and nature conservation.

Myanmar

To achieve the priority objectives of the national water vision, the working-group members recommended the following actions:

1. A national-level water authority should be instituted first to adopt the policies regarding the control, conservation, development, use and protection of the country's water resources.
2. All existing laws, rules and regulations should be reviewed with a view to enacting a unified water resources law so as to promote a more effective legal framework for coordination and management of water resources.
3. Resources for the development and management of water resources for the socio-economic development of the country should be mobilized.
4. An IWRM plan should be formulated to guide the coordination of development activities.
5. Effective measures should be taken on the basis of community participation through educational programmes and programmes designed to help meet the basic needs of the communities.

6. The specific responsibilities of the focal agencies, especially in developing national water quality standards and control, should be identified.

c. Programme to turn the national water visions into reality

The results of the national consultations conducted for the country studies revealed that the consultations had reinforced the acceptance of the national water visions, thus making them “**shared visions**”. All key agencies have thus recognized and appreciated the need to establish concrete programmes of action for consistent and fruitful implementation of the national water visions. These key agencies have thus expressed their interest in and commitment to implementing the respective national water visions. In this context, the establishment of the frameworks for turning the national water visions into reality was studied and discussed during the preparatory seminars and national round-table workshops using the strategic planning process. In this strategic planning process, the analysis focused on the need for the effective integration of relevant efforts and activities into the national development process and a sustainable programme of action. The planning analysis also included the implications of the participatory approach (**shared vision**), the need for brief institutional analyses (**key agencies and their respective missions**), key approaches to planning and management (**integrated river-basin approach**) and good governance principles (**performance indicators and monitoring**). It should be pointed out that from the strategic planning analysis mentioned above, the opportunities identified by the participants in the various consultative workshops differed, depending on the actual conditions and stage of development of each country, including ongoing efforts and existing policies. As such, no attempt was made to bring these opportunities together under a single framework.

The key elements of the frameworks to turn the national water visions into reality are summarized in the following sections.

Cambodia

To turn the national water vision into reality, the roundtable workshop identified the following three priority objectives:

- a. To strengthen the mechanism for coordination of and stakeholder participation in water resources management and development.
- b. To strengthen through human resources development for the water sector.
- c. To improve financial resources mobilization and allocation.

The workshop also proposed an overall strategy of promoting the adoption of the national water vision and establishing a mechanism for turning the vision into reality, including the mobilization of financial resources.

Strategy to strengthen the mechanism for coordination of and participation in integrated water resources management

- a. Indicators and targets: To reduce the number of conflicts related to water use and the number of violations of the water law by half within five to ten years.
- b. Priority actions:
 - To establish a coordination committee, consisting of MOWRAM and other line ministries and agencies.
 - To develop laws and regulations and strengthen their enforcement.

Strategy to strengthen human resources development for the water sector

- a. Indicators and targets: To double the number of experts and technical staff in the water sector within five to ten years.
- b. Priority action: To establish a scholarship programme for short- and long-term training within the country and abroad.

Strategy to improve financial mobilization and allocation

- a. Indicators and targets: To increase the total investment in the water sector by 30 to 40 percent within the next five to ten years.
- b. Priority action:
 - To collect and compile information on total investment in the water sector during the past decade.
 - To develop strategies for better mobilization of financial resources.
 - To establish a clear mechanism to implement the strategy immediately.

Possible mechanisms for coordination

Existing mechanisms include MOWRAM, Cambodia National Mekong Committee or river basin organizations. The strength of the existing agencies is that the laws and regulations are in place at all line agencies. However, the weaknesses of the existing system are the lack of effective law enforcement, lack of effective and popular mechanisms and means of communication and information dissemination, and lack of financial resources.

Possible roles of MOWRAM

- a. To prepare the enactment of the water law and other regulations.
- b. To maintain a database and disseminate information and data to the line agencies.
- c. To monitor the implementation process.
- d. To organize the preparation of the master plans for all main river basins in the country.

Suggested priority activities of MOWRAM

- a. To collect, compile and disseminate information and data to the line agencies.
- b. To monitor the implementation process of turning the national water vision into reality.
- c. To organize the master plan for the main pilot river basins in the country.

Lao PDR

At the round-table workshop, all participants from the line agencies expected the Water Resources Coordination Committee Secretariat to play the main role in the realization of the national water vision. The participants also recognized the importance of such a role in the implementation of fundamental and cross-cutting activities, such as training and capacity building, and enhancement of public awareness and public participation.

Strategic roles of Water Resources Coordination Committee

These fundamental activities are necessary in view of the following priority issues identified by the working group:

- Protection of water resources and efficient use of water;
- establishment of regulations, effective enforcement, and participation of stakeholders; and
- establishment of funds for water resources development and promotion of international cooperation.

Priority indicators and targets

In order to monitor the implementation of coordinated activities designed to help achieve the priority objectives, the working group identified the following indicators and targets:

- (1) Regarding sustainable development, it was considered necessary to develop indicators to reflect the overall quality of watersheds in the long run. In the short term, the working group recognized that the water quality should be a priority indicator for monitoring to ensure that the current good conditions were maintained.
- (2) With respect to the need to have a clear water resources policy, it was recommended to monitor the number of conflicts in water utilization or violations of the law and to reduce the number of conflicts or violations by half in five years.
- (3) Concerning the mobilization and utilization of resources, the working group proposed to inventory the current allocation and investment of funds in the water resources sector and recommended the preparation of a strategy to increase annual financial resources and to improve allocation among the subsectors. It was thought that this would ensure effective support to the national socio-economic development process and sustainable development. It was recommended that resource mobilization be doubled in five years.

Core mechanisms of monitoring

For proper monitoring and reporting, the working group suggested the use of the existing mechanisms as follows:

- (1) The Science, Technology and Environment Agency and Water Resources Coordination Committee should monitor and report on water quality and Water Resources Coordination Committee to develop indicators for the watershed quality.
- (2) Water Resources Coordination Committee should monitor and establish a programme for reduction of the number of violations of the law or conflicts in water utilization.
- (3) Either Water Resources Coordination Committee or a new mechanism should monitor financial resources allocation and utilization for the water sector.

Priority activities of Water Resources Coordination Committee

In support of the above programme, the working group recommended the following priority activities to be undertaken by Water Resources Coordination Committee:

- (1) Water Resources Coordination Committee to implement the plan of monitoring changes in water resources, including the new indicators of watershed quality, and report the results to the government.

- (2) Water Resources Coordination Committee to compile the number of conflicts and violations and make reports and suggestions for improvement.
- (3) Water Resources Coordination Committee to compile the resources allocation to water sectors and to consult all subsectors to prepare the strategy or plan to increase resource mobilization and utilization.

Among the priority activities, it was recommended that attention be paid to increasing financial resources with contributions from the government, donors and the people, and to ensuring that adequate amounts are allocated to all subsectors.

Priority programmes for coordination

In reviewing existing key programmes related to the priority objectives, the working group identified the following obstacles in the implementation of these programmes:

- (1) Sustainable development: Lack of good coordination among the subsectors concerned, including between Water Resources Coordination Committee, Science, Technology and Environment Agency, Ministry of Agriculture and Forestry and Ministry of Public Health; lack of sufficient number of capable technical staff; and weak administration system.
- (2) Clear water policy: Water utilization regulations are not clear and not complete; and responsibility-sharing in monitoring the subsector is not clear.
- (3) Fund raising and utilization: Insufficient budgetary resources and inadequate contribution from water users.

The working group discussed intensively the role of the Water Resources Coordination Committee in the creation of an effective framework for the realization of the national water vision and recommended the following:

- (1) The Water Resources Coordination Committee should assist in promoting the action plan.
- (2) The Water Resources Coordination Committee should be a neutral coordinator among subsectors.
- (3) The Water Resources Coordination Committee should be a neutral coordinator for cooperation with international agencies, including funding agencies.
- (4) The Water Resources Coordination Committee should assist in the coordination of activities concerned with the allocation of budgetary resources to satisfy the real needs of people.

Similarly, the working group also identified the priority activities of the Water Resources Coordination Committee and water subsectors as follows:

- (1) The Water Resources Coordination Committee should establish a system for monitoring and assessing water resources development.
- (2) The Water Resources Coordination Committee should establish strict regulations for water utilization.
- (3) The Water Resources Coordination Committee should establish a system for monitoring and data collection and exchange.

In this connection, the working group also recommended that all water-related agencies and stakeholders should:

- (1) Improve and strengthen human resources development in the water sector;
- (2) improve coordination and corresponding implementation procedures;

- (3) promote public participation in planning and implementation;
- (4) enhance public awareness on the effects of water utilization; and
- (5) increase cooperation with international organizations for more technical and financial assistance.

Myanmar

Priority objectives, issues and strategic approaches

a. Priority objectives

In recognizing the importance of the national water vision being accepted by all key stakeholders and the creation of an effective mechanism to promote, implement and monitor priority activities to turn the national water vision into reality, the working group recommended the following priority objectives:

- (1) To establish a national water authority.
- (2) To provide safe and adequate water to the public as the foundation for water resources management.
- (3) To ensure adequate availability of water for development.

b. Key conditions

- (1) Key conditions in the establishment of an effective national water authority would include the commitment of the government and acceptance by the agencies concerned.
- (2) Key conditions in the provision of safe and adequate water to the public would include reliable accessibility and convenience for the communities, and effective water quality control.
- (3) Important factors to ensure adequate availability of water for development would include clear action programmes of the concerned agencies, and the promotion and enforcement of water policies and action programmes for sustainable development.

c. Priority issues

- (1) National Water Policy.
- (2) Initiative of the government.
- (3) Coordination of agencies concerned.
- (4) Water quality control.
- (5) Public participation.
- (6) Financial support.
- (7) Economic development.
- (8) Integrated activities among the agencies.
- (9) Water policy and action programmes for sustainability.

d. Possible courses of action

- (1) By the Ministry of Agriculture and Irrigation and the Ministry of Electric Power
 - Provision of a frame for a national water authority.
 - Establishment of a national agency for water resources management.
- (2) By the Ministry of Finance and Revenue
 - Support for water resources projects.
 - Support for operation and maintenance.
- (3) By the Ministry of Planning and Economic Development
 - Long-term planning for economic development.
 - Development of natural resources.

e. Possible strategic approaches

- (1) Promotion of the national water vision.
- (2) Establishment of a national water commission.

Framework for a strategic plan

a. Indicators

- (1) Adoption of the national water vision by the government.
- (2) Establishment of a national water commission.
- (3) Promotion of water resources investment.
- (4) Improvement of community living standards.

b. Mechanisms

- (1) The Department of Agriculture Planning and the Ministry of Agriculture and Irrigation to coordinate the adoption of a national water vision.
- (2) Ministry of Agriculture and Irrigation to formulate and coordinate the establishment of a national water vision.
- (3) All the water-related departments and agencies need to carry out planning, prioritization and implementation of water resources projects.
- (4) Information, education and communication through capacity building in cooperation with institutions.

c. Time frame

- (1) For Target 1: The national water vision should be adopted within one year.
- (2) For Target 2: The national water commission should be established soon after adoption of the national water vision.
- (3) For Target 3: Water resources investment projects should be planned with a short term of five years and a long term of ten years.
- (4) For Target 4: The rural poverty line will be improved in parallel with the implementation of short- and long-term plans.

d. Possible courses of action

- (1) Coordination of concerned agencies; submission of the proposed national water vision to the competent authority; and collection of data and information on resources.
- (2) Effective utilization of safe water; public awareness on education of water-related diseases; and exploitation of new water resources.
- (3) Short- and long-term master plan(s); clear action programmes of concerned agencies; and sustainable financial support.

e. Recommended immediate action

- (1) Interim authority should be held by the Ministry of Agriculture and Irrigation.
- (2) Interim authority should proceed to promote adoption of the national water vision.
- (3) Interim authority to assign functions and duties to various departments and agencies.

Possible mechanism of the coordination body and priority functions

The working group also reviewed the functions of key agencies to be coordinated by the proposed national water commission and recommended that all functions of the key agencies should be executed under the guidance of the proposed national water commission. The priority activities are as follows:

1. Establishing a national-level authority for water resources management to develop national policies, master plans, legal and market instruments and guidelines;
2. ensuring long-term supply and demand planning and effective use of water resources including groundwater resources, in a complementary manner and with water quality control; and
3. promoting better coordination among water users and the agencies dealing with water resources development, sustainable water supply, capacity building for human resources and environment impact assessment.

d. Key components and other highlights of the national consultation process

Apart from focusing on the implementation of the national water visions as discussed above, most of the countries included other key components for national consultation, depending on the number of national experts participating in the national workshops. The list of these components is given below.

- **Cambodia:** Water for people: Poverty reduction and rural development; water for economic development and nature conservation; pilot river basin management – Prek Thnot river basin; and establishing a framework to turn the national water vision into reality.
- **Lao PDR:** Water for people: Poverty reduction and rural development; water for nature and economic development; pilot river basin management – Nam Ngum river basin; and establishing a framework to turn the national water vision into reality.
- **Myanmar:** Water for people: Poverty reduction and rural development; water for economic development and nature conservation; pilot river basin management – Sittoung river basin; and establishing a framework to turn the national water vision into reality.

Further details can be found in the case study reports.

e. Important features in the water resources for poverty reduction programmes

Cambodia

The majority of the population of Cambodia is poor and about 80 percent lives in rural areas. The current five-year national social and economic development plan aims to serve this poor majority and water resources management will play an important supporting role. On the basis of the general issues related to integrated water resources management identified in the preceding sections, the working group conducted three working sessions to identify priority objectives and related programmes of action for poverty alleviation and rural development in the countries, including identification of key actors, indicators of achievements and possible roles and priority activities of MOWRAM. Further details of the discussion are presented in the following sections.

Priority objectives and related programmes of action

Three priority objectives of water resources development for rural development and poverty reduction were selected as follows:

- a. Increase the incomes of the poor.
- b. Provide clean water and sanitation to the rural area.
- c. Create non-farm employment.

Regarding the first priority objective, the following programmes of action are required:

1. Construct or rehabilitate an irrigation system with capacity to supply water round the year (agriculture and domestic supply):
 - Carry out surveys and investigations to develop projects with high economic efficiency for the government or donors to invest in.
 - Ensure the participation of farmers in the operation and maintenance of the system.
2. Train farmers on diversified farming systems with high economic returns incorporating vegetables, aquaculture and livestock:
 - Organize a training seminar to introduce all concerned institutions to this programme (Ministry of Agriculture, Forestry and Fisheries, FAO).
 - Provide seeds and extension services (Ministry of Agriculture, Forestry and Fisheries, NGOs and donors).
 - Establish an agriculture credit system for rural areas (low or no interest system) (NGOs, international organizations).
3. Water user communities and agriculture communities:
 - Allocate water for use among the localities and individuals (MOWRAM and Ministry of Rural Development).
 - Provide guidance to local authorities on water use through training seminars and legislation (Ministry of Agriculture, Forestry and Fisheries, MOWRAM).

Key actors/agencies

To support efforts to increase poor farmers' incomes, the following key agencies were identified together with their priority activities:

- MOWRAM: Survey and investigate total areas for irrigation; provide training and disseminate information on good irrigation practices and the operation and maintenance of

an irrigation system; provide guidance and training on water utilization technology; disseminate information on water use law to different institutions.

- Ministry of Agriculture, Forestry and Fisheries: Determine areas of cultivation suitable for different crops; disseminate advanced technology; disseminate techniques on aquaculture in ponds and paddy fields; disseminate cultivation practices and water management practices; disseminate and provide guidance on modern technology; and provide training and guidance on the cultivation of specific crops as widely as possible; provide guidance on water management practices for different crops.
- Ministry of Rural Development: Improve health and sanitation in rural areas; provide information on markets; provide guidance on water use and hygiene; monitor clean water quality.

Indicators, targets and mechanisms

1. Increase income: From US\$300/year to US\$600/year in five years. Mechanisms include MOWRAM, Ministry of Rural Development reporting to the government. Issues and action: Capacity and skills and budget are required; planning and identifying areas for priority action. Strategy: Implementation and expansion of target areas.
2. Provide clean water and sanitation: Increase from 20 to 50 percent in ten years. MOWRAM and Ministry of Rural Development are required to be accountable to the government, including the efficient use of budgetary resources and meeting the set standards. Other priority programmes may include improving the existing water supply system and creating new water supply systems.
3. Create new employment opportunities: To increase non-farm activities by 60 percent in five years. Promotion could be carried out by Ministry of Agriculture, Forestry and Fisheries, MOWRAM and Ministry of Rural Development with necessary technical assistance and financial resources for the identification and planning of the priority areas for implementation.

Suggested improvement in existing programmes

- Provide and exchange information.
- Determine clearly the role of each ministry.
- Initiate collaboration between related ministries.

Lao PDR

Priority objectives

Three priority objectives of water resources development for rural development and poverty reduction were selected:

- Water resources development for agriculture and rural development (plantation, livestock and fisheries, etc.).
- Water resources development to meet basic needs, especially water supply for drinking and domestic uses.
- Water resources development for quality of life, including electrification: development of micro and small hydropower projects.

In order to create a conducive environment to achieve the above objectives at the national level, the working group suggested the following:

- Identification of development areas and focus areas (who, what and where, how) to create success cases for subsequent replication;
- participation of all stakeholders in all stages of development, including construction, and operation and maintenance;
- organization of water user associations and aquaculture groups; and
- promotion of conservation and management.

The working group also identified the following most common obstacles to achieving the three above priority objectives:

- Usually, the water sources or suitable sites are far from settlement areas.
- Construction cost is usually high.
- For water supply, water is usually of poor quality and often polluted and rural areas often lack testing equipment.
- Lack of financial resources.
- Lack of technical capacity for operation and maintenance.

Core agencies and key actors

The working group identified the following agencies to be the key actors in efforts to achieve the three priority objectives: (1) Ministry of Agriculture, Forestry and Fisheries, (2) Ministry of Public Health, and (3) Ministry of Industry and Handicrafts. The following priority actions were recommended:

- Formulation of clearer strategies for all ministries concerned for the short, medium and long terms;
- detailed planning and project investigations — human resources, funds, equipment, infrastructure facilities and time are required); and
- detailed planning with participation of local people — this would lead to (a) a feasibility study; (b) survey and design; (c) construction; and (d) operation and maintenance.

Indicators and targets

In order to help monitor progress in the implementation of priority activities, the working group identified the some key indicators and proposed targets, based on previous studies.

For agricultural development, indicators will be based on expected increase in incomes in the targeted areas. For the pilot area in the northern part of the country, GDP per capita is to increase from the current level of US\$240 to US\$500/yr by 2010. For this purpose, it is expected that the Ministry of Agriculture and Forestry, provincial authorities and the Ministry of Trade will play the key roles.

Specific activities to be carried out within the time frame up to 2010 would include the following:

- Rehabilitation of existing irrigation schemes to improve efficiency;
- expansion of irrigated area in appropriate locations;
- diversification of agriculture;

- improvement in agriculture extension work; and
- promotion of plantations, livestock and fisheries.

For the supply of drinking and domestic water, the number of people with access to water will increase from the current level of 52 to 60 percent in 2005 and 80 percent in 2020. To achieve these targets, the Ministry of Public Health and the Clean Water Authority will need to undertake the following priority activities:

- Planning and data collection;
- assessment of needs;
- design and construction; and
- the transfer of management to local authorities.

With the development of the region's small hydropower potential, it was expected that 20 percent of the households in the north would be provided with electricity from hydropower by 2010. It was proposed that the key agencies, the Ministry of Industry and Handicrafts, Water Resources Coordination Committee and Science, Technology and Environment Agency, undertake the following priority activities:

- Planning and data collection;
- water demand assessment;
- design and construction; and
- transfer management to local authorities.

Major priority programmes

The working group also identified major existing programmes that may have complementary roles in ensuring that the three objectives are achieved. These programmes are:

- Water for agriculture and rural development — it was considered that the rural development committees and various departments of Ministry of Agriculture and Forestry might not have functioned according to their mandates. Furthermore, problems also resulted from the lack of coordination and counterpart contribution.
- Water supply to meet basic needs — the Ministry of Public Health (Coordinating Committee for Clean Water) and Rural Development Committees are responsible for the main programmes on water supply. Improvement in communications was recommended.
- With respect to small hydropower development, the Ministry of Industry and Handicrafts is currently responsible, but it was considered that the lack of coordination with the Rural Development Committees might have hampered progress in the development of these resources for the welfare of the people.

In promoting coordination for agriculture and rural development, the working group recommended that the following key functions be played by Water Resources Coordination Committee:

- Coordinating with all above agencies to achieve the set objectives;
- seeking assistance from domestic and international resources (FAO, UNESCAP); and
- providing water resources data and information to all subsectors concerned.

In connection with these coordinating functions, the following priority activities should be undertaken by Water Resources Coordination Committee:

- Organize another meeting to present the findings of the workshop;
- draft a proposal for assistance;
- establish a team to deal with data collection; and
- promote and disseminate water resources regulations widely and at the grassroots level.

Myanmar

Agriculture, including livestock, fishery and forestry, is the most important sector of the national economy. Agriculture and rural poverty are closely linked. Development of the agriculture sector is the key to poverty reduction, and water is the most fundamental requirement for agricultural development.

Priority objectives

Members in the working group discussed many topics and basic concepts reflecting the importance of water resources management for poverty reduction. After discussion and identification, working-group members selected the following priority objectives for water resources management for poverty reduction:

- (1) To improve the quality of life of the people by developing and using the country's productive resources and social investment.
- (2) To provide water resources for the rural population in sufficient quantity and appropriate quality for sustainable development.
- (3) To protect the water environment so as to conserve water resources (surface and ground water) and natural flow regimes, biodiversity and cultural heritage, and to mitigate water-related hazards.

Priority issues

With respect to the first objectives, the following issues were identified as priority issues requiring special attention: Inadequate investment, inadequate technical know-how and inadequate infrastructure.

Regarding provision of safe and adequate water, the priority issues include: Inadequate water supply infrastructure, lack of public awareness, and lack of a water quality surveillance and monitoring system.

Concerning the protection of water resources, the working group proposed the following priority issues: Lack of public awareness, improper water resources management and a lack of effective participation of stakeholders.

Principal actors

The principal actors responsible for each of the above-mentioned issues would include:

- (i) Department of Agriculture Planning, Irrigation Department, Myanmar Agriculture Services.
- (ii) Department of Health, Ministry of Industry, General Administration Department.
- (iii) Irrigation Department, Department for the Progress of Border Areas and National Races and Development Affairs.

- (iv) Irrigation Department, Water Resources Utilization Department, General Administration Department.
- (v) Department of Health, Department of Health Planning, Department of Development Affairs; General Administration Department, Ministry of Industry.
- (vi) Irrigation Department, Water Resources Utilization Department, General Administration Department, Ministry for the Progress of Border Areas and National Races, and Development Affairs.
- (vii) Irrigation Department, Water Resources Utilization Department.
- (viii) Ministry of Industry, General Administration Department, Yangon City Development Committee, Mandalay City Development Committee, Department of Development Affairs.
- (ix) Irrigation Department, Water Resources Utilization Department, Department of the Progress of Border Areas and National Races, Department of Development Affairs.

From the nine principal actors mentioned above, the working group identified the Irrigation Department, the Water Resources Utilization Department and the Department of Development Affairs as the three key agencies in the efforts to achieve the priority objectives.

Possible strategic approaches

Possible strategic approaches recommended under water resources management for poverty reduction include the following:

- (1) Extension of irrigated land;
- (2) proper operation and maintenance of existing irrigation facilities;
- (3) improved technology (tillage, seeds, mechanization etc.);
- (4) improvement of the economy of rural areas;
- (5) facilitation and formulation of related laws and regulations;
- (6) community participation and involvement; and
- (7) adoption of an integrated approach.

Framework of a strategic plan

The working group identified the three top indicators of success as income generation, water consumption, and water conservation including water quality.

Regarding income generation, it was proposed that attempts be made to reach 1 million Kyat per household by 2005 through various economic measures, including an increase of the irrigated area from 4.5 million acres in 2000 to 5.89 million in 2005 and an increase in yield from 66 baskets/acre to 100 baskets/acre in 2005. The responsible agencies are the Ministry of Agriculture and Irrigation, Ministry of Home Affairs, Ministry of Labour, Ministry of Industry.

In addition, promotion of model villages with safe and sufficient water supply will be carried out in order to reach 65 000 villages by 2030. Water quality monitoring and surveillance systems will be established to cover all townships from the current level of 200 townships. The responsible agencies are the Ministry of Health, Ministry of Agriculture and Irrigation, Ministry of Home Affairs.

Concerning water conservation, the working group proposed the establishment of a national water authority by 2005 to unify all laws and regulations related to water resources utilization

and protection and to improve law enforcement. The responsible agencies are the Ministry of Agriculture and Irrigation, Ministry of Home Affairs, Department of Development Affairs, Ministry of Industry.

Priority action programme

1. Establishment of model villages;
2. measures to increase yield and quality; and
3. establishment of a water quality monitoring and surveillance programme.

4. CONCLUSIONS

Achievements in the implementation of the pilot project can be considered at two levels, national and regional.

4.1 National level

In all three selected countries, the government agencies invited to take part in the pilot project were recognized through their respective internal processes by all water-related bodies as key agencies in the formulation and implementation of a national water vision. In Cambodia, the Ministry of Water Resources and Meteorology and in Lao PDR, the Water Resources Coordinating Committee Secretariat — both project counterparts — were recognized as the lead agencies for the implementation of national water visions of those countries. In the Union of Myanmar, the process of identifying the focal point required more time as there had not been such a coordinating body previously. The study team, headed by the Director General of the Irrigation Department with participation of many other agencies, was established to undertake the work. This resulted in a major input by the participating agencies.

It must be pointed out, however, that the success in the implementation of the pilot project was also due in large measure to the results of previous efforts made by the Southeast Asia Technical Advisory Committee of the Global Water Partnership in Cambodia and Lao PDR and to a certain extent in the Union of Myanmar.

4.2 Regional level

Through the partnership of FAO and UNESCAP in the implementation of the second phase of this joint regional project, exchange of information on ongoing activities as well as on existing networks has greatly increased. The driving forces behind important achievements of this regional project can be identified as the ongoing efforts of FAO in modernizing the irrigation sector and of UNESCAP in promoting strategic planning and management in the water resources sector. These activities have also provided opportunities for FAO and UNESCAP to enhance the impact of their ongoing activities. Where possible, project activities were coordinated with the activities of other regional organizations, as follows:

- Southeast Asia Technical Advisory Committee — coordination with its key activities in Cambodia and the Lao PDR, which are part of its efforts to enhance the capacity of these countries in water resources management.
- The Asian Development Bank and the Agence de France pour le Développement — sharing information derived from their activities in the Lao PDR.
- UNDP-Myanmar and FAO offices in the three countries — assisting in the coordination of the studies.

The above achievements of the partnership of FAO and UNESCAP in collaboration with other regional institutions provided not only important evidence of the benefits of cooperation, but also strategic elements in the development of a regional strategy and programmes for long-term collaboration in the sustainable management of water resources in the region.

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NATIONAL WATER VISION TO ACTION FOR THE KINGDOM OF CAMBODIA

2

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SUMMARY

As a riparian state in the Mekong river basin and an active participant in the work of the Mekong River Commission, Cambodia has strong international linkages in the water sector. Water is a central aspect of Cambodian life. Cambodia covers an area of about 181 000 km², 86 percent of which is located in the Mekong river basin. The nation's water resources are therefore dominated by the Mekong and Tonlé Sap system, and by the annual cycle of monsoonal flood and dry seasons. Water contributes to national life in several subsectors, and is of particular importance with regard to its potentials for domestic water supply, irrigated agriculture, freshwater fisheries, hydropower, navigation and ecotourism. Several laws provide the legal framework for water resources management. About ten central government agencies have major roles in water resources affairs. The provincial governments are increasingly significant, particularly through the provincial rural development committees, and a process of devolution is transferring responsibility to commune councils, village development committees and other community organizations such as the farmer water user communities.

Cambodia faces many water-related issues, which can be grouped as follows:

- Competition for water: Sharing the resource.
- Sustaining the resource: Water quality and aquatic ecosystems.
- Extreme events: Mitigating the effects of floods and droughts.
- The knowledge base: Knowledge, information and technology.
- Institutional arrangements and management capacity.

To address them, a National Strategic Framework for the Water Sector and a National Water Resources Strategy have been prepared. Implementation will depend on actors from the central level, such the Ministry of Water Resources and Meteorology (MOWRAM) and other ministries, through to the smallest water point committees and individual householders. Cambodia is making very satisfactory progress towards an effective strategy for water resources management, bearing in mind the serious lack of capacity caused by years of civil strife. The development of the strategic approach has been made in the context of the national development goals and policy objectives enunciated in the Royal Government's socio-economic development requirements and proposals and the Public Investment Programme. In this process, led by line ministries, including MOWRAM, and in successive consultations with stakeholders, commonly using seminars and workshops, the country has been able to develop a Law on Water Resources Management, a National Water Sector Profile (including an "agenda for action"), a National Water Resources Policy, and a National Water Resources Strategy. A Vision for Water is being developed also and the draft Vision for Water in Cambodia includes the following objectives:

- *Access for all to safe, adequate and affordable drinking water, hygiene and sanitation.*
- *Freedom for all from the threat of loss of life and livelihood as a result of floods and droughts.*
- *Sufficient water where it is needed, to provide for food security, people's livelihoods, and economic activity.*
- *A water environment that is unpolluted and supports healthy fisheries and aquatic ecosystems.*

On the basis of the above achievements, a national round-table workshop was organized by MOWRAM in cooperation with UNESCAP and FAO in January 2003 to formulate a national water vision to action programme. The workshop recognized the importance of the national water vision as a guide for integrated water resources management and recommended various priority actions in four priority areas: (1) Poverty reduction and rural development; (2) economic development and nature conservation; (3) pilot basin management for the Prek Thnot river basin; and (4) the establishment of a framework to turn the national water vision into reality. The workshop also recommended a dual approach for the realization of the national water vision — an overall approach to be coordinated by MOWRAM to provide an effective and comprehensive framework to turn the national water vision into reality, and a sector-by-sector approach to assist the related subsector agencies in the implementation of priority activities related to the above four priority areas.

1. INTRODUCTION

After many years of isolation, Cambodia is pursuing opportunities to engage with the international community in a number of areas. The kingdom has become a member of the Association of Southeast Asian nations (ASEAN), and is working towards accession to the World Trade Organization (WTO). These and other moves contribute to one of the three elements of the government's "Triangle Strategy" for national reconstruction.

Water resources management is an area in which Cambodia has no choice over international linkages. The kingdom shares the Mekong river basin with five other countries — Viet Nam, Lao PDR, Thailand, Myanmar and China — and 86 percent of its own land area lies within the Mekong basin. In 1995, it became a signatory to the Agreement on the cooperation for the sustainable development of the Mekong river basin, which established the Mekong River Commission (MRC), and it participates in the work of the commission.

It is in this spirit that Cambodia approaches the World Water Vision process. The nation must adopt a strategic approach to managing water, because water is one of its most important resources. Since 1998 in particular, it has taken a number of important steps to do this. An element of one of these steps

— preparation of a national water resources policy — has been to enunciate a national vision for water. Cambodia is pleased to be working with the wider international community in this activity.

1.1 Background: The World Water Vision process

The World Water Council initiated the World Water Vision project and in 1998 established the World Commission for Water for the 21st Century. The commission prepared a long-term vision on water, life and the environment which provides a basis for addressing water-related issues at global, regional and national levels. The project to develop a world water vision used a participatory process characterized by extensive consultation and innovative thinking and brainstorming. It was global in scope, with special attention given to the needs of developing countries and of the poor. The process has used two types of consultation, by sector and by region. Sector and regional visions were prepared as contributions to the overall World Water Vision, which describe the desired future and the actions needed to achieve sustainable water resources management.

Sector consultation recognizes that there are several water-related subsectors, but that they are necessary parts of an integrated approach to water management. Twelve subsectors are considered in the process; the four main ones are “water for people”, “water for food and rural development”, “water and nature” and “water in rivers”. These subsectors are very relevant given Cambodia’s particular reliance on water.

Regional visions for water were developed, because in practice water is managed at a sub-global scale. This is most obviously the case in large international river basins such as the Mekong. There have been 22 regional consultations — including one in Southeast Asia — which were conducted in close collaboration with the regional technical advisory committees of the Global Water Partnership and the International Hydrology Programme of UNESCO.

In the Southeast Asian region, the FAO and UNESCAP began, in 1999, a cooperative programme to promote the development of national water visions. The pilot project focused on four countries — Viet Nam, the Philippines, Malaysia and Thailand. The process included the preparation of country case studies, round-table discussions of case study findings, and the preparation of final country reports. A synthesis of the results was produced as a basis for extending the programme to other countries in the region (Le Huu Ti and Thierry Facon, 2001).

The present report follows this model and presents the results of the country case study for the Kingdom of Cambodia.

1.2 Cambodia’s national development goals

National development goals must provide the context within which Cambodia’s Vision for Water is developed. The main objectives of Cambodia’s ‘Economic Government’ are geared towards poverty alleviation, through high and sustainable economic growth (six to seven percent per annum is the objective) and equitable sharing of the benefits of growth. The Second Socio-economic Development Plan presents three policy objectives. These are:

- To foster broad-based, sustainable economic growth with equity, with the private sector playing the leading role.
- To promote social and cultural development by improving access of the poor to education, health, water and sanitation, power, credit, markets, information and appropriate technology.
- To ensure the sustainable management and use of natural resources and the environment.

A supporting fourth policy objective is to improve the governance environment through effective implementation of the Governance Action Plan.

The government's *Socio-Economic Development Requirements and Proposals* (SEDRP May 2001) makes several references to water resources.¹ Water is seen as contributing to the government's priority areas of poverty alleviation and economic growth, mainly in terms of irrigated agriculture, which is seen as essential to addressing poverty through achieving food security and promoting income generation in rural areas. The importance of water is recognized also in the context of water supply and sanitation, whose improvement is seen as necessary to raise the health status of the population, particularly the poor. The Royal Government's Public Investment Programme proposes to allocate more than US\$180 million of projected investment funds (2001-03) to the 'Water resources, water supply and sanitation' sector; 11 percent of the total, \$12.6 million, is allocated to irrigation and other water-related items in the agriculture sector.

Water-related aspects of other sectors also receive mention in the *Socio-Economic Development Requirements and Proposals*. They include continued appraisal of the potential contribution of hydropower, which is almost wholly undeveloped, and conservation of freshwater fisheries, which are of considerable importance to the country's nutritional status, but which are under threat from environmental degradation and overexploitation. Other areas, however, such as tourism, industrial development and transportation, make little mention of the role that water resources management should play.

The government's environmental plans incorporate water-related matters to some extent, mainly in terms of conservation of the Tonlé Sap hydrological system and ecosystems. Some components of the investment proposals would improve water-related information. A particularly important aspect of water-related information is flood forecasting. Flooding is a natural aspect of life in the Mekong/Tonlé Sap plain which Cambodians have inhabited for centuries. However, a growing population, urbanization and economic development in the floodplain make flood warning and mitigation an increasingly important service.

Water is a pervasive aspect of life, important to many sectors of Cambodia's economy and society. As in many countries, it is difficult to reconcile all the demands on water resources while sustaining them for the benefit of natural ecosystems and future generations. According to the *Socio-Economic Development Requirements and Proposals* 'water resources management... is a sector where there is a need to develop a well-defined strategy'.

1.3 Cambodia's process of developing a national water vision

Cambodia has taken several major steps in recent years to develop a sound foundation for water resources management. Parallel processes have contributed different perspectives on the country's Vision for Water. They have not always been well coordinated, but together they are enabling rapid progress. In each case, technical assistance from an international organization has been invaluable in assisting Cambodian experts to carry out the work. These processes include:

- The drafting of a Law on Water Resources Management and the supporting decrees required for implementation — the draft law had by mid-2002 been approved by the Council of Ministers and was being considered by the National Assembly;
- compilation of a National Water Sector Profile, a document that comprehensively summarizes the status of the water sector and proposes an 'agenda for action';
- the drafting of a National Water Resources Policy to provide a basis for managing the nation's water resources as a whole, and for developing subsector policies and strategies — by October 2002, a draft policy was close to being submitted to the Council of Ministers for deliberation;

¹ The Royal Government's draft Poverty Reduction Strategy also includes significant references to water, principally in terms of rural development.

- compilation of a National Water Resources Strategy, completed in mid-2001 — this document provides an extensive list of proposed objectives, strategies and actions in all areas of the water sector; and
- development of strategies, policies and action plans in specific subsectors, including urban water supply and sanitation, rural water supply and sanitation, irrigation management and fisheries management — these are at various stages of completion, and each provides, in a sense, an element of the national vision for water.

A similar approach has been used in all of these exercises. It reflects the stage to which Cambodia's governmental system has evolved, and the distribution of expertise in the country. In each case, a particular ministry of the Royal Government — in many cases the Ministry of Water Resources and Meteorology (MOWRAM) — goes through the internal process of drafting a document, calling on other ministries, provincial governments, NGOs and international organizations for information, where necessary. When the draft is judged by the initiating ministry to be satisfactory, it is distributed for comment, and revised accordingly. The subsequent process normally includes two or more stages of consultation, commonly in the form of national workshops, seminars or conferences. At these, representatives of concerned ministries, provincial government departments, NGOs and international organizations debate the draft document and propose changes. There may be additional consultation at a more personal level to refine the material. Often, a major national conference is used to 'sign off' on the document, in effect transmitting it to the appropriate minister.

During the last two or three years a number of major events have contributed to the process of establishing a national approach to water resources management. It is worth listing some of these to indicate the extent of the debate and sharing of information that has taken place:

August 2000	Seminar on a National Water Sector Profile for Cambodia.
December 2000	National Conference on Cambodia's Water Resources: An Agenda for Action.
March 2001	National Conference — Cambodia's Water Resources: The Next Steps.
March 2002	National Workshop on Water, Public Awareness and Sustainable Development.
March 2002	Celebration of World Water Day 2002: Water for Development.
August 2002	National Workshop: Defining Water Resources Management Issues in Cambodia.
October 2002	Workshop on the National Water Resources Policy.

As a result of Cambodia's recent history, expertise is quite limited and concentrated in government agencies, and thus line ministries necessarily have taken the lead in this work. Moreover, much of the work has been carried out with technical assistance from international funding agencies, which normally work through the government and use central government ministries as implementing agencies. However, as expertise develops at other levels of government and outside government, it is being drawn on to an increasing extent. This is exemplified in particular by the workshop held in October 2002 to debate a draft of the National Water Resources Policy. Half of the people invited were from provincial rural development councils, one quarter represented NGOs and international organizations, and the remaining quarter MOWRAM and the Inter-Ministerial Task Force responsible for drafting the policy.

1.4 Principles of water resources management in Cambodia

Most societies seem to agree on a number of fundamental, unchanging principles related to water. Some of these are long established; for instance, almost all countries regard water as being vested in the state and not owned by any one person. The Constitution of the Kingdom of Cambodia states this particular

principle. Other principles have been stated by the international community only recently, as pressure on global water resources has forced many countries to address water-related issues in a determined way.

Cambodia has not formally enunciated a set of principles for water resources management. Three articles in the draft Law on Water Resources Management state what might be regarded as basic principles for water resources management:

- ‘All water and water resources, the beds, banks and shores of rivers, streams, lakes, canals and reservoirs, are owned by the state’ (Article 3).
- ‘Water resources projects shall be prepared based on the data and information resulting from the water resources inventory, in accordance with the national water resources plan, the economic development plan and the national and regional environmental plans, and by maintaining the balance between water availability and present and foreseeable demand’ (Article 7).
- ‘Everyone has the right to use water resources without a licence for drinking, washing, bathing and other domestic purposes, the watering of domestic animals, fishing and the irrigation of gardens and orchards, in an amount not exceeding that necessary to satisfy the individual and family needs of the user, and for the purpose of extinguishing fires, testing fire-extinguishing equipment and training people in the use of such equipment’ (Article 8).

The draft National Water Resources Policy implies a fourth principle:

- ‘River basins and aquifers are the fundamental units for equitable and sustainable planning, development and management of water resources. They also are the fundamental biophysical units of the hydrological cycle’ (Section 3.1.2)

An early draft of the policy proposed a number of additional principles based on Agenda 21, but these were removed in the process of simplifying and focusing the document.

2. THE VISION FOR WATER

Water is a basic resource for many sectors. Because of population growth and economic development, the increasing demand for water will place severe pressure on the country’s water resources. As part of the process of preparing its National Water Resources Policy, the government has expressed its goal for effective and sustainable management of water in a Vision for Water in Cambodia:

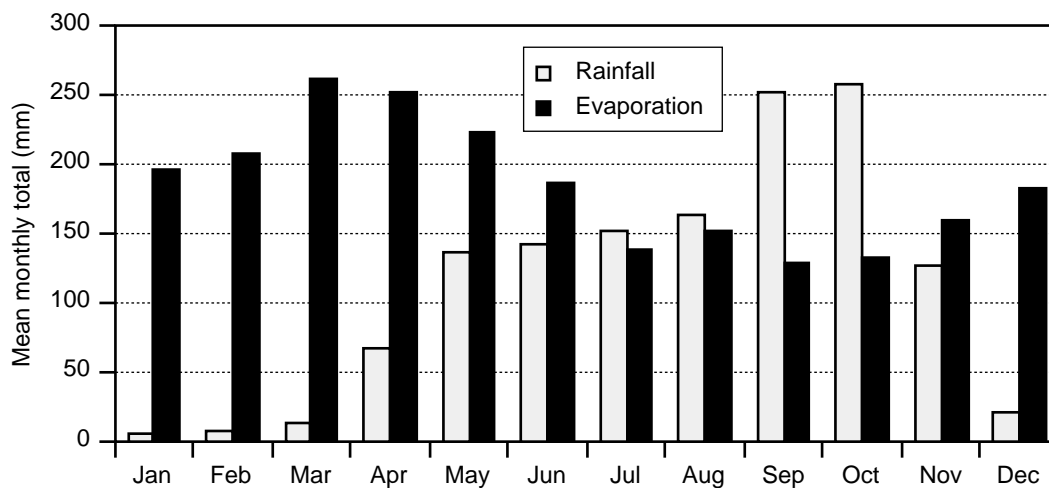
- *Access for all to safe, adequate, and affordable drinking water, hygiene and sanitation.*
- *Freedom for all from the threat of loss of life and livelihood as a result of floods and droughts.*
- *Sufficient water where it is needed, to provide for food security, people’s livelihoods, and economic activity.*
- *A water environment that is unpolluted and supports healthy fisheries and aquatic ecosystems.*

3. WATER RESOURCES IN CAMBODIA

Water has for centuries been a central aspect of Khmer life, with most of the main settlements located beside the Mekong, Tonlé Sap or other perennial streams or lakes. Even — or especially — away from perennial water, the availability of water for domestic purposes, care of livestock and growing rice is a basic determinant of the quality of life for a large proportion of the population.

3.1 Cambodia's water resources: An overview

The water resources of Cambodia are dominated by the Mekong river and Tonlé Sap system, and 86 percent of the country is drained by these rivers and their tributaries. The kingdom could be described as a bowl, with rivers and streams flowing from ranges of mountains around the periphery to the Central Plains around the Great Lake (Tonlé Sap) and the floodplain/delta of the Mekong. The annual inflow from upstream is approximately 410 billion m³, and about 90 billion m³ is generated by runoff from within the kingdom. Rainfall and river flows are highly variable throughout the year, and also from year to year (Figures 2.1 and 2.2). The Northwest monsoon brings 90 percent of the rainfall, which can reach up to 3000 mm in the mountains. The monsoonal flood during May-October provides an abundance of water, nutrients and fresh silt for floodplain areas, which support rice-growing and one of the most productive freshwater fisheries in the world. On the other hand, in some years the flood may cause severe losses of crops, property and life. The dry season during the Northeast monsoon from December to April is, from an agricultural point of view, unproductive, except in the few areas of the country where irrigation is provided.

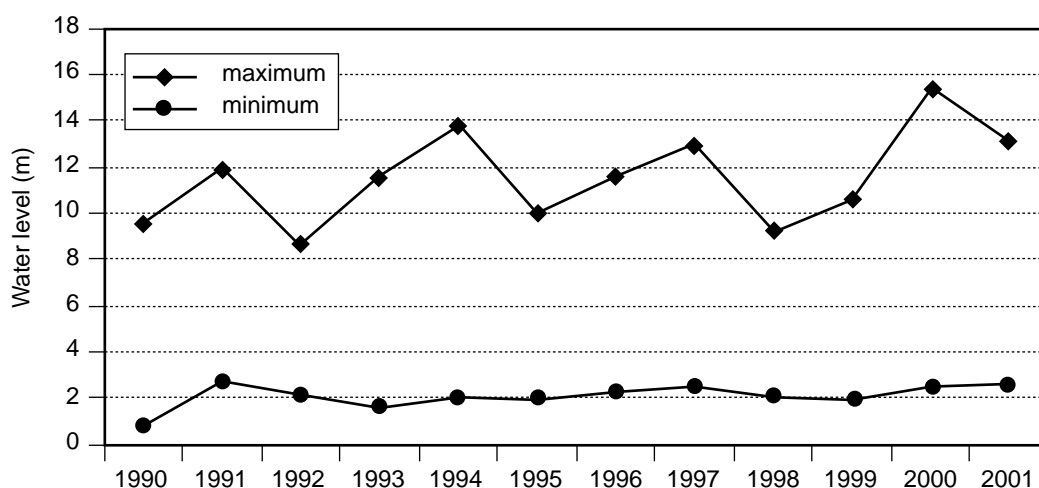


Note: Evaporation exceeds rainfall for much of the year.

Figure 2.1 Mean monthly rainfall and evaporation at Phnom Penh meteorological station

During the monsoon flood, water flows upstream from the Mekong into the Tonlé Sap. The Great Lake expands in area from about 2500 km² to about 15000 km², and stores some 70 billion m³ of water. This annual cycle is of huge importance for the fishery on which many Cambodians depend for protein food intake.

Water is generally of high quality during the flood season, because any contaminants (from natural processes or from human activity) are diluted by the huge quantities of rainfall and runoff. However, water pollution during the dry season is an increasing concern, because there is less dilution of contaminants. Apart from the heavy pollution load from Phnom Penh city into the Tonlé Sap and Bassac, many contaminants come from non-point sources, such as livestock and human waste disposal, and are very difficult to deal with. The consequences of pollution for human health are obvious in the kingdom's statistics regarding water-related diseases. The consequences for aquatic ecosystems, fisheries, and livestock health are likely to be just as serious, but are unknown.



Note: The low flow level is usually 2-3 metres above sea level. The annual flood level has varied from 8.6 to 15.4 metres during the 12 year period, and seems to be increasing. Flooding in the town becomes serious when water level reaches 15.5-16.0 metres.

Figure 2.2 Maximum and minimum water levels at Kampong Cham, on the Mekong river, 1990-2001

Cambodia has an estimated groundwater resource of 17.6 billion m³. This figure is small in comparison with the quantity of surface water, but represents a year-round storage which could be a source of water during the dry season. It is being exploited to an increasing extent; there are at least 25000 community water supply tube wells, and large-diameter motorized tube wells for irrigation.

Total withdrawals of water are estimated to be 0.75 billion m³ per year (Table 2.1). This appears to be very small in comparison with the total water resource, but in practice the availability of water during the dry season is very much less. Non-consumptive uses — navigation, washing and bathing, hydropower generation, fishing — also are restricted by a lack of water during the dry season. In summary, water of acceptable quality is already insufficient for many purposes, and population growth and economic development in the future will make the situation worse.

Table 2.1 Estimated water withdrawals

Use	Quantity (billion m ³ /year)
Domestic water	0.136
Livestock	0.1
Crops	0.455
Industry	0.03
Miscellaneous	0.079
Total	0.75
Total flow from Mekong to the sea	500

3.2 The key sectors

Water contributes to life in Cambodia in several subsectors. These conventionally are considered separately, and the following paragraphs provide some information on them. Increasingly, however, it is recognized that water must be managed in an integrated way, in which the various subsectors interact and compete is taken into account.

Domestic water supply

According to the 1998 Census, only 24 percent of rural households had access to a safe drinking water supply, and only 60 percent of urban households (85 percent in the capital, Phnom Penh) (Figure 2.3). Only 9 percent of the rural and 41 percent of the urban populations have access to sanitation facilities, so that exposure to waterborne disease is high, and a major cause of illness and death.

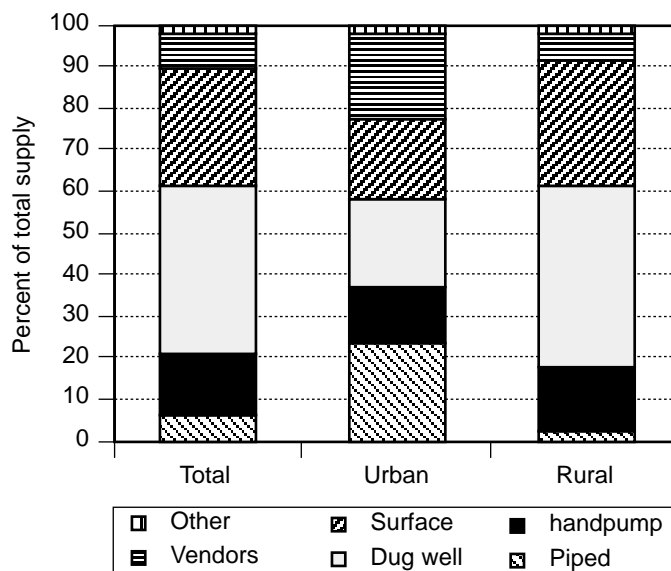


Figure 2.3 Water sources for domestic supply

There has been substantial investment in water supply in Phnom Penh, and the Phnom Penh Water Supply Authority has become a financially self-sustaining entity. In provincial towns, the long-term objective is to provide water that meets WHO standards to at least 70 percent of their populations and their water supply authorities are being transformed into self-sustaining autonomous bodies, in some cases in private ownership or management. Several current projects will improve water supplies in over 150 towns. In rural areas, some 6.4 million people depend on unprotected water sources. There has been a significant effort by the government, international organizations like UNICEF, and NGOs like World Vision to install wells for water supply and to introduce sanitary latrines. There are an estimated 93000 functioning wells and 20000 water supply ponds, and the current socio-economic development plan includes provision of an additional 45000 water points in rural areas, and the construction of 135000 latrines.

Waste disposal to water

Data are available for waste water disposal in Phnom Penh city, but not in general for other towns. Commercial and industrial discharges in Phnom Penh are estimated to be about 6 million m³, and discharges from houses and public institutions are estimated to be in the range of 24 to 34 million m³. However, sewers carry both storm water and foul water, and many properties (particularly industrial sites located along watercourses) are not connected to the sewer network and discharge directly into the natural drainage system. Many Phnom Penh sewers discharge directly into the Tonlé Sap, Tonlé Bassac or other watercourses; others discharge into holding ponds, which provide a measure of treatment before the water is pumped to the river. Of 148 factories in Phnom Penh, only eight have onsite primary treatment, and most effluents exceed Cambodia's water quality standards.

Irrigated agriculture

Rice growing accounted for 90 percent of all field crops in 1997, and provides the food staple for the population. Rainy-season yields (1.85 million ha harvested) averaged 1.81 tonne/ha in 1999, and dry season yields (233 000 ha harvested) averaged 3.04 tonne/ha. The country is more or less self-sufficient in food in an average year. However, seasonal and year-to-year variability in rainfall, and periodic droughts, expose farmers to variations in crop production that, without control over water availability, they have limited ability to manage.

The level of irrigation development is low, with irrigated land representing less than 20 percent of the total area under food crop production. Nevertheless, irrigated areas produce approximately 40 percent of the total rice production. There is little double-cropping, and most irrigation is supplementary irrigation of dry season flood recession crops or wet season rain-fed lowland crops. A wide range of water delivery methods is used, from traditional water wheels and lift devices to the rapidly growing use of small, motorized pumps to exploit groundwater. The amount of artificial storage is very small — the lowest in Southeast Asia as a percentage of the total water resource.

More than 1000 irrigation systems are fed by surface water abstraction, although an inventory in 1994 indicated that about 65 percent was only partially operational, and 14 percent not operating at all. Because of poor design and inadequate construction methods and materials, particularly during the Khmer Rouge regime, many structures or entire schemes are of little value, or are definitely harmful to water management. On the other hand, groundwater use is growing rapidly as individual farmers recognize the opportunity it offers to control crop water availability. For example, it is estimated that about 2000 treadle pumps are installed annually for domestic water supply and home garden irrigation. It is estimated that shallow wells could be used over 48000 km².

To cater for expected population growth (2.4 percent per year) and requirements for improved nutrition — not to mention export of agricultural products to generate foreign exchange — it will be necessary to increase agricultural production. The Ministry of Agriculture, Forestry and Fisheries target for rice production in 2005/06 is that it exceeds the 1999/2000 figure by 18 percent. Irrigation is not the only means of increasing yields, but it is an essential means if farmers' exposure to variability in crop yields is to be reduced.

Freshwater fisheries

Fish (freshwater and marine) account for about 75 percent of Cambodians' animal protein intake. Cambodia possesses an exceptional inland fishery resource, the fourth largest in the world, in the Tonlé Sap–Mekong river system and floodplain. The Tonlé Sap Lake is estimated to have a productivity of 65 kg/ha/year (dry season area), and to account for about 75 percent of Cambodia's wild freshwater fish production. Many of the species are migratory, and breed in the Mekong main stem or in tributaries. Freshwater capture fisheries account for 62 percent of consumption, aquaculture for 8 percent, and marine fisheries for the balance.

An estimated one million people depend on fishing for their livelihoods, notably the residents of the floating villages on the Tonlé Sap. The most recent estimates for fish catches are: large-scale fisheries — 45000-80000 tonnes/year (t/y); medium-sized fisheries — 85000-100000 t/y; family fisheries — 115 000-140000 t/y; rice-field fisheries — 45000-1 10000 t/y. It appears that the catch of large and medium-sized fish is declining, but the catch of small fish has increased. The total catch therefore is stable, but environmental degradation of the seasonally flooded areas, conversion of floodplain forestland for agricultural use, and growing fishing pressure present a threat to the sustainability of capture fishery.

Hydropower development

At present, the electricity supply in Cambodia is largely dependent on thermal (diesel) generation and on a number of isolated systems that serve Phnom Penh and the main provincial towns. Only 7 percent of the population has access to a reliable supply, and the great majority of the rural population have access only, at best, to 12-volt car batteries. Cambodia's hydroelectric power potential (including some on the Mekong main stream) is estimated to be 8 000/15 000 MW, but so far only 12 MW has been developed. A number of feasibility studies are being undertaken at a range of scales, although at present the country's power planning tends to focus on construction of transmission lines to import power from neighbouring Viet Nam.

Navigation and other in-stream uses

The Tonlé Sap, the Bassac, the Mekong, and a number of other tributary rivers provide a water transport network of about 1 800 km, over a third of which can be used year-round. The Mekong between Phnom Penh and Kratié can accommodate vessels of up to a few hundred tonnes, and between Kratié and Stung Treng vessels of 20 to 50 tonnes. Navigation is limited by low water during the dry season, and the existence of bars — particularly at the entrance to the Great Lake — that require regular dredging. The dredging programme has been neglected in recent years, however, and other constraints on river transport include a lack of navigational aids, hydrographical surveys and skilled sailors.

The port of Phnom Penh handles about 25 percent of the country's total international cargo; three quarters of the tonnage is imported fuel, which is the cause of some concern over possible environmental damage from accidental spillage. The port also plays an important role as a hub for inland water transport, and in the export of rubber and timber.

The Mekong system is used extensively for commercial passenger transport, and for non-commercial (private) transportation of people and goods in small boats. Particularly significant, perhaps, is the use of the river by tourists, particularly between Phnom Penh and Siem Reap (Angkor Wat). No data are available on passenger numbers or on the number of people whose livelihoods depend on water transport. A notable feature of society in Cambodia is, however, the floating villages on the Great Lake, and the many other riverside villages throughout the Central Plains. Other in-stream uses of Cambodia's surface waters include recreation, fishing and food gathering, bathing, washing clothes, waste disposal etc. by riverside villagers. No data are available, but given that 85 percent of the population is rural, in some 13 400 villages, this usage must be very significant overall. On the other hand, commercial recreational uses of Cambodia's rivers and lakes are negligible, although it can be expected that tourist ventures will make greater use of the Mekong main stem and of the Tonlé Sap as the tourism industry develops.

3.3 Water resources management in Cambodia

The Constitution vests water ownership in the state (Article 58) and assigns to the state the task of planning the management of water resources (Article 59). It states that 'the control, use and management of state properties shall be determined by law', and therefore provides the basis for the water law. Several laws and decrees are relevant to water resources management.

The Law on Environmental Protection and Natural Resources Management provides that natural resources (including water) 'shall be preserved, developed and managed to use in a rational and sustainable manner'. It has provisions that relate to environmental impact assessment, natural resources (including water) management, environmental monitoring, and pollution. Article 5 of the Law on Land (1992) states the principle of state ownership of land, by which rivers and lakes may not be privately owned. Articles 113-140, dealing with easements, regulate the relationship between upstream and downstream

land with regard to natural water flow, and the establishment of easements for the purpose of irrigating or draining land.

The Law on Fisheries Management and Administration (1987) regulates fishing and aquaculture in inland waters. It is being reviewed and revised to stimulate investment in the fishery sector and provide better protection of fishery resources. Prime Minister's Circular No. 01 SR (11 January 1999) on the Implementation Policy of Sustainable Irrigation Systems contains model statutes for farmer water user communities, and provisions on the assessment and collection of irrigation fees.

A draft Law on Water Resources Management in Cambodia has been presented by the Council of Ministers to the National Assembly, for review and approval. The draft law includes chapters on water resources inventory and planning, water resources use and development, groundwater, protection of water resources, flood control, servitudes (rights and obligations), incentives and penalties, and international rivers. When its supporting decrees are passed, it will provide a sound basis for sustainable water resources management.

Several government institutions have responsibilities in the water sector (Table 2.2). The principal vehicles for inter-agency cooperation are the Cambodia National Mekong Committee, the Ministry of Economy and Finance and the Council for the Development of Cambodia. At provincial level, operational activity is focused through provincial governors, who are responsible to the Minister of the Interior. Coordination among ministry/departmental staff at provincial level may be stronger than at national level because of more immediate oversight by governors.

Provincial rural development committees, which are chaired by the governors, provide an increasingly important coordinating mechanism at provincial level. Commune councils and village development committees provide additional mechanisms for bringing resource management decisions to the local level. The village development committees are democratically elected, which provides the foundation of a participatory community approach to rural development, including rural water supply and community irrigation.

International organizations such as UNICEF and a large number of NGOs are active in water-related activities in Cambodia, principally domestic water supply, sanitation and small-scale irrigation. These are commonly small-scale interventions, at the neighbourhood or village level. The EU-supported Programme de Réhabilitation et d'Appui au Secteur Agricole du Cambodge (PRASAC) has incorporated water point committees (for domestic water supply) and water user associations (for irrigation systems) in its interventions in over 1 250 villages in six provinces around Phnom Penh. Similarly, other interventions in rural water supply and sanitation, such as the UNICEF-assisted Water and Environmental Sanitation programme (which during 1992-97 benefited 0.7 million people), increasingly have incorporated a bottom-up approach starting at the village level. In irrigated agriculture, the government policy is to devolve responsibility for all aspects of scheme operation to farmer water user communities, with support from MOWRAM. The government's expressed urban sanitation policy is based on community participation and the urban water supply policy also allows for community participation, principally in neighbourhoods that do not yet have water supply systems.

Cambodia is moving rapidly along the path to a fully open market economy. The government is committed to reducing its direct involvement in delivering water services. The Kirirom power station was rehabilitated recently under a Build-Operate-Transfer agreement with a Chinese company, and licences to operate existing water supply systems have been issued to private operators in eleven towns. A project to provide water to 150 district towns will use two approaches: in the first approach, the private sector will undertake feasibility studies, design the systems and build and operate them, and in the second approach, the Ministry of Industry Mines and Energy will design and construct the systems, then lease them to private sector operators.

Table 2.2 Institutional basis for water resources management

Institution	Water-related responsibilities
Cambodia National Mekong Committee	<ul style="list-style-type: none"> ● Advise the Cambodian representative to the Mekong River Commission Council (MRC) on all matters relating to activities within the Mekong river basin that could affect Cambodian interests. ● Review proposals prepared by government agencies in the light of the Mekong Agreement. ● Liaise between MRC and government agencies.
Ministry of Water Resources and Meteorology (MOWRAM)	<ul style="list-style-type: none"> ● Responsibilities defined by government Decree on 30 June 1999 include (in abbreviated form): <ul style="list-style-type: none"> – Define policies relating to the strategic development of water resources – Research on and investigation of water resources – Prepare plans for water resources development and conservation – Manage direct and indirect water resources use, and mitigate water-related disasters – Draft water law and monitor its implementation – Gather and manage hydro-meteorological and groundwater data and information – Provide technical advice – Administer international collaboration, including within the Mekong basin
Ministry of Industry, Mines and Energy (MIME)	<ul style="list-style-type: none"> ● Water-related responsibilities include: <ul style="list-style-type: none"> – Planning industrial water uses and hydropower – Water supply provision to provincial towns – Administration of single-purpose schemes involving hydropower
Ministry of Rural Development (MRD)	<ul style="list-style-type: none"> ● Water-related responsibilities include: <ul style="list-style-type: none"> – Hydro-geological data collection and archiving – Water supply, sanitation, land drainage in rural areas
Ministry of Public Works and Transport (MPWT)	<ul style="list-style-type: none"> ● Water-related responsibilities include: <ul style="list-style-type: none"> – Land drainage and sewerage in Phnom Penh and provincial towns – Study, survey, construct and maintain river works for navigation and water transport
Phnom Penh Water Supply Authority (PPWSA) and Municipality of Phnom Penh (under the Minister of the Interior)	<ul style="list-style-type: none"> ● Water supply in Phnom Penh ● Water resources in the Phnom Penh region
Ministry of the Environment (MoE)	<ul style="list-style-type: none"> ● MoE is mandated to protect Cambodia's natural resources and environmental quality from degradation. The list of media for which it is responsible includes water. It is responsible for water quality and pollution control, including monitoring wastewater discharges and issuing permits. ● The Natural Environmental Action Plan includes six focal areas, one of which is fisheries and floodplain agriculture in the Tonlé Sap region; otherwise, water receives limited mention.
Ministry of Agriculture, Forestry and Fisheries (MAFF)	<ul style="list-style-type: none"> ● MAFF is engaged in development of policies and strategies for agriculture, forestry and fisheries that have significant implications for the management of the water resources required for irrigation and capture fishery/aquaculture. MAFF responsibilities for forestry also have relevance to catchment conditions, hydrological regimes and water quality issues.
Ministry of Economy and Finance (MEF)	<ul style="list-style-type: none"> ● MEF is responsible for compiling the <i>Socio-Economic Development Programme</i> and <i>Public Investment Programme</i>. To the extent that water-related investments are proposed in a number of components of the programmes, MEF has the role of harmonizing proposals and matching them against government investment priorities.
Ministry of Health (MOH)	<ul style="list-style-type: none"> ● MoH is responsible for controlling the quality of surface and ground water used for public water supply, as well as for health education and other matters related to public health.
Provincial governments	<ul style="list-style-type: none"> ● Provincial governments have an oversight and coordinating role with regard to the provincial departments of ministries with water-related responsibilities. They provide the framework for provincial and sub-provincial development committees, some of which are engaged in water-related development (mostly water supply, sanitation, small scale irrigation).
Municipalities	<ul style="list-style-type: none"> ● Some municipalities operate public water supply systems. ● Municipalities are responsible for drainage and sewerage within their areas.
Development committees	<ul style="list-style-type: none"> ● Development committees at provincial, district, commune and village levels have responsibility for socio-economic development initiatives. In some, water-related initiatives may be included, particularly with regard to water supply and sanitation.

Private sector activity in irrigation is limited mostly to that based on groundwater, where individual farmers are able to install wells and pumps independently. This involves the individual farmers, well drillers and pump suppliers. It is estimated that there are several thousand such applications, which have been multiplying rapidly during the last two years, as the idea spreads.

4. THE WATER-RELATED ISSUES CHALLENGING CAMBODIA

4.1 The nature of the issues

Cambodia has a relatively small population and underdeveloped economy, but future population growth and economic development will place rapidly increasing demands on water resources. Before these demands become severe, it is essential that the country define the issues that it confronts now and that can be expected to arise in future.

Box 2.1 The government's priorities

At the National Workshop on Water, Public Awareness, and Sustainable Development, Prime Minister Hun Sen presented the closing speech.

The Prime Minister placed water resources firmly in the context of the government's policy agenda for food security and economic growth, responding to climate change, and providing clean water and healthful sanitation. He pointed to a wide range of needs, including the needs to:

- provide education and capacity building;
- rehabilitate existing irrigation systems;
- improve and expand medium- and large-scale irrigation systems after institutional capacity building has enabled sustainable management;
- establish community capability to manage water, through farmer water user communities;
- develop groundwater resources;
- establish databases on water resources;
- provide state services to deal with floods and droughts;
- carry out strategic design of water resources systems in all areas, considering small, medium- and large-scale systems as interconnected parts of the whole; and
- participate in international cooperation, especially at regional and subregional levels.

In addition to the above, Premier Hun Sen pointed to the need for action in a number of areas, including:

- enabling the MOWRAM to carry out the duties for which it was established;
- responding to the problems and opportunities that are presented by many of the irrigation systems constructed during the Khmer Rouge regime;
- promoting cooperation among water users and solving problems that cause conflicts;
- dealing with water pollution and sedimentation, especially in the Tonlé Sap and at key locations along the Mekong river;
- completing fishery reforms and ensuring the long-term sustainability of fisheries;
- balancing Royal Government of Cambodia intervention in the water management sector with the actions of individual landholders;
- managing human activity in rivers and wetlands, including construction and land reclamation; and
- ensuring effective cooperation with other riparian states in the Mekong river basin.

(from *Summary Report* of the national workshop)

Water-related issues can be grouped in many different ways. For instance, there are issues that relate to sector-by-sector exploitation of water, such as the need to develop hydropower generation to reduce expenditure on imported oil. On the other hand, one might consider trans-sector issues relating to resource management practices, such as the need for appropriate financial arrangements to ensure sustainability of infrastructure.

Recently, three major exercises have considered the issues facing the water sector in Cambodia. These are: (1) Preparation of a National Water Resources Strategy as a component of the Agricultural Productivity Improvement Project; (2) preparation of a National Water Sector Profile and Agenda for Action, as a component of a technical assistance project to help build capacity in the MOWRAM; and (3) the National Workshop on Defining Water Resources Management Issues in Cambodia (August 2002). Each of these exercises appraised issues within a different conceptual framework, and proposed somewhat different sets of responses.

For simplicity, the different sets of issues are considered here in the following groups:

- Competition for water: Sharing the resource.
- Sustaining the resource: Water quality and aquatic ecosystems.
- Extreme events: Mitigating the effects of floods and droughts.
- The knowledge base: Knowledge, information and technology.
- Institutional arrangements and management capacity.

4.2 Competition for water: sharing the resource

At present, there are few cases of direct competition for water (Table 2.3). In the wet season, water is abundant, and the main issue is excess. In the dry season, water shortages occur in many localities, but for the time being they do not appear to be exacerbated significantly by competition between users. The main instances of competition are at community level, between rice farmers and fisher folk, and between upstream and downstream farmers along the river system. Competition can easily grow into conflict and sabotage, but at present it is managed more or less effectively by village and commune authorities.

Table 2.3 Interactions between competing uses of water

	Salinity Control	Hydro-power	Irrigated agriculture	Domestic water supply	Industrial water supply	Waste water disposal	Naviga-tion	Aqua-culture	Recrea-tion/ Fisheries
Salinity control	-	C	2	0	0	C	C	C	C
Hydropower		-	C	0	0	0	C	0	2
Irrigated agriculture			-	0/C	0	0/C	C	C	0
Domestic water supply				-	C	3	0	0	C
Industrial water supply					-	1	0	0	0
Waste water disposal						-	0	1	3
Navigation							-	0	0
Aquaculture								-	C

0: no competition; 1: minor competition; 2: moderate competition; 3: severe competition; C: complementary use

The aspect of competition that is of greatest importance is between the use of watercourses for waste disposal and other uses that require uncontaminated water, particularly domestic water supply, contact in-stream uses, and fisheries/food gathering. Contaminated water and food are significant contributors to morbidity and mortality in Cambodia, particularly among children. As both rural and urban populations grow, the impact of uncontrolled waste discharge upon water quality and public health can be expected to increase. The government is devoting considerable attention to its water supply and sanitation policy, and international organizations and NGOs are investing substantially in water supply facilities in Phnom Penh, provincial towns and rural areas. This should alleviate the competition between safe water supply and waste disposal as uses of watercourses.

A major issue for Cambodia is the effect of water resources development on upstream countries, particularly in terms of the impact of large dams on the Lower Mekong flow regime. Already, construction of a dam on the Se San river in Viet Nam appears to have had a severe impact on residents downstream in Cambodia. Future development of large dams and channelling of the river for navigation could have a significant impact on Cambodia, particularly with regard to fish production, navigation, and flood hazard. Some of the impact could be positive, for example by reducing flood peaks and the severity of flooding on the Mekong floodplain. On the other hand, negative effects are feared, particularly with regard to fish migration and breeding in upstream tributaries and the navigability of the Mekong and Bassac during low flows. The Mekong Agreement provides the basis for resolving conflict among signatories, and the Water Utilization Programme of the Mekong River Commission will provide the means of implementing it.

4.3 Sustaining the resource: Water quality and aquatic ecosystems

In general, Cambodia's water quality is good, particularly during the wet season when large volumes of water are flowing and diluting contaminants. However, particularly during the dry season and downstream from population centres, surface waters can be contaminated with human, animal and other wastes. Some groundwater wells have levels of arsenic, fluoride and total hardness that are a cause for concern, and the possibility of contamination of shallow aquifers by human and animal waste and agricultural chemicals must be taken very seriously.

It is quite feasible to provide potable water throughout the country, for instance by tapping uncontaminated shallow aquifers in villages and rural areas, or by rehabilitating water supply infrastructure in urban areas. The constraints on completing the task are financial and social, rather than hydrological. Maintenance of water quality will not be so straightforward. Point sources such as sewer outfalls can be dealt with using well established (and not necessarily expensive) technology, such as oxidation ponds, artificial wetlands, and irrigation of wastewater onto tree plantations. Non-point-source contamination from non-sewered urban and rural populations and agricultural activities is difficult to address. Plans for agricultural development imply increasing use of agricultural chemicals and an intensification of livestock rearing and thus non-point-source pollution in rural areas can be expected to increase in the coming years.

Perhaps the most critical aspect of the kingdom's aquatic ecosystems is the condition of the rivers, lakes and wetlands of the Mekong and Tonlé Sap system. They support freshwater capture fishery, the fourth largest in the world, that supplies Cambodians with an estimated 290 000-430 000 tonnes/year of fish, 75 percent of their animal protein intake. However, this resource appears to be at its sustainable maximum production and in danger of deteriorating because of overfishing, clearance and degradation of the lakeshore forests, and siltation caused by conversion of forest land to agriculture. These concerns are being addressed within the context of the National Environmental Action Plan, and a major research exercise is seeking to better understand the system.

Concern is often expressed that extensive exploitation and clearance of forests in the Mekong and Tonlé Sap river basin is causing increased flooding, increased erosion, and downstream silting of rivers and lakes. Forest management to conserve biodiversity and minimise offsite effects is an important element of Cambodia's National Environmental Action Plan. Uncontrolled mining also is thought by many observers to result in sedimentation in rivers and deterioration of water quality. Unfortunately, the data needed to assess the severity of the impact of these activities on the watershed are not available.

4.4 Extreme events: Mitigating the effects of floods and droughts

A negative aspect of Cambodia's abundant water resource is the cost of damage and loss suffered as a result of extreme flooding. The risk of periodic flooding is an inevitable feature of living on a floodplain, and Cambodians have adjusted to it for many centuries. Indeed, a significant portion of the population depends on annual flooding for its rice and fish, and the system of colmatage canals is intended in effect to increase the flooded area. However, extreme floods, such as that experienced in 2000, can cause considerable hardship, particularly to the rural poor who can least afford it.

The draft Law on Water Resources Management provides for flood mitigation, and a comprehensive flood mitigation strategy will be required to implement its provisions effectively. However, the scale of the natural hydrological system and the pressure to settle and exploit flood-prone areas are so great that comprehensive flood mitigation (structural or non-structural) is unlikely to be practicable, except where the capital value of land improvement justifies the cost. At present, Cambodia's flood mitigation measures rely on the flood forecasting capability of MOWRAM, flood embankments and drainage serving an area of 260 km² in and around Phnom Penh, and piecemeal flood protection elsewhere (including the flow impeding effects of highways built on raised embankments). The Cambodia Natural Disaster Management Committee is increasingly effective in helping communities to prepare for and cope with the threat of flood disasters.

There is growing recognition of the effects of drought on Cambodia's farmers. In the bad drought year of 1994, only 69 percent of the total rice-growing area was harvested, with crop losses ranging from two percent in Kompong Speu to 54 percent in Battambang province. Periodic drought is a significant constraint on the attempts of farmers in rain-fed areas to increase both agricultural productivity and production. Various forms of drought relief are provided, including emergency pumping of water to farmers, provision of seed for replanting crops, and in the worst case, emergency food aid.

4.5 The knowledge base: Knowledge, information and technology

Cambodia's arrangements for the management of water-related information are in general very weak. There are many areas in which information simply is not available or extremely limited, e.g. groundwater quality, quantities and impact of water use, consumption and return flows by irrigation schemes. Acquisition and management of water-related data and information appear to have a low priority in Cambodia at the moment, with activity tending to reflect the emphases of international agencies and donors, e.g. data related to ecological and environmental issues.

As in many countries, many consultants' reports have been prepared, generally on a project basis, which collectively would provide a huge information base if only they could be securely archived and readily accessed. The Mekong River Commission is a source of substantial water-related data and information for Cambodia, dating back over forty years. MOWRAM has established a computerized database of water-related information, and there are a number of other initiatives, often associated with specific investment projects, to extend data collection. Nevertheless, the lack of water-related data is a serious impediment to water resources development and management.

There is limited national research and development (R&D) capacity or activity in the water sector, whether in the government, educational or private sectors. Cambodia, therefore, is heavily dependent on international organizations for innovation. Foremost among such organizations in the water sector is the Mekong River Commission, whose investigations of a wide range of matters — fisheries, flood management, resource assessment, etc. — provide a major potential information resource for Cambodia. Other international organizations (directly or via consultants) carry out necessary in-country R&D, or introduce technology developed elsewhere. An example is the groundwater resource investigations carried out by the FAO. Some R&D in the areas of governance and policy development are very relevant to the water sector, though aimed at rural and socio-economic development in general. For example, the interventions of the Programme de Réhabilitation et d'Appui au Secteur Agricole du Cambodge have a significant R&D component to test innovative methods of rural and village development. These methods have been applied *inter alia* to water supply and sanitation and small irrigation schemes.

4.6 Institutional arrangements and management capacity

Institutional arrangements in the water sector and related sectors (e.g. the environment) and subsectors (e.g. rural water supply) are undergoing rapid change and capacity building. Many arrangements are very recent, or are not yet fully operational. For example, MOWRAM dates only from 1999, and the draft Law on Water Resources Management was transmitted to the National Assembly only in 2002. Institutional strengthening is being carried out in several institutions with water-related responsibilities, including MOWRAM.

Policies have been promulgated for several water subsectors, including irrigation, urban water supply, urban sanitation, and rural water supply and sanitation. There are also strategies, strategic frameworks and action plans in other water-related areas, including electricity, fisheries, agriculture, forestry and the natural environment. They have been developed at different times and for different time scales. Most have been developed with the assistance of international organizations and consultants that coordinate their activities to a limited extent. The National Environmental Action Plan considers water only from the perspective of the Tonlé Sap fishery and ecosystem. An overarching National Water Resources Policy is now, in 2002, being drafted, to provide a context within which subsector policies are developed. Hitherto, the various documents have not been developed as parts of a single integrated package of policies and strategies.

The draft Law on Water Resources Management has been prepared in order to regulate water sector management which is, to a certain extent, the prerogative of several institutions. A series of agreements between MOWRAM and the Ministry of Industry, Mines and Energy, the Ministry of Rural Development and the Ministry of Agriculture, Forestry and Fisheries, which define their respective spheres of competence, imply that MOWRAM will perform a regulatory role in water resources management, whereas the other ministries will continue to perform the role of water resources developers or service providers, under the overall supervision of MOWRAM.

Relationships among agencies with water-related responsibilities appear to be weak, or hindered by requirements for staff to follow strict lines of communication. MOWRAM is still establishing its position as the lead water-sector agency, while the Cambodia National Mekong Committee provides a venue for communication and coordination among agencies with water-related responsibilities in the Mekong river basin, which accounts for 86 percent of Cambodia's land area.

A critical issue in the water sector is the capacity of MOWRAM and other relevant institutions to carry out their responsibilities, at both national and provincial levels. Because of the country's recent traumatic history, government agencies do not have sufficient numbers of experienced, trained staff, particularly in

the age group that normally would fill middle to senior professional posts. The problem is compounded by low public service salaries, and the limited availability of funds for any purpose — human resources development, facilities and equipment, data collection and information management, routine operations. Thus, institutional development often is carried out as part of capacity building projects funded by overseas development agencies. Without a comprehensive approach for the whole water sector, reliance on project funding may not meet Cambodia's overall national priorities, and may divert scarce staff resources into areas of activity or training that are not top priority.

5. FORMULATION OF A WATER VISION TO ACTION PROGRAMME FOR CAMBODIA

On the basis of the experiences in the establishment of the framework for action in association with the Southeast Asia Technical Advisory Committee of the Global Water Partnership as well as the findings of the first phase of the FAO-UNESCAP Regional Cooperation Project, the following four themes and their associated priority activities were identified as being necessary for the realization of the Cambodian National Water Vision, which is part of the national socio-economic development process:

- Water for people: poverty reduction and rural development.
- Water for economic development and nature conservation.
- Pilot river basin management – Prek Thnot river basin.
- Establishment of a framework to turn the national water vision into reality.

The above four themes were adopted by four working groups at the round-table workshop on the formulation of a national water vision to action programme, organized by MOWRAM in cooperation with UNESCAP and FAO in Phnom Penh on 8-9 January 2003. The workshop was attended by 39 participants from various agencies, as listed in Annex 2.1. The main findings are summarized in the proceeding sections.

5.1 Water for people: Poverty reduction and rural development

Being an LDC, the majority of Cambodians are poor and about 80 percent lives in the rural area. The current five-year plan of national social and economic development aims to uplift the social and economic conditions of this poor group. On the basis of the general issues related to integrated water resources management identified earlier, the working group on the theme of 'Water for People' conducted three working sessions to identify priority objectives and related programmes of action for poverty alleviation and rural development, including identification of key actors, indicators of achievements and possible roles and priority activities of MOWRAM. Further details of the discussions are presented in the following sections.

5.1.1 Priority objectives and related programmes of action

Three priority objectives of water resources development for rural development and poverty reduction were selected as follows:

- a. To increase the incomes of the poor.
- b. To provide clean water and sanitation to the rural areas.
- c. To create non-farm employment.

Regarding the first priority objectives, the following programmes of action would be required:

1. The construction or rehabilitation of an irrigation system with the capacity to supply water throughout the year (agriculture and domestic supply).
 - a. Survey and investigation to develop projects with high economic efficiency for the government or donors to invest in.
 - b. Participation of farmers in operation and maintenance of the system.
2. Training of farmers on diversified cultivation for crops with high economic return such as vegetables, aquaculture and livestock.
 - a. Organization of a training seminar to introduce all institutions to implementation (Ministry of Agriculture, Forestry and Fisheries, FAO).
 - b. Provision of seeds and extension services for implementation (Ministry of Agriculture, Forestry and Fisheries, NGOs and donors).
 - c. Establishment of an agriculture credit system for rural areas (low or no interest system) (NGOs, international organizations).
3. Resolution of conflicts between water user communities and agriculture communities.
 - a. Allocation of water for use among the localities and individuals (MOWRAM and Ministry of Rural Development).
 - b. Provision of guidance to local authorities on water use through training seminars and legislation (Ministry of Agriculture, Forestry and Fisheries, MOWRAM).

5.1.2 Key actors/agencies

To support efforts to increase poor farmers' incomes, the following key agencies were identified together with their priority activities:

MOWRAM: Survey and study total areas for irrigation; provide training and dissemination on good irrigation practices and on appropriate operation and maintenance of an irrigation system; provide guidance and training on water utilization technology; disseminate information on water use law to different institutions.

Ministry of Agriculture, Forestry and Fisheries: Determine areas of cultivation suitable for different crops; disseminate advanced technology; disseminate techniques on aquaculture in ponds and paddy fields; disseminate cultivation practices and water management practices; disseminate and provide guidance on modern technology; and provide training and guidance on the cultivation of specific crops throughout the country; provide guidance on water supply practices for different crops.

Ministry of Rural Development: Improve health and sanitation in rural areas; provide information on markets; provide guidance on water use and hygiene; monitor clean water quality.

5.1.3 Indicators, targets and mechanisms

1. Increase income from US\$300/year to US\$600/year in five years. Mechanisms include MOWRAM, Ministry of Rural Development reporting to the government. Issues and action: Capacity and skills and budget are required; identifying and planning areas for priority action. Strategy: Implementation and expansion of target areas.

2. Provide clean water and sanitation: Increase from 20 to 50 percent in ten years. MOWRAM and Ministry of Rural Development to report to the government, including on efficiency and budget, and the setting of standards is required. Other priority programmes of the council may include improving existing water supply systems and creating new water supply systems.
3. Create new employment opportunities: To increase non-farm activities by 60 percent in five years. Promotion could be carried out by Ministry of Agriculture, Forestry and Fisheries, MOWRAM and Ministry of Rural Development with necessary technical assistance and financial resources for the planning and definition of the priority areas for implementation.

5.1.4 Suggested improvement in existing programmes

- Provide and exchange information.
- Determine clearly the role of each ministry.
- Establish collaboration between related ministries.

5.1.5 Expected enhanced role of MOWRAM

- It should act as a centre for information on water resources.
- It should provide enough water for development.
- It should more effectively conserve and maintain water resources and water facilities.
- It should provide water resources data to other institutions.

5.1.6 Priority activities expected from MOWRAM

- Preparation work for collaboration with other ministries.
- Cooperation and negotiation with neighbouring countries.
- Control of water quality.

5.2 Water for nature and economic development

Cambodia is known for its rich fishery resources, abundant waterways and ecotourism development. These waterways have been recognized for their strategic role in transportation development in the subregion, particularly maritime and inland navigation. The aim therefore should be to further strengthen the strategic role of the country in economic development and cooperation in the Greater Mekong subregion. On the basis of the integrated water resources management issues identified in the preceding chapter, the working group focused its attention on opportunities for economic development and nature conservation. In particular, the working group discussed the importance of water resources for agricultural development, waterborne transport, tourism development and hydropower generation.

5.2.1 Priority objectives

- a. To develop agriculture (irrigation, fisheries, aquatic culture, etc.).
- b. To develop waterborne transport and ecotourism.
- c. To develop hydropower.

5.2.2 *Issues*

Related to Objective 1: (1) Lack of finance; (2) lack of international market, technical knowledge and skill; (3) lack of law enforcement.

Related to Objective 2: (1) Lack of finance; (2) lack of technical capacity, planning and management; (3) lack of national and international law enforcement.

Related to Objective 3: (1) Lack of finance; (2) lack of investment; (3) lack of technical capacity, knowledge and skill.

5.2.3 *Three main key actors:*

1. Ministry of Water Resources and Meteorology.
2. Ministry of Agriculture, Forestry and Fisheries.
3. Ministry of Public Works and Transport.

5.2.4 *Strategies*

- a. For agriculture, including irrigation systems:
 - Rehabilitation of existing irrigation system;
 - rehabilitation of small-scale irrigation by gravity (short-term);
 - expansion of irrigation area and development of capacity building;
 - increase of water use efficiency;
 - public participation in project development and design;
 - land ownership reform;
 - provision of credit;
 - establishment of farmer water user communities; and
 - construction/Expansion of rural road infrastructure.
- b. For hydropower:
 - collection data to identify potential sites and
 - strengthening of environmental impact assessment (EIA) capacity.
- c. For navigation:
 - construction/Expansion of safe navigation infrastructure.

5.2.5 *Indicators and target*

- a. To develop agriculture (irrigation, fisheries, aquatic culture, etc.):
 - Irrigated area will increase from 14.4 to 34 percent (Ministry of Agriculture, Forestry and Fisheries and MOWRAM to monitor and report).
 - Aquaculture production will increase from 40 to 60 percent.
- b. To develop waterborne transport and ecotourism:
 - Number of tourists to be doubled in ten years with protection of water resources and ecosystems.
 - Volume of waterborne transport to be doubled in ten years, which would involve removal of shoals.

- c. To develop hydropower:
 - Double or triple the hydropower capacity.
 - Actions include: Study feasibility, involve private sector, establish transmission system and HRD.

5.2.6 Existing programmes and existing mechanisms for coordination

- a. Water resources sector: Water supply, water resources conservation, irrigation and drainage works, hydrology and meteorology and agriculture.
- b. Hydropower sector: Relationship between line agencies (Ministry of Industry, Mines and Energy); seek local and foreign partnerships for development; cooperation with government and private sector; mobilization of financial resources.
- c. Navigation and ecotourism: Relation among line agencies (Ministry of Public Works and Transport, Ministry of Tourism); relation to promotion of tourism.

5.2.7 Expected roles of MOWRAM

- a. To promote action programme: Water resources work — increase and rehabilitate irrigation systems for all areas; strengthen strategies related to flood control and drought; strengthen hydrological networks and information system urgently; strengthen the use of the irrigation system in a sustainable manner.
- b. Meteorological activities — extend the meteorological network; build capacity on modern instruments.

5.2.8 Proposed priority activities of MOWRAM

- a. Rehabilitate irrigation systems.
- b. Strengthen operation and maintenance of the irrigation system in a sustainable manner.
- c. Build capacity and develop human resources.

5.2.9 Consolidating recommendations

- a. All line agencies should work closely with MOWRAM on the water sector.
- b. Government should give priority to providing financial and budgetary support to MOWRAM.
- c. Request the government to facilitate activities related to the water resources sector.
- d. Request donors to provide priority support to the water resources sector.

5.3 Pilot river basin management (Prek Thnot river basin)

In order to institutionalize integrated water resources management, it is considered important to decentralize that management. Thus, the initiatives of Cambodia in cooperation with Mekong River Commission and the Asian Development Bank (ADB) in their capacity building for water resources management of the country should be supported.

On the basis of the current practices of water resources management at the basin level, the working group reviewed current efforts and possible improvement priorities to support the socio-economic development of the country. On the basis of the discussion, the working group recommended the Prek Thnot river basin as a pilot river basin in view of its strategic location and the increasing need for

better water resources management in the basin and in the capital, Phnom Penh. As a result of the discussion and review of current efforts, the following priority objectives were recommended along with subsequent priority issues and programmes of action:

5.3.1 Objectives

- a. To carry out integrated planning of the river basin, including flood control, hydropower generation and irrigation.
- b. To establish an effective mechanism for river basin management.
- c. To ensure sustainable development of the river basin.

5.3.2 Priority issues

- a. Deforestation and forest conservation.
- b. Lack of public participation.
- c. Lack of budget and human resources development.
- d. No law and regulation on water resources management.
- e. No mechanism for coordination and decentralization.
- f. Electricity cost is highest in the region.

5.3.3 Key actors and agencies

- a. MOWRAM: Main tasks are to establish regulation and law on water resources management; to promote public awareness; and to provide mechanisms for coordinate and decentralization.
- b. Ministry of Agriculture, Forestry and Fisheries: Main tasks to strengthen the forest law.
- c. Ministry of Industry, Mines and Energy: Main task is to mobilize resources, including grants, aid and private investment for development.

5.3.4 Strategies

- a. Improvement of regulation and law.
- b. Establishment of farmer water user communities and forest communities.
- c. Ensuring financial support from government and donors.
- d. Capacity building and gender mainstreaming in river basin development projects.

5.3.5 Indicators

- a. Total production of the water resources sector.
- b. Total budget investment in the water resources sector.
- c. Conflict prevention in the river basin.

5.3.6 Targets

- a. Double water production in five years.
- b. Private investment promotion over the next thirty years.
- c. Reduced conflict in the river basin within two years.

5.3.7 *Priority actions*

- a.1 Establish the river basin committee.
- a.2 Mobilize financial support from the government and donors.
- a.3 Strengthen the laws.
- b. Encourage private investment and active participation of beneficiaries in investment.
- c. Establish farmer water user communities.

5.3.8 *Existing programmes*

The most important existing programmes were identified as those of the Mekong River Commission, especially the following three:

- a. Basin Development Programme.
- b. Water Utilization Programme.
- c. Environmental Programme.

5.3.9 *Possible roles of MOWRAM*

The expected roles of MOWRAM could be those already defined in the decree on MOWRAM dated 30 June 1999, which includes the following:

- a. Define policies relating to the strategic development of water resources;
- b. conduct research on and investigation of water resources;
- c. prepare plans for water resources development and conservation;
- d. manage direct and indirect water resources use and mitigating water-related disasters;
- e. draft water law and monitoring its implementation;
- f. gather and manage hydro-meteorological and groundwater data, information;
- g. provide technical advice; and
- h. administer international collaboration, including that within the Mekong basin.

5.3.10 *Suggested priority activities of MOWRAM*

- a. Developing government policies relating to the strategic development of water resources.

5.3.11 *Observations/recommendations*

All water-related agencies should try their utmost to coordinate their activities and collaborate with each other, particularly on data and information exchange, to achieve integrated water resources management.

5.4 *Framework to turn the national water vision into reality*

5.4.1 *Objectives*

The working group focused its discussions not only on the detailed activities of turning the national water vision into reality, but also (and mainly) on establishing a framework to create

the conditions for all key stakeholders of the water resources sector to play their proper roles in the implementation of the national water vision. For this purpose, the working group recommended the sustainable development of the basin's natural resources through clearer water resources policies and the mobilization and effective use of resources. Towards these goals, the working group identified the following three priority objectives:

- a. To strengthen the mechanism for coordination of and participation in water resources management and development.
- b. To strengthen human resources development in the water sector.
- c. To improve financial resources mobilization and allocation.

5.4.2 Issues

- a. The policy implementation mechanism:
 - Lack of a well-established basin committee for the implementation of water resources policies;
 - overlapping of responsibilities among agencies; and
 - lack of a programme to enhance awareness of all stakeholders on water law and policies.
- b. Human resources development in the water sector:
 - Lack of experience and capacity at all levels (national, provincial and local);
 - existing human resources development capacity is still very limited; and
 - no clear curriculum for integrated water resources management.
- c. Problems related to financial resources:
 - Lack of financial resources for management and development of water resources;
 - few investors and donors are interested and willing to support the water resources sector; and
 - poor efficiency in the use of the limited financial resources.

5.4.3 Actors/agencies

The key actors in the water resources sector were identified by the working group to include the following: MOWRAM, Cambodia National Mekong Committee, Ministry of the Environment, Ministry of Agriculture, Forestry and Fisheries, Ministry of Rural Development, Ministry of Industry, Mines and Energy, and Ministry of Public Works and Transport.

5.4.4 Possible courses of action and overall strategy

- a. Submit the national water policy to the Council of Ministers for adoption.
- b. Disseminate and enhance the national water policy and water vision among line agencies.
- c. Mobilize financial support to implement the water vision.
- d. Explain the water policy to the other riparian countries and to the Mekong River Commission.
- e. Seek financial support from the line agencies.
- f. Facilitate and promote cooperation between Cambodia and others countries.

On the basis of the above courses of action, the working group proposed a strategy to promote the adoption of the national water vision and to establish a mechanism for turning the vision into reality, including the mobilization of financial resources.

5.4.5 Strategy to strengthen the mechanism for coordination and participation in integrated water resources management

- a. Indicators and targets: To reduce the number of conflicts related to water use and the number of violations of the water law by half within five to ten years.
- b. Priority actions:
 - To establish a coordination committee, including MOWRAM and other line ministries and agencies.
 - To develop laws and regulations and strengthen their enforcement.

5.4.6 Strategy to strengthen human resources development for the water sector

- a. Indicators and targets: To double the number of experts and technical staff in the water sector within five to ten years.
- b. Priority action: To establish a scholarship programme for short and long-term training within the country and abroad.

5.4.7 Strategy to improve financial mobilization and allocation

- a. Indicators and targets: to increase the total investment in the water sector by 30 to 40 percent within the next five to ten years.
- b. Priority actions:
 - To collect and compile information on total investment in the water sector during the past decade.
 - To develop strategies for better mobilization of financial resources.
 - To establish a clear mechanism to implement the strategy immediately.

5.4.8 Existing programmes and responsible agencies

- Programmes on agricultural and irrigation development (Ministry of Agriculture, Forestry and Fisheries, Ministry of Rural Development, MOWRAM).
- Programmes on hydropower development (MOWRAM and Ministry of Industry, Mines and Energy).
- Programmes on water supply and sanitation (MOWRAM, Ministry of Industry, Mines and Energy and Ministry of Rural Development).
- Programmes on navigation (MOWRAM, Ministry of Public Works and Transport).
- Programmes on water quality monitoring (MOWRAM and Ministry of the Environment).
- River basin planning and management (Cambodia National Mekong Committee, MOWRAM, Ministry of Rural Development, Ministry of Industry, Mines and Energy, Ministry of Public Works and Transport).
- Programmes on groundwater management (MOWRAM and Ministry of Rural Development).

5.4.9 Possible mechanisms for coordination

Existing mechanisms include MOWRAM, Cambodia National Mekong Committee or river basin organizations. The strength of the existing agencies is that the laws and regulations are in place in all line agencies. However, the weaknesses of the existing system are the lack of effective

law enforcement, lack of effective and popular mechanisms and means of communication and information dissemination, and lack of financial resources.

5.4.10 Possible roles of MOWRAM

- a. To prepare the enactment of the water law and other regulations.
- b. To maintain and disseminate information and data to the line agencies.
- c. To monitor the implementation process.
- d. To organize the preparation of the master plans for all main river basins in the country.

5.4.11 Suggested priority activities of MOWRAM

- a. To collect, compile and disseminate information and data to the line agencies.
- b. To monitor the implementation process of turning the national water vision into reality.
- c. To organize the master plan for the main pilot river basins in the country.

5.4.12 Recommendation

It is recommended that MOWRAM should focus on strengthening and enforcing the water law, related water regulations and policies.

6. CONCLUDING REMARKS

During the past two years, MOWRAM has undertaken various important studies related to the formulation of water resources policies and strategy, including the drafting of the water law. These efforts lay down the foundation for the introduction of integrated water resources management into the national development process at national, provincial and local levels. Cooperation with the Global Water Partnership and Southeast Asia Technical Advisory Committee has helped identify detailed programmes of action. The latest joint efforts with UNESCAP and FAO have contributed to streamlining national activities towards more systematic implementation of integrated water resources management at national, provincial and local levels. The round-table workshop has highlighted the following strategic elements in the systematic implementation of integrated water resources management:

1. All representatives of line ministries and related agencies recognized the importance of the national water vision as a guide for integrated water resources management in all sector activities and at all levels of water resources management in the country. It was also recognized that the enhancement of awareness and acceptance of the national water vision would facilitate coordination of activities among the sectors and at all levels.
2. All representatives of line ministries and related agencies agreed that MOWRAM should be the key agency responsible for the implementation and realization of the national water vision. In this connection, they identified key activities required to create an effective framework for turning the vision into reality. These activities include those related to the water law, policies and regulations as well as mobilization of resources and participation of the key stakeholders in the management and development of the country's water resources.
3. The participants recognized the importance of successful implementation of the national water vision in different sectors and for different priorities of the national development process, including poverty reduction and rural development; economic development and nature conservation; pilot basin management for the Prek Thnot river basin; and the establishment of

a framework to turn the national water vision into reality. The participants could identify indicators and targets as well as the expected role of MOWRAM in facilitating achievement of the proposed targets.

4. The above findings of these initial efforts raised a number of challenges to MOWRAM as leader of the water sector to meet specific expectations in the national development process, especially with respect to the mobilization and allocation of financial resources to the water sector. These challenges would need to be included in the strategy and programme of work of MOWRAM. The participants therefore expected the continued support of UNESCAP and FAO as well as other international organizations in these tasks.
5. These findings suggest a new systematic approach to the coordination of the introduction of integrated water resources management in the management of water resources of Cambodia. This systematic approach is centred on the key role of MOWRAM. This is the most important and fundamental difference from the previous findings related to the implementation of the national water vision. In the coming months, efforts should be made to identify the core activities that MOWRAM would undertake to build on the confidence entrusted to the ministry by the representatives of the line ministries and related agencies.
6. As indicated in the opening message of Mr Ravi Sawhney, Director of the Environment and Sustainable Development Division of UNESCAP, UNESCAP would be willing to include the priority recommendation of the round-table workshop into the implementation of its ongoing project on “Enhancement of capacity on strategic planning and management of natural resources development and environment protection”. The participants hope that UNESCAP assistance would be continued to incorporate these initial findings into the strategic plan of MOWRAM.
7. Similarly, from the opening statement of Mr Thierry Facon, representative of FAO, the participants expect FAO to continue its assistance to MOWRAM to enable it to keep modernizing its irrigation programme.

In the above context, efforts should be made to introduce a dual approach to the realization of the national water vision:

1. Overall approach: MOWRAM is to undertake the programmes related to the framework of turning the national water vision into reality and to the implementation of the pilot river basin management.
2. Sectoral approach: Related subsector agencies are to undertake priority activities related to the programmes on poverty mitigation and rural development, and economic development and nature conservation.

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ANNEX 2.1

Round-table meeting on water resources management in Cambodia: Vision to action

List of participants

Name	Position	Institution
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H.E. Ly Chana	General Director	Directorate General of Administrative Affairs, MOWRAM
H.E. Ney Lon	Deputy Director	General Inspection, MOWRAM
Mr Chuon Bithol	Dep. Gen. Director	Directorate General of Technical Affairs, MOWRAM
Mr Mey Lyhuoth	Dep. Gen. Director	Directorate General of Administrative Affairs, MOWRAM
Mr Prom Saroeun	Dep. Gen. Director	General Inspection, MOWRAM
Mr Le Huu Ti		UNESCAP
Mr Thierry Facon		RAPA-FAO
Mr Sen Vuthy	Director	Department of Administrative and Human Resources, MOWRAM
Mr Chornng Seng Im	Director	Department of Finance, MOWRAM
Mr Pich Veasna	Director	Department of Planning and International Cooperation
Mr Theng Tara	Director	Department of Water Resources Management and Conservation
Mr Te Navuth	Director	Department of Hydrology and River Works
Ms Seth Vannareth	Director	Department of Meteorology
Mr Te Auv Kim	Director	Department of Irrigated Agriculture
Mr Pang Peng	Director	Department of Water Supply and Sanitation
Mr Em Bunthoeun	Director	Department of Engineering
Mr Kong Sovuthy		Department of Finance, MOWRAM
Mr Te Rompey		Department of Planning and International Cooperation
Mr Am Norin	Deputy Director	Department of Water Resources Management and Conservation
Mr Thach Sovanna		Department of Water Resources Management and Conservation
Mr Say Sokun		Department of Water Resources Management and Conservation
Mr Saun Sam Aun		Department of Water Resources Management and Conservation
Mr Chea Sophal		Department of Water Resources Management and Conservation
Mr Luy Chanrith		Department of Water Resources Management and Conservation
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Mrs Seum Sokema		Department of Water Resources Management and Conservation
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Mr Bak Buna		Department of Water Supply and Sanitation
Mr Eng Cheasan		Ministry of Agriculture, Forestry and Fisheries
Mr Ouk Dara		Ministry of Rural Development
Mr Saun Panarith	Vice Chief	Ministry of Industry, Mines and Energy
H.E. Pich Don	Deputy Sec General	Cambodia National Mekong Committee
Mr Sok Saing Im	Senior Officer	Mekong River Commission Secretariat
Mr Takanobu KOBAYASHI	Advisor	JICA Expert to MOWRAM
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FROM NATIONAL WATER VISION TO ACTION: A FRAMEWORK FOR INTEGRATED WATER RESOURCES MANAGEMENT IN THE LAO PEOPLE'S DEMOCRATIC REPUBLIC

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1. BACKGROUND

The World Water Vision process and the Second World Water Forum held in March 2000 have generated a great deal of enthusiasm for better management of water resources in the region, as well as elsewhere. Building on this enthusiasm, a regional programme of cooperation involving FAO, UNESCAP, and selected countries in the region was launched in 2000 to promote the process of developing national water visions. In the initial phase of this programme that was implemented between 2000 and 2001, four country case studies were carried out in Southeast Asia with funding from FAO. Subsequently, a report containing the four country case studies and a synthesis of the related lessons was published (Le Huu Ti and T. Facon, 2001) and widely disseminated.

A second phase of this regional cooperation project was carried out between 2002 and 2003 involving three of the least developed countries in Southeast Asia, namely Cambodia, Lao People's Democratic Republic, and Myanmar.

This present report summarizes the results of previous studies related to the water resources management in Lao PDR and presents the findings of the Lao PDR country case study carried out as part of the second phase of the regional cooperation programme.

2. COUNTRY OVERVIEW

Lao People's Democratic Republic (Lao PDR) is a landlocked country with an area of 236 800 square kilometres, most of which is mountainous and about 47 percent is forested. The country has 16 provinces, one municipality and a special zone. Lao PDR has the third lowest population of the ASEAN countries. The estimated year 2000 population is 5218000, giving an average population density of 21 people per square kilometre. Population density ranges from 149 people per square kilometre in Vientiane Municipality to eight people per square kilometre in Xaysomboun Special Zone. In some of the mountainous areas the population is very scattered.

The Lao people include many ethnic groups with different customs and beliefs. These must be taken into account in the socio-economic development of the country. The main impediments to socio-economic development include a high illiteracy rate, high birth and infant mortality rates, low productivity, lack of experienced staff and skilled labour, and a legal and regulatory system that is still incomplete. However, Lao PDR has a high potential for socio-economic development owing to its abundant natural resources, especially water resources, which have yet to be exploited fully.

The agricultural sector is the foundation of the country's current socio-economic development. It accounts for the largest share of the country's foreign exchange earnings (40 percent), about 52 percent of the GDP, and 85.5 percent of the employment. The industrial and service sectors are in their infancy. However, hydropower is one of the main export sectors of the country and production for export is expected to double in the next ten years.

2.1 National policy and long-term goals of socio-economic development

a. National socio-economic development policy

This policy focuses on:

- Alleviating poverty, minimizing the gap in the socio-economic status between urban and rural areas, and increasing harmony and understanding among ethnic groups;
- basing the national economic development process on the wealth of natural resources, especially water and water resources, and supporting commerce and economic cooperation in the region through greater agricultural production and improved capability in the service sector;
- developing human resources, public health and social welfare with special emphasis on the ethnic groups in remote areas;
- protecting the environment and natural resources (soil, groundwater, minerals, forests, wildlife, water sources and air) through the cooperation of people and various organizations; and
- promoting more effective management of natural resources through community ownership.

b. Long-term socio-economic development goals

The long-term socio-economic development goals of the country are to increase the national income and achieve a better living standard for the people, while protecting the environment and maintaining the culture of the Lao people.

To achieve the objectives of socio-economic development, the government has identified eight priority programmes as follows:

1. Food production.
2. Stabilization of shifting cultivation.
3. Commodity production.
4. Infrastructure development.
5. Rural development.
6. Human resources development.
7. Services development.
8. External economic relations.

2.2 Status of water and water resources management

a. Overview

Lao PDR has abundant water and water resources. The annual average rainfall is 1650 mm ranging from 1 300 mm/year in the north, 1 500 mm/year in the central regions, to 2 000 mm/year in the south, whereas on the Boloven plateau it is 3 700 mm/year. The average flow from the tributaries of the Mekong river is 8500 m³/second or 35 percent of the total flow within the Mekong river basin.

The abundant water resources in Lao PDR have the potential to support socio-economic development, especially the hydropower and irrigation subsectors. The hydropower potential of Lao PDR is large compared to other countries in the lower Mekong river basin, providing an opportunity to earn foreign income. The hydropower sector also has the ability to develop rapidly, indeed it has multiplied its production fivefold from 247 million kilowatt hours in 1976 to 1187 million kilowatt hours in 1999 when it exported 473 million kilowatt hours. The government has given high priority to investment in the irrigation subsector since agriculture is the foundation of national economic development, is necessary for food stabilization and about 85 percent of the population lives in rural areas. From 1976 to 2000, the area of irrigated dry season rice increased from 2700 ha to 1 10 000 ha. The irrigation subsector also significantly increased the average yield of rainfed paddy rice from 1.43 t/ha in 1976 to 3.27 t/ha in 2000. However, water resources development is still at a low level: irrigated area is only 20 percent of the national paddy area and hydropower production is still at two percent of its potential of 30 000 MW. Development in other sectors is still at a low level compared to hydropower and irrigation.

Although some advances have been achieved in the water sector, problems still remain. These include: unusual rainfall patterns in some years, high rates of evaporation, flood and drought in some of the main agricultural areas of the country; the impact of shifting cultivation on water resources (although this activity has been significantly reduced); and conflict of interests for management within the sector since most water subsector agencies are still responsible for regulation, management and service provision.

b. Water management activities

In order to achieve sustainable exploitation of water and water resources and to improve their management the following managerial, legal and institutional changes in the water sector have been made:

The Water and Water Resources Law (approved October 1996), the Environmental Protection Law (approved April 1999), and some Ministerial decrees and regulations have been approved. These latter regulations are to implement the Water and Water Resources Law and some other related laws.

The mandate of the Water Resources Coordination Committee (approved February 1999) established the Water Resources Coordination Committee within the Prime Minister's Office. The Committee is to provide advice to the government on matters related to water and water resources and to coordinate the planning, management, follow-up, inspection and protection of water and water resources aimed at their sustainable development and utilization in line with the government's socio-economic development policy.

The mandate of the Lao National Mekong Committee has been updated (approved November 1999) and it is to formulate policy, strategic plans, water resources related development projects and programmes within the Mekong basin, taking into consideration the protection of the environment and ecological balance, and community participation. It also cooperates with other Mekong riparian countries, various non-Mekong riparian countries and foreign donors. The Lao National Mekong Committee's aim is to ensure the fruitful implementation of water resources development projects within the territory of Lao PDR.

A policy identifying the different management responsibilities of central and district authorities has been adopted: The provincial level authorities are to undertake strategic planning; the district level authorities are to be responsible for planning and budgeting; and the village level authorities are to implement the plans.

A process of institutional review has been commenced to separate the regulatory, standard setting and management functions at the national level and improve the efficiency of management, development and social services.

A policy of public involvement in water resources management and development has been implemented. Examples include consultation on planning hydropower development projects and user involvement in rural water supply and small irrigation schemes.

Regulations and measures have been adopted to attract private participation and direct foreign investment in water resources development. There are several examples of such direct investment in the hydropower sector.

A draft decree on the water and water resources law is being prepared in order to clarify the responsibilities of agencies within the subsectors for managing, exploiting, using and developing water and water resources.

c. Institutional arrangements in the water sector

There are 12 agencies within the water sector and a further 10 agencies have a direct interest in it. These agencies and their responsibilities and roles are set out in Table 3.1. In this table the following definitions are used:

Regulator refers to a body that develops high level policy, defines the broad outcomes sought by the government for the management and use of natural resources, sets standards or performance targets, and audits and reports to the government on the performance of other bodies in meeting those standards or targets. It may also approve lower level policy and management plans developed by the manager.

Manager refers to a body that assesses the ongoing status and availability of natural resources, develops and coordinates the implementation of lower level policies that set out in more detail how the resources will be both protected and utilized, develops and coordinates the implementation of plans for the management of specific resources, grants rights (permits/licenses)

Table 3.1 Organizations with a direct interest in the water sector

Organization	Function	Role
Science, Technology and Environment Agency, Office of the Prime Minister	Has overall responsibility for activities related to science, technology and the environment. Coordinates agencies related to research and management of scientific, technological and environmental affairs. Ensures Lao PDR is up to date in scientific and technological advancements. Regulates wastewater disposal.	Regulator
National Mekong Committee Secretariat, State Planning Committee	Coordinates international aid assistance associated with investigation and development of the water resources of the Lower Mekong river basin. Follows up, controls and supervises utilization of that aid and reports regularly on the outcome and execution of each project.	Manager
Department of Irrigation, Ministry of Agriculture and Forests (MAF)	Implements government policies, strategies and programmes related to the development and management of irrigation, drainage and rural flood control. Monitors and evaluates data and information on irrigation and reports on changing situations. Issues standards relating to irrigation survey and design.	Regulator/ Manager and Service Provider
Department of Livestock and Fisheries, MAF	Implements government policies, strategies and programmes related to the management of fisheries (and livestock). Monitors and evaluates data and information related to fisheries (and livestock) and reports on changing situations.	Regulator/ Manager
Department of Meteorology and Hydrology, MAF	Collects, evaluates and disseminates rainfall, evaporation, river height and flow information for the Lao hydrometeorology network.	Service Provider
Inland Waterway Division of Communication Department, Ministry of Communication, Transport, Post and Construction (MCTPC)	Manages the use of waterways for transport and ensures safe navigation via dredging and navigation aids. Responsible for riverbank and urban flood protection. Collects hydrologic and hydrographic data on Mekong river and main tributaries.	Manager and Service Provider
Department of Housing and Urban Planning, MCTPC	Responsible for formulating the urban water supply strategy, preparing the training programme on planning and management, drafting regulations and standards.	Regulator
Water Supply Authority, MCTPC	Assists the MCTPC on technical issues including detailed elaboration of strategic plan, directing the implementation of the water supply sector policy, strategy and development plan.	Manager
State Enterprises Water Supply (Vientiane Municipality and Provincial Nam Papa)	Supplies water to urban locations (greater than 2 000 ha and density greater than 30 people/ha); Implements guidelines for drinking water quality (WHO); manages sewerage and drainage.	Service provider
Department of Electricity (DOE), Ministry of Industry and Handicrafts (MIH)	Determines policies, plans, laws and regulations for developing and controlling the production and distribution of electricity. Reviews and evaluates power project proposals, contracts and agreements.	Regulator/ Manager
Electricite du Laos (EDL) State-owned Corporation, MIH	Owens and operates main public sector generation, transmission and distribution assets. Undertakes project development and joint ventures.	Service Provider
Department of Industry, MIH	Determines policies, plans regulations and standards relating to industrial wastewater.	Regulator/ Manager
National Institute of Hygiene & Epidemiology Rural Water Supply, Ministry of Health	Formulation of rural supply policy and strategy, responsible for developing water and sanitation services to non-urban locations. (Nam Sa-at)	Regulator/ Manager

to use the resources, sets the conditions for the access and enjoyment of those rights, and monitors, reviews and reports on the use of the resources.

Service provider refers to a body that provides local services related to water, such as water supply, irrigation, information, technical and scientific expertise or advice on water issues, or government funding for users. Such bodies may construct, operate and maintain works to control the supply and delivery of the resource or a service (e.g. drainage) to a number of users. It may issue permits or licenses to users, but should be licensed by the manager if the body has responsibility for significant use of the water and water resources.

2.3 Policy on water and water resources

The objective of the Policy on Water and Water Resources is to ensure that the management, exploitation, use and development of water and water resources are sustainable, equitable, and support the goals of socio-economic development and environmental protection in Lao PDR.

This Policy specifically emphasizes cross-sector issues, which are important to present and future activities in the water sector. The policy does not discuss issues specific to a single water subsector and it is recommended that these issues be covered in subsector water policies. However, this policy is to be the basis for any policies developed for the water and water resources subsectors.

The Policy on Water and Water Resources addresses seven areas as follows:

- Water and water resources management principles;
- water resources development and management;
- public involvement in water resources management;
- financial resources for water source development and management;
- water allocation, quality management and use;
- data and information management; and
- capacity building and human resources development.

a. Water and water resources management principles

Water and water resources management is to be undertaken by subsectors in order to be consistent with the policy of decentralization and to ensure coordination among the water and water resources subsectors and provincial authorities.

The relationships between processes for water and water resources development planning and socio-economic planning, and the roles and responsibilities of the subsectors are to be clarified by approving regulations on water and water resource planning processes and methodologies.

Coordination arrangements are to be identified and established between water and water resource and land and forest subsectors of the economy to ensure the sustainability of water resources.

Coordination systems related to the management, development, exploitation and use of water are to be established among the water and water resource subsectors and among the different provinces to increase water use efficiency, and to ensure environmental sustainability.

The processes and methodologies for updating the Water and Water Resources Policy, the National Water and Water Resources Management Plan and other water source management plans are to be identified to ensure compatibility with changing socio-economic conditions and priorities for water use.

The responsibility for water and water resources in individual river basins must be assigned to existing organizations or to newly established organizations, which are to be designed to suit the location, size, human and social values, characteristics of the river basin and opportunity for development. The river basin organization must ensure that the local authority and community are appropriately involved and must report periodically on the status of the water and water resources to the Prime Minister's Office to ensure efficient management of water and water resources.

The decree to implement the water and water resources law must be urgently developed and must identify the process, methodologies and the sharing of responsibilities among the water subsectors and local authorities for implementing that law, including responsibilities for developing related regulations that may be required to avoid inefficient and unsustainable water resource development.

Drafting regulations and management of water resources must be included in the annual, five-year and long-term plans of the water and water resources subsectors and the Water Resources Coordination Committee. Budgets will be allocated for the activity of developing regulations.

b. Water resources management and development

With regard to planning and implementation of water resources development projects, each water and water resources subsector must coordinate their activities to take into account needs at the national and local level, issues of economic and financial efficiency, social equity, environmental impacts, and to allow the government to meet its international obligations.

National water resources development and management planning is to be prioritized and provide the basis for subsectoral and local water resource development projects. The national plans must include plans for emergencies, floods and droughts.

An integrated river basin management and development plan is to be developed for those sub-basins of the Mekong river and sub-basins of other rivers that are important for socio-economic development plans at the national and local level, or which have a high potential for water use conflicts. These integrated river basin management and development plans must include groundwater where appropriate.

Water resource development projects and water resource management plans must be coordinated with land and forest management plans. The public is to be involved in developing and implementing these plans. The environmental impacts of implementing plans are to be assessed.

Community benefit through the public involvement process must be taken into account when initiating water resource development projects and water resource management plans.

Ecosystems of rivers that have a high potential for hydropower and irrigation projects or for conflict over water use, are to be analysed to enable the development of water quality and quantity standards necessary for the protection of the environment.

c. Public involvement

Public involvement in the management, development and protection of water and water resources will be promoted. This involvement will allow for differences in society, culture and customs of the ethnic groups.

Guidelines for the process and methodology of public involvement in planning, implementing and management of water source development projects will be developed.

The capacity and institutional strength of relevant organizations to implement policies for public involvement will be increased and awareness developed to achieve community ownership of water and water resources management, development and protection.

Information on water and water resources status and trends, and the subsectoral activities will be disseminated to the public to achieve effective management and protection of water and water resources.

Water users' education, which has been initiated in the irrigation, rural water supply, and fisheries subsectors, will be further developed and appropriately extended to other water subsectors. In collaboration with the education sector, the media and mass organizations, a programme of public awareness on the protection of water resources will be initiated.

d. Financial resources for water resource development and management

Regulations and methodologies will be used as necessary to ensure the economic efficiency of water resource developments and their environmental sustainability. Investment in the water and water resources subsectors will be promoted by giving high priority to hydropower, irrigation, urban and rural water supply. The efficiency of existing water resource developments and uses will be promoted by involvement of the beneficiaries in the management of water resource development projects and by implementing necessary regulations.

The selection of water resources development projects must take into account the readiness and, except in the case of projects for poverty alleviation, the ability of users to make a contribution. Management responsibility will be transferred to the direct beneficiaries of existing water resources development projects, where appropriate.

When initiating projects using state budgets, the source of funds for operation and maintenance, and the level of contribution by beneficiaries must be clearly identified in order to reduce the demand on the state budget.

Charges for water use should consider the capability of low-income families to pay. The structure of these charges should create economic incentives to increase the efficiency of water use and should generate sufficient revenue for management, operation and maintenance and allow eventual expansion of the supply system.

Each subsector will encourage direct private and foreign investment to reduce demands on limited public funds while using appropriate measures to ensure the nation benefits.

e. Water allocation, quality management and use

Water allocation, and the monitoring and management of water quality methods and systems must be developed through analysis, research and implementation in selected areas and gradually introduced throughout the country. The management of water use in the subsectors should be promoted by training and awareness of the users. License and water use fees and other measures should be introduced to increase water use efficiency.

Water allocation plans for water resources important for national and local socio-economic development plans, or which have a high potential for cross-sector conflicts over water use are to be developed as a priority. Where water allocation plans have yet to be developed, guidelines and measures to share water equitably and minimize the effects of a crisis or emergency are to be developed.

Water allocation plans must take into account domestic uses, cultural and social activities, environmental protection and existing water users. The plans must also link with land and forest use management plans. The plans must identify the processes and the methodologies to modify and to update water allocation in order to adjust to changing conditions.

Water quality must be periodically monitored and waste disposal to rivers controlled by appropriate measures. Public awareness of the need to protect the riverine environment must be increased.

Protected areas are to be defined to ensure water quality and quantity for human consumption. Activities such as construction, manufacturing and use of land for any purpose will be prohibited in these areas.

Permits must be obtained for disposal of waste water and any use of water other than small-scale use. The permit must clearly identify the purpose of the use, or wastewater discharge and any conditions applying. A fee for the permit will be levied and will be based on the purpose, size, location of the use and disposal, duration and measures for protecting the environment and other water users.

Work plans of organizations responsible for the management, development, and exploitation of water and water resources must include activities for the promotion of effective water and water resources use and their protection.

f. Data and information management

Data and information collection, analysis, exchange and management must be coordinated and improved to reduce duplication and ensure accuracy and reliability of data and information.

Water related data collected by government agencies shall be considered as the property of the state and be accessible to agencies in the water resources subsectors and other stakeholders under the terms stipulated in the regulations.

Regulations and data use fees will be developed and implemented, taking into consideration objectives for widespread data dissemination, cost recovery, sustainability and expansion of the data collection network.

Data necessary for the management and development of water and water resources that are important for national and local socio-economic development plans or that have a high potential for cross-sector water use conflict should be collected and analysed.

g. Capacity building and human resources development

Management and technical staff at all levels should be encouraged to continually upgrade their capacities through various means to be specified in human resources and capacity building plans, appropriate to the mandates of each organization and the responsibilities of each officer. The plans will also indicate actions to improve working procedures, regulations, and guidelines to improve the efficiency in implementing government policy.

The plans will emphasize the urgent necessity to implement laws, decrees, regulations for the integrated and sustainable management and development of water resources.

They will include prioritized actions to strengthen institutions at provincial and district levels to increase their efficiency in implementing decentralization policy that specifies a strategic role for provincial authorities, a planning and budget role for district authorities, and an implementation role for village authorities.

Water resource development plans or projects should consider the ability of the line agencies to implement projects and must include human resource development and capacity building to improve the effectiveness in implementing projects or plans.

3. NATIONAL WATER VISION AND THE FRAMEWORK FOR ACTION

3.1 Vision statement of the water sector

On the basis of previous studies and also in line with the experiences from the World Water Vision process at the global and regional levels, including advice provided by the Southeast Asia Technical Advisory Committee of the Global Water Partnership, the following vision statement was discussed and adopted at the Consultation Workshop on Programme For Action of the Water Sector organized by the Water Resources Coordination Committee on 25 March 2002 in Phonsavanh, Xieng Khouang Province, Lao PDR.

“To Achieve the Coordinated Development and Management of Water and Water Resources for the Health, Wealth and Happiness of the People”

Also on the same occasion, it was felt necessary to address the priority goals of the socio-economic development process of the country as reflected in the following overall target for the water sector:

“To contribute effectively to the national programme of poverty alleviation and the socio-economic development objective of liberating the country from the status of least-developed country”

3.2. Approach in preparing the Programme For Action in the water sector

a. Coordination with other line agencies

As a coordinating agency without a management role in any specific water subsector, the Water Resources Coordination Committee works closely with all water related line agencies in the preparation of the Programme For Action and also gathers inputs from other institutions that have an interest in the management of water resources through consultation meetings. The main role of the Water Resources Coordination Committee here is to consolidate in a single document the strategy and the programme for action of line agencies that were formulated independently with no institutionalized coordinating mechanism.

Basically, the Programme For Action prepared by the Water Resources Coordination Committee for the Consultation Workshop covers four main aspects of water resources management: (1) development; (2) management; (3) regulation and legislation; and (4) conservation/protection.

The Programme For Action for the water sector presented hereunder was based on the results of the Consultation Workshop and should only be considered in the context of the workshop. The view and ideas expressed by participants do not necessarily represent those of their agencies.

b. Choice of targets

The planning time horizon for short-term targets is 2005. This date coincides with the time frame of the national socio-economic development plan. The proposed short-term targets of each water subsector Programme For Action are based on the respective five-year plan targets.

At this stage there is no documented long-term sector plan beyond the five-year plan. Therefore, the targets proposed for the long-term Programme For Action are rather an indication of what the participants from each subsector consider as appropriate based on their own experiences and their views regarding the subsector strategy. No common time frame could be decided because water subsectors have different time horizons for strategic planning. Therefore, the date for the long-term target could vary from year 2010 to year 2020.

The meeting agreed that subsector targets should be rearranged under the following headings as deemed appropriate:

- (1) Access to safe water for urban communities.
- (2) Access to safe water for rural communities.
- (3) Irrigated agriculture for increasing food production.
- (4) In-land fishery sector.
- (5) Hydropower production.
- (6) The management of water resources.

Although this set of targets is not comprehensive, it does reflect the main activities in the water sector for the forthcoming years.

Participants to the Consultation Workshop included senior government officials from central and provincial water-related agencies. Most participants had been involved in drafting the water sector policy decree to implement the Water and Water Resources Law and in formulating the sector vision.

3.3 Programme For Action

a. Access to safe water for urban communities

(i) Current situation

- Of the total population of around 5.8 million, the urban population comprises an estimated 20 percent, or some 1.2 million people. It is estimated that the urban water supply coverage is about 54 percent of the urban population with, however, huge differences among towns.
- Since 1999, the water supply utilities in each province are performing as service providers only. All the activities related to policy, strategy, planning for urban water supply development and regulation have been handed over to the newly established Water Supply Authority.

Major water supply targets and the Programme For Action in urban communities are shown below:

(ii) Targets

1. By 2005, 60 to 62 percent of the urban population will have access to clean water and by 2020, 80 percent of the urban population will have access to clean water.
2. By 2005, average unaccounted-for water of all urban water supply facilities countrywide will be reduced to around 20 percent.

3. By 2005, the tariff structure of newly funded projects will take into account the loan covenants and the affordability for the most disadvantaged consumer group.
4. The implementation of the ongoing decentralization programme will be reinforced.

(iii) *Short-term Programme For Action*

1. Construct new water supply systems for 12 small towns (population of more than 4000 or density of more than 30 persons/hectare) that have highest priority in the investment programme of the water supply sector.
2. Extend the water supply system in Vientiane and rehabilitate the water supply system in Savannakhet town, the second most populated town of Lao PDR.
3. By 2005, strengthen the Water Supply Authority so that it can perform as Executing Agency for six to eight projects per year with an average project cost of US\$1 500 000.
4. Develop a Lao PDR urban water tariff policy for a high quality, sustainable and affordable level of service.
5. Conduct capacity building for provincial water supply utilities, especially focussing on technical and financial management operations and corporate planning.

(iv) *Long-term Programme For Action*

1. Provide clean water to about 90 to 100 small towns, rehabilitate and extend the water supply systems in all the 16 remaining provincial capitals.
2. Strengthen the regulatory function of the Water Supply Authority.

b. Access to safe water for rural communities

(i) *Current situation*

1. The responsibility for development and management of rural water supply facilities is under the National Centre for Environmental Health and Water Supply (commonly referred to in Lao PDR as *Nam Sa-at* — meaning Clean Water), Department of Hygiene, Ministry of Health;
2. The strategy of *Nam Sa-at* stresses the principle of ownership and participation of the beneficiaries, strong organization at grass root level and benefit evaluation and monitoring.
3. About 52 percent of the population has access to clean water.

(ii) *Targets*

Targets for 2005 include:

1. Clean water supply will be provided to 60 percent of the rural population.
2. Good service will be delivered to the new water supply schemes.
3. The quality of rural water supply schemes will be enhanced technically and in terms of sustainability.
4. Water quality control and surveillance will be in place and functioning.

Targets for 2025 include:

1. Clean water supply will be provided to more than 80 percent of the rural population.
2. Investment by the beneficiaries in the rural water supply and sanitation sector will be increased.

(iii) Short-term Programme For Action

1. Implement the strategy of institutional strengthening at the central, provincial, district and village levels.
2. Develop planning, budgeting and financial management skills.
3. Establish a management information system.
4. Improve the coordination and the participation of the stakeholders in the planning, implementation and management of rural water supply schemes.

(iv) Long-term Programme For Action

1. Set up and gradually strengthen the three Regional Centres for Rural Water Supply and Sanitation.
2. Develop and implement a programme of devolution of the management to the regional level.

c. Irrigated agriculture for increasing food production

(i) Current situation

1. The irrigation sector is one of the highest priority sectors of Lao PDR and accounts for 40-50 percent of the public investment in the agro-forestry sector.
2. Almost all the irrigated area is used for rice cultivation.
3. The existing irrigation schemes cover about 36 percent of the agricultural land.
4. Obstacles to efficient irrigation are the poor management of irrigation schemes and the fluctuating and low prices of agricultural goods, which discourage investment in the irrigation sector.

(ii) Target

1. By 2005, the irrigated area will be increased to cover 50 percent of the agricultural land.
2. By 2020, the irrigated area in the rainy season will be increased to cover over 80 percent of the agricultural land and the dry season irrigated area to cover over 50 percent of the agricultural land.
3. Irrigation efficiency will be gradually improved.

(iii) Short-term Programme For Action

In order to achieve the above-mentioned targets, the programme for action up to 2005 will focus on:

1. Expanding water user associations;

2. continuing implementation of the Irrigation Management Transfer to Beneficiaries programme;
3. improving and developing small irrigation schemes by communities;
4. building capacity at all levels, especially the communication skills of grassroots organizations, and the management and technical capacity of water user associations;
5. improving the efficiency of existing schemes in order to make them more attractive to beneficiaries prior to management transfer; and
6. improving the hydro-meteorological network for more reliable planning of medium and large schemes.

d. *In-land fishery sector*

(i) Current situation

1. Traditionally, fish has been the main source of animal protein for the population of Lao PDR, especially in the rural communities where more than 50 percent of the people rely on living aquatic resources for their dietary protein.
2. Capture fishery and aquaculture are the second occupation of over 80 percent of the rural population.
3. In 2001, fish accounted for about seven to eight percent of the GDP. This amounted to approximately 73000 tonnes, of which 60 percent is from aquaculture.
4. Recent studies of the fishery sector indicate that the demand for fingerlings in 2000 was about 500 millions and the supply was around 185 millions.

(ii) Targets

1. The demand for aquatic animal products is expected to increase from 14 kg/head/year in 2001 to 16 kg/head/year in 2005 and 23 kg/head/year in 2020, resulting in a total demand of 91000 tonnes and 187000 tonnes in 2005 and 2020 respectively .
2. As capture fisheries has limited potential, fish production through aquaculture and enhanced fisheries will be increased.
3. Research and development work related to the production of some pangasias and ornamentals for both the domestic and export markets will be undertaken.

(iii) Short-term Programme For Action

1. Continue the assessment of Mekong fisheries organized by the Mekong River Commission.
2. Strengthen fisheries information systems.
3. Promote the aquaculture of indigenous fish species.
4. Develop reservoir fisheries.
5. Strengthen measures to eliminate the use of illegal and destructive fishing gear.

(iv) Long-term Programme For Action

1. Increase supplementary food supplies to the urban communities by promoting peri-urban semi-intensive aquaculture with attention to aquatic animal health and good management practices.

2. Gradually integrate sustainable aquaculture farming into agricultural mixed farming, generating new employment.
3. Decentralize fisheries management.

e. *Hydropower sector*

(i) Current situation

1. Lao PDR has an abundant hydropower potential of about 30000 MW , far beyond the domestic demand. So far, only about 1.8 percent of this has been developed.
2. Because of rugged and mountainous terrain, remote areas cannot be reached by electric grid and as a result have to import electricity from neighbouring countries.
3. The export of hydropower energy is one of the important sources of Lao foreign exchange earnings.
4. The government has encouraged private investment in the sector, particularly in large hydropower schemes for energy export.

(ii) Targets

Short-term targets

1. The production of electricity will be increased by 3.7 percent per year, and electricity will be supplied to over 40 percent of villages.
2. The policy of decentralization of the electricity sector together with the enhancement of the regulatory function of the Electricity Department will be implemented.

Long-term targets

1. Ninety percent of the population will have access to reliable electricity.
2. A country-wide grid from the north to the south will be constructed.

(iii) Short-term Programme For Action

1. Develop small and medium hydropower schemes for supplying those areas far from the electric grid and areas currently importing electricity.
2. Extend the electric grid, focussing on areas with high economic development potential and major towns.
3. Carry out pre-investment studies of major schemes for energy support.
4. Finalize the formulation and initiate the implementation of the decree on the creation of funds for the protection of watersheds through the contribution of the revenue from hydropower projects.

(iv) Long-term Programme For Action

1. Develop large schemes for export and domestic consumption of electricity.
2. Expand the energy exchange with neighbouring countries.
3. Continue to promote private participation in the hydropower sector.
4. Strengthen the institutions and the human resources for the implementation of the decree on the creation of funds for watershed protection.

f. Cross-sectoral issues in water management

(i) Recent achievements

1. Integrated water resources development planning of Nam Ngum river basin, one of the major rivers in Lao PDR, has been carried out thanks to the technical assistance of ADB.
2. A decree to implement the Water and Water Resources Law has been approved by the government.
3. The policy on the water sector has been approved by the State Planning Committee.
4. The Water Sector Profile, the Draft Vision, and the Strategy of the water sector have been drafted.

(ii) Major targets

Short-term targets

1. The decree widely disseminated and effectively applied (as mentioned in item 2 above).
2. Integrated water resources management will be implemented in one of the river basins.
3. The Water Resources Coordination Committee will be further strengthened so that it has an actual role in the ongoing activities of the water sector.

Long-term targets

1. Integrated water resources management will be practiced in the most important river basins.
2. All fundamental regulations for the implementation of the Water and Water Resources Law will be formulated.

(iii) Short-term Programme For Action

1. Coordinate the implementation of integrated water resources management in the Nam Ngum river basin.
2. Prepare regulations on water management required for the implementation of integrated water resources management in the Nam Ngum river basin.
3. Strengthen the Water Resources Coordination Committee focusing on the coordination function at river basin level.
4. Undertake a programme of public awareness on the protection and conservation of the water resources.

(iv) Long-term Programme For Action

1. Expand the practice of integrated water resources management to other river basins.
2. Further strengthen the Water Resources Coordination Committee in order to be able to perform effectively its role as apex body for coordination and regulation in the water sector.

4. IDENTIFICATION OF PRIORITY ISSUES IN INTEGRATED WATER RESOURCES MANAGEMENT

In order to promote integrated water resources management, a national workshop was held from 17-18 October 2002 in Keo-Oudom, Vientiane Province, attended by 41 participants from various ministerial and provincial agencies and mass media organizations. A specific aim of the workshop was to identify issues and perspectives in the management of water resources of various sectors in the country. It was also expected that the workshop would come up with priority recommendations on integrated water resources management. On the basis of previous studies, it was decided to focus the discussion on four key areas:

- Policy and legislation.
- Management.
- Training and capacity building on integrated water resources management.
- Public awareness issues.

The following issues were recommended as priority issues that need to be addressed for successful implementation of integrated water resources management in the country.

4.1 Policy and legislation issues

The Draft Water Sector Policy Framework should be updated to include:

- (1) The protection and control of water pollution;
- (2) impacts of physical infrastructures on natural water channels;
- (3) international cooperation on the management and use of international rivers;
- (4) protection from the harmful impacts of natural calamities involving water; and
- (5) legal measures and incentives to protect water and water resources.

Moreover, it was felt that the updated draft policy framework should be discussed in detail with all concerned, submitted to the higher authority for approval and used as a basis for preparing a detailed water policy.

4.2 Management issues

As regards the water subsectors, priority should be given to:

- (1) Formulating a policy on decentralization specifically for the water sector — this should set out clearly the role, the function and working procedures of central and provincial line agencies;
- (2) formulating a policy on meteorological-hydrological data collection, management and sharing;
- (3) setting up a coordination mechanism between the Water Resources Coordination Committee and the Lao National Mekong Committee;
- (4) formulating a fishery subsector policy;
- (5) reviewing the prevailing policy on water users in the irrigation subsector;
- (6) preparing regulations for the water supply subsector;
- (7) establishing water standards for use in different water subsectors; and
- (8) formulating a policy for managing and protecting groundwater resources.

All participants recognized that the enforcement of the Water and Water Resources Law and related regulations is still very weak and that there is an urgent need for improvement, starting with the broad dissemination of information and the preparation of education and public awareness programmes. Most participants identified that one of the major issues is the lack of a strong and effective regulatory institution in most, if not all, water subsectors.

Most of the competition or conflict related to water use has been solved at operational level by local authorities. There is no institutionalized mechanism for solving water use competition and conflict. Several examples were given by participants. Project planning has been carried out in isolation and therefore has sometimes led to water use conflicts not only between different users, but also between users of the same subsectors. These two issues should be addressed as soon as possible as serious conflicts on water use, especially in the dry season, may occur in the future.

As regards the sharing and management of data collection, most participants expressed that the problem is not only the lack of data, but also the lack of management of existing data. Sometimes data is kept with individuals and not with the organization, and access to data depends on having a good connection or relation with a particular individual. Sometime, data is given free of charge, thus there is no sharing of the cost of data collection, processing and storing. This issue needs to be discussed and a clear policy on data management needs to be formulated.

4.3 Public awareness issues

The workshop expressed support for the Draft Public Awareness Programme prepared by the Water Resources Coordination Committee Secretariat in consultation with line agencies concerned, which proposed to focus on:

- Reviewing and investigating the customs, belief and practices of various ethnic groups concerning the use and conservation of water and water resources to prepare an awareness programme for each specific ethnic group;
- disseminating the existing laws, decrees and regulations of the water sector to a broad public using different media; and
- preparing exhibitions and other public activities during major festivals and public celebrations.

4.4 Capacity building issues

The participants considered the need for training on a number of topics, as follows:

- Preparing/updating policies and strategies related to the water subsectors.
- Issuing and implementing regulations for the management of the water resources.
- Raising public awareness.
- Promoting public participation.
- Dealing with gender issues.
- Implementing the decentralization policy.
- Demand management.
- Economic-financial evaluation of projects.
- Cost recovery.
- Conservation of the environment.
- Shifting from the role of service provider to the role of regulator and manager.

Highest priority was given to training and capacity building in the fields of policy and regulations. This opinion reflects well the present situation of the water sector. It is clear that the water sector in the country still lacks policies and regulations on cross sectoral as well as subsectoral matters. Training on public participation, gender issues and conservation of the environment was also considered to be important.

5. FORMULATION OF THE WATER VISION TO ACTION PLAN

On the basis of the experiences related to the establishment of the framework for action in association with the Southeast Asia Technical Advisory Committee of the Global Water Partnership as well as the findings of the first phase of the FAO-UNESCAP Regional Cooperation Project, the following four themes were identified as priority activities required for the realization of the Lao National Water Vision as part of the national socio-economic development process:

1. Water for people: poverty reduction and rural development.
2. Water for nature and economic development.
3. Pilot river basin management.
4. Establishment of a framework to turn the national water vision into reality.

The above four themes were adopted for consideration by four working groups for the round-table workshop on the formulation of the national water vision to action plan, jointly organized by the Water Resources Coordination Council Secretariat in cooperation with UNESCAP and FAO in Vientiane from 18-19 December 2002. The main findings are summarized below.

5.1 Water for people: Poverty reduction and rural development

Under this theme, three priority objectives from several objectives of water resources development for rural development and poverty reduction were selected as follows:

- Water resources development for agriculture and rural development (plantation, livestock and fisheries, etc.).
- Water resources development to meet the basic needs, especially water supply for drinking and domestic uses.
- Water resources development for quality of life, including electrification, development of micro and small hydropower projects.

In order to create a conducive environment to achieve the above objectives at the national level, the working group suggested the following measures:

- Identification of development areas and focus areas (who, what and where, how) to create 'success cases' for subsequent replication;
- participation of all stakeholders in all stages of development, including the construction, operation and maintenance stages;
- organization of water user associations and aquaculture groups; and
- promotion of water conservation and management.

The working group also identified the following most common issues faced in achieving the three above priority objectives:

- Usually, the water resources or suitable sites are far from settlement areas;
- construction costs are usually high;
- water for water supply is usually of poor quality and often polluted and often rural areas lack testing equipment;
- lack of financial resources; and
- lack of technical capacity for operation and maintenance.

The working group identified the following agencies to be the key actors for the respective three priority objectives: (1) Ministry of Agriculture and Forestry, (2) Ministry of Public Health, and (3) Ministry of Industry and Handicrafts. They also recommended the following priority actions to be taken for the three priority objectives:

- Clearer strategies for all ministries concerned for the short, medium and long terms;
- detailed planning and project investigations (for which human resources, funds, equipment, infrastructure facilities and time are required); and
- detailed planning with participation of people would lead to (a) feasibility study (b) survey and design (c) construction and (d) operation and maintenance.

In order to help monitor progress in the implementation of priority activities, the working group identified key indicators and proposed targets, based on previous studies.

For agricultural development, indicators will be based on expected increases in incomes of the targeted areas. For the pilot area in the northern part of the country, GDP per capita is proposed to increase from the current level of US\$240 to US\$500/yr in 2010. For this purpose, it is expected that the Ministry of Agriculture and Forestry, provincial authorities and the Ministry of Trade will play the key roles.

Detailed activities to be carried out within the time frame up to 2010 would include the following:

- Rehabilitation of existing irrigation schemes to improve efficiency;
- expansion of irrigated area in appropriate locations;
- implementation of diversified agriculture activities;
- improvement of agriculture extension work; and
- promotion of plantation, livestock and fisheries.

For the supply of drinking and domestic water, it was proposed that the number of people with access to water would increase from the current level of 52 to 60 percent in 2005 and 80 percent in 2020. To achieve this, the Ministry of Public Health and the Clean Water Authority would need to undertake the following priority activities:

- Planning and data collection;
- assessment of needs;
- design and construction; and
- transfer of management to local authorities.

With the development of small hydropower potentials, it was expected that 20 percent of the households in the North would be provided with electricity from hydropower by 2010. It was proposed that the key agencies, namely the Ministry of Industry and Handicrafts, Water Resources Coordination Committee and Science, Technology and Environment Agency, would undertake the following priority activities:

- Planning and data collection;
- water demand assessment;
- design and construction; and
- transfer of management to local authorities.

The working group also identified major existing programmes that may have complementary roles in achieving the three above-mentioned objectives as follows:

- Water for agriculture and rural development — it was considered that the rural development committees and various departments of the Ministry of Agriculture and Forestry might not have functioned according to their mandates. Furthermore, problems also resulted from the lack of coordination and counterpart contribution.
- Water supply for basic needs — the Ministry of Public Health (Coordinating Committee for Clean Water) and Rural Development Committees are responsible for the major existing programmes on water supply. Improvement in communications was recommended.
- Small hydropower development — the Ministry of Industry and Handicrafts is currently responsible, but it was considered that the lack of coordination with the Rural Development Committees might have hampered progress in the development of these resources for the welfare of the people.

In promoting coordination for agriculture and rural development, the working group recommended the following key functions be played by the Water Resources Coordination Committee:

- Coordinate with all above agencies to achieve the set objectives.
- Seek assistance from domestic and international resources (FAO, UNESCAP).
- Act as a centre for water resources data and information to provide to all subsectors concerned.

With regard to with these coordinating functions, it was recommended that the following priority activities be undertaken by Water Resources Coordination Committee:

- Organize another meeting to present the findings of the Workshop;
- draft a proposal for assistance;
- establish a team to deal with data collection; and
- promote and disseminate water resources regulations widely and at the grassroots level.

5.2 Water for nature and economic development

Considering different opportunities, the rich resources and the strategic geographical location of the country, the working group recommended the following priority objectives for economic development and nature conservation:

- Hydropower development for export;
- ecotourism development; and
- water-borne transport development.

In view of the limitation in financial and human resources faced by the country, it was recommended that strategies to achieve the above three priority objectives would involve the establishment of a conducive environment and mobilization of financial resources for the development of tourism, water-borne transport and conservation of water resources.

Apart from the lack of financial resources, major issues faced in the development process for the three priority objectives were identified as follows:

- Lack of sufficient quantity of water for development, especially during the dry season;
- technically difficult to develop tourism potential; and
- difficulties involved in improving waterways for navigation, especially during the low flow period.

The working group identified the following agencies as the key actors in the implementation of the above strategies: Ministry of Industry and Handicrafts, the Lao Tourism Authority, Ministry of Communication, Transport, Post and Construction, Ministry of Agriculture and Forestry and Committee for Planning and Cooperation.

The following priority courses of actions were recommended for the establishment of a conducive environment for the development of these areas: law and feasibility studies, water resources conservation activities, investigation of potential tourism sites, survey and inventory of islands and rapids, and mobilization of funds.

In order to help monitor progress towards achieving the above priority objectives, the following indicators and targets were suggested:

- Hydropower development: Increased income from electricity export with a total export capacity of 1500 MW by 2010 and increased annual investment for hydropower development by 12 percent.
- Tourism development: The number of tourists to increase by 20 percent in 2005 and annual expansion in tourism infrastructure by eight percent by 2005.
- Water-borne transport: Increased income from water-borne transport annually by ten percent up to 2010 and annual expansion of trade and increased frequency of boat trips and volume by ten percent up to 2010.

It was recommended that a mechanism with tools and capacity for monitoring and reporting of progress be set up, especially with respect to the mobilization of financial resources to complement the limited budgetary resources of the government and the process of capacity building and technology transfer.

The following priority activities were identified:

- Hydropower development: Promotion and management of foreign investment, undertaking feasibility studies and strengthening national capacity in fund mobilization.
- Tourism development: Undertaking feasibility study of tourism development for selected areas, promotion and publicity and financial mobilization.
- Transport development: Survey and data collection, feasibility study and fund mobilization.

In reviewing the current conditions, several lessons were drawn from problems with the existing development coordination mechanisms, particularly with respect to the availability of sufficient water to meet all purposes. For example, in Nam Kor in Udomxay Province water shortages, especially for

irrigation and water supply, were caused by poor planning and coordination. Nevertheless, it was found that several existing coordinating mechanisms could coordinate among the agencies concerned, such as the unit which provides training on tourism services or the committee for improvement in navigation. However, these mechanisms would need to be strengthened to overcome problems caused by the lack of water utilization regulations, especially detailed regulations for subsectors, and the lack of sufficient technical capacity.

The supporting roles of the Water Resources Coordination Committee were recognized in the following priority functions: basin planning, establishment of regulations for river basin management, and establishment of river basin organizations. It was recommended that the Water Resources Coordination Committee carry out the following priority activities: establishing models for river basin management, promoting capacity building and assisting in fund raising.

5.3 Pilot river basin management

At the beginning of the working group discussions, the primary concern with respect to the management of river basins was to ensure sustainable development of their natural resources. Interaction with the other working groups revealed also the needs for poverty eradication and for economic development. The working group therefore recommended the following priority objectives for river basin management:

1. To ensure the sustainability of river basin management.
2. To harmonize the relationship between humankind and nature.
3. To develop optimally the river basin's resources.

Given the rich potential for water resources development in many parts of the country, particularly the northern, central and southern regions, several candidate river basins could be selected for the pilot study. Among these river basins, the Nam Ngum river basin was adopted as the basis for discussion and the priority strategies recommended under this theme included the following:

1. Improving the enforcement of existing laws and regulations (Water Law, Environmental laws, etc.);
2. establishing a River Basin Coordination and Management Committee; and
3. mobilizing financial support from government and donors.

It was suggested that the following issues should be accorded priority so as to ensure effective introduction of integrated water resources management:

- Establishment of an effective mechanism for water use coordination;
- establishment of a mechanism to develop river basin regulations;
- development of the river basin's regulations;
- participatory environmental management;
- enhancement of public awareness; and
- development of alternatives for income generation.

The working group identified the three key agencies which would play central roles in successful river basin management: the Water Resources Coordination Committee, the Science, Technology and Environment Agency, and the Ministry of Agriculture and Forestry. The following priority actions were recommended to be undertaken by these agencies:

- Water Resources Coordination Committee: Establish a coordination committee and a draft river basin regulations.
- Science, Technology and Environment Agency: Draft environment protection regulations and create a participatory mechanism.
- Ministry of Agriculture and Forestry: Provide agriculture extension (technology, credit and training) promote public awareness through media and produce materials, journal, kits, etc.

In order to monitor the improvement in water resources utilization effectiveness for the three priority objectives in the pilot river basin (Nam Ngum), the working group recommended the following indicators and targets:

- (1) Water quantity for use during the dry season will be increased by ten percent by ten years;
- (2) the number of conflicts in the use of the river basin's water resources will be reduced by 70 percent in five years; and
- (3) incomes will be increased by 10 percent per annum over a five-year period.

In the above context, independent mechanisms for monitoring will be required and the following agencies were recommended to accept responsibility in this area. The Department of Meteorology and Hydrology was recommended to be responsible for monitoring of the flow conditions and to report to responsible agencies and the government. A River Basin Coordination and Management Committee was recommended to be established so as to monitor progress in reducing the number of conflicts in water utilization and in improvement of the socio-economic conditions of the people in the river basin and to report to the provinces and the government. The working group recommended the following priority activities to be undertaken by the key actors in this theme: detailed studies (including discussion and data collection), detailed and coordinated planning (participatory approach) and implementation (including resources mobilization).

The working group reviewed existing programmes related to integrated water resources management, especially those related to subsectors, such as national Water Resources Development Programmes on Hydropower, Irrigation and Water Supply as well as those initiated by the Mekong River Commission. The working group therefore recommended possible improvement measures for coordination such as clear, related government policies, laws, regulations and decrees and the creation of effective River Basin Organizations. The important roles of the Water Resources Coordination Committee to coordinate with the ministries concerned and of the Lao National Mekong Committee to develop policy, laws, regulations including establishment of River Basin Organizations were recognized. The working group recommended the following priority activities of the Water Resources Coordination Committee to support progress in river basin management at the national level: capacity strengthening, plans of action, financial resources mobilization.

5.4 Establishment of a framework to turn the national water vision into reality

The working group focused its discussions not only on the detailed activities of turning the national water vision into reality, but also and mainly on the framework to create the right conditions for all key stakeholders of the water resources sector to play appropriate roles in the realization of the national water vision. For this purpose, the working group recommended the following three priority objectives:

- Sustainable development;
- clearer water resources policy; and
- mobilization and effective utilization of resources.

It was interesting to note that all participants from the line agencies expected the Water Resources Coordination Committee Secretariat to play the key role in the realization of the national water vision. The participants also recognized the importance of such a principal role in the implementation of fundamental and cross-cutting activities, such as training and capacity building, enhancement of public awareness and public participation. These fundamental activities are necessary in view of the following priority issues identified by the working group:

- Protection of water resources and efficient use of water;
- establishment of regulations, effective enforcement, and participation of stakeholder; and.
- establishment of funds for water resources development and promotion of international cooperation.

In order to help monitor the implementation of coordinated activities towards achieving the priority objectives, the working group identified the following indicators and targets:

- (1) Sustainable development — it was considered necessary to develop indicators to reflect the overall quality of watersheds in the long run. In the short-term, the working group recognized that the water quality should be a priority indicator for monitoring to ensure the current good conditions are maintained.
- (2) Clearer water resources policy — it was recommended to monitor the number of conflicts in water utilization or violations against the law and to reduce the number of conflicts or violations by half in five years.
- (3) The mobilization and utilization of resources — the working group proposed to make an inventory of current resources allocation and investment in the water sector and recommended to prepare a strategy to increase annual financial resources and to improve allocation among the subsectors to ensure effective support to the national socio-economic development process and sustainable development. It was recommended that resource mobilization be doubled in five years.

For proper monitoring and reporting, the working group suggested the use of the existing mechanisms as follows:

- (1) Science, Technology and Environment Agency and Water Resources Coordination Committee to monitor and report on water quality and Water Resources Coordination Committee to develop indicators for watershed quality.
- (2) Water Resources Coordination Committee to set up and monitor a programme to reduce the number of violations against the law or conflicts in water utilization.
- (3) Either the Water Resources Coordination Committee or a new mechanism to monitor financial resources allocation and utilization for the water sector.

In support of the above programme, the working group recommended the following priority activities to be undertaken by the Water Resources Coordination Committee:

- (1) Water Resources Coordination Committee to implement the plan of monitoring of changes in water resources, including the new indicators of watershed quality and report the results to the government.
- (2) Water Resources Coordination Committee to compile a record of the number of conflicts and violations and write a report on these with suggestions for improvement.

- (3) Water Resources Coordination Committee to compile a record of the resources allocated to the water subsectors and to consult with all subsectors to prepare the strategy or plan to strengthen resource mobilization and utilization.

Among the priority activities, it was recommended that attention be paid to help increase financial resources with the contribution from government, donors and all people, and to help adequate allocation to all subsectors.

In reviewing existing key programmes related to the above-mentioned priority objectives, the working group identified the following obstacles in the implementation of the programmes:

- (1) Sustainable development: Lack of good coordination among subsectors concerned, including between Water Resources Coordination Committee, Science, Technology and Environment Agency, Ministry of Agriculture and Forestry and Ministry of Public Health; lack of sufficient number of capable technical staff; and administration system is not strong enough;
- (2) Clear water policy: Water utilization regulations are not clear and not complete; and responsibility sharing in monitoring of subsectors is not clear;
- (3) Fund raising and utilization: insufficient budgetary resources; and inadequate contributions from water users.

The working group discussed intensively the role of the Water Resources Coordination Committee in the creation of an effective framework for the realization of the national water vision and recommended that it should:

- (1) Assist in promoting the action plan;
- (2) act as a neutral coordinator among subsectors;
- (3) act as a neutral coordinator for cooperation with international agencies, including fund raising; and
- (4) assist in the coordination for allocation of budgetary resources to satisfy the real needs.

Similarly, the working group also identified priority activities of the Water Resources Coordination Committee and water subsectors as follows:

- (1) Establishment of a system for monitoring and assessment of water resources development;
- (2) establishment of strong regulations for water utilization; and
- (3) establishment of a system for monitoring and data collection and exchange.

The working group also recommended the following activities to be undertaken by all water-related agencies and stakeholders:

- (1) Human resources development in water sector should be improved and strengthened;
- (2) improvements in coordination and corresponding implementation procedures;
- (3) promotion of public participation in planning and implementation;
- (4) enhancement of public awareness on impacts of water utilization; and
- (5) increased cooperation with international organizations for more technical and financial assistance.

6. CONCLUDING REMARKS

During the past three years, important progress in the improvement of water resources management in the Lao PDR has been made, especially following the establishment of the Water Resources Coordination Committee. The most important achievements were related to the coordination of activities and the increase of interest and attention by the government and the donor community in the management of water resources. Among these achievements was the development of the national water vision and the related change in perception of key water resources stakeholders on the need for better coordination. These changes enabled the round-table workshop on turning the national water vision into action to introduce a more centralized approach to coordination in the realization of the national water vision. As can be seen from the discussion of the four working groups in Section 5, all participants recognized the importance of the coordinating role of the Water Resources Coordination Council in the promotion of integrated water resources management at the national and river basin levels. This change in perception made it possible to introduce a two-pronged approach in the realization of the national water vision:

- (1) Overall approach: Water Resources Coordination Committee to undertake the programmes related to the framework of turning the national water vision into reality and the implementation of the pilot river basin management.
- (2) Sectoral approach: Related subsectoral agencies to undertake priority activities related to the programmes on poverty mitigation and rural development, and economic development and nature conservation.

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REPORT ON THE FORMULATION OF A NATIONAL WATER VISION TO ACTION IN THE UNION OF MYANMAR

4

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1. INTRODUCTION

The Union of Myanmar is rich in water resources. Estimated runoff from rivers in a normal year is about 876 million acre-feet (or about 1 082 km³). The total amount of the nation's water resources utilized is only about five percent or 45 million acre-feet. It is clear that the physical potential for further development of water resources in Myanmar is quite substantial.

The country has now reached a turning point in the use of water resources for all-round development. Providing innovative and integrated solutions for the sustainable management of water resources to meet the country's development needs has become an absolute necessity.

1.1 Climate and rainfall

There are three seasons in Myanmar, namely summer, winter and the rainy season. Ninety percent of the annual rainfall occurs between May and October and is monsoonal. Precipitation varies countrywide, reaching 5000 mm per year in the south and western coastal strips, 2000 to 3 000 mm in the delta, 1300 to 3000 mm in the north and eastern hilly regions, and dropping to below 760 mm in central Myanmar. As a result of the differences in precipitation, moisture availability for plant growth is not sufficient in certain regions, even during the rainy season, and during the dry season the problem becomes more acute. Thus, it is obvious that successful crop production depends on the availability of stored water from rivulets and ponds.

Central Myanmar, especially the Bagan Nyaung Oo area, is vulnerable to desertification in the coming decades. Reforestation projects implemented in its 13 districts have had positive effects on climate and rainfall, but there is a need for sustainable development in the area.

1.2 Potential water resources

Water basin characteristics in Myanmar are quite variable due to the differences in physiographic features. The principal watercourses flowing separately in Myanmar are the Ayeyarwaddy, Sittoung, Thanlwin and Bago rivers and their main tributaries, such as the Chindwin, Myittha, Mu, Zawgyi, Paunglaung, Samon, Myitnge, Mone, Man, Salin, Yaw and Mindon. All rivers, with the exception of the Thanlwin, are wholly within Myanmar and can be considered nationally owned water assets. Their drainage area spreads widely over the country, endowing it with 876.73 million acre-feet (1082 km³) of water volume per year, as shown in Table 4.1.

Table 4.1 Potential water resources in Myanmar

River/rivulet	Volume of inflow (km ³)	Catchment area (km ²)
Chindwin river	141.29	115 300
Ayeyarwaddy river (up to junction with Chindwin)	227.92	193 300
Ayeyarwaddy river (from junction with Chindwin to its mouth)	85.8	95 600
Sittoung river	41.96	34 400
Bilin river and rivulets	31.17	8 400
Rivers/rivulets in Rakhine State	139.25	58 300
Rivers/rivulets in Taninthary Division	130.93	40 600
Thanlwin river (Myanmar border to mouth of river)	257.92	158 000
Mekong river (within Myanmar territory)	17.63	28 600
Bago river	8.02	5 300
Total	1 081.88	737 800

The tributaries originating in the western hills and the southern part of the country cover about ten percent of the catchment area and surface runoff. They have high hydropower potential. According to a UN report and various studies, the hydropower potential of Myanmar is estimated at 40000 MW. At present, the total number of identified hydropower potential sites is about 270 and suggested installed capacity is about 39 700 MW, excluding small-scale hydropower schemes, as shown in Table 4.2 and Figure 4.1.

Table 4.2 Hydropower potential in Myanmar

State/division	Sites	Potential MW	State/division	Sites	Potential MW
Kachin	39	2 061	Magwe	8	123
Kayah	7	3 909	Mandalay	17	3 482
Kayin	21	17 021	Mon	10	292
Chin	22	1 312	Rakhine	14	247
Sagaing	21	2 399	Shan	83	7 699
Taninthary	14	692			
Bago	11	397	Total	267	39 624

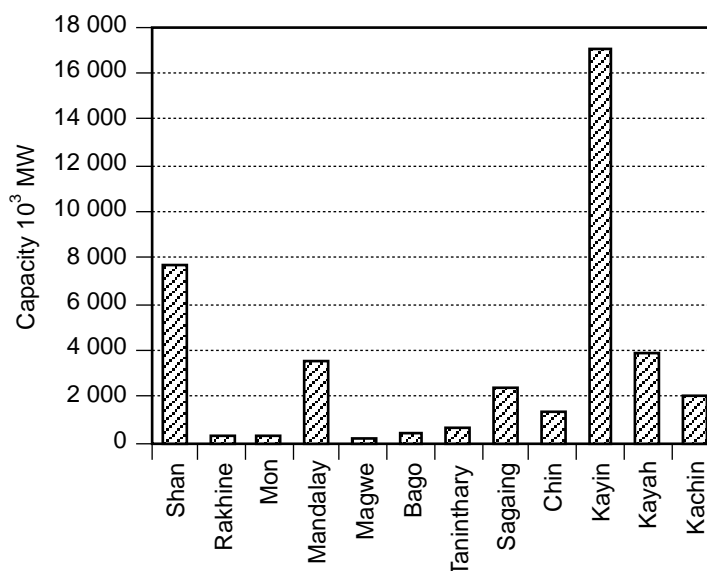


Figure 4.1 Hydropower potential in Myanmar

The estimated groundwater potential in Myanmar is of about 495 km³, as shown in Table 4.3.

Table 4.3 Annual groundwater potential in Myanmar

River Basin No.	Name of principal river basin	Catchment area for each stretch (km ²)	Groundwater potential (km ³)
I	Chindwin river (Upper Ayeyarwaddy river)	115 300	57.578
II	Ayeyarwaddy river (up to its confluence with Chindwin river)	193 300	92.599
III	Lower Ayeyarwaddy river (from confluence with Chindwin to its mouth)	95 600	153.249
IV	Sittoung river	48 100	28.402
V	Rivers in Rakhine State	58 300	41.774
VI	Rivers in Taninthary Division	40 600	39.278
VII	Thanlwin river (from the boundary to its mouth)	158 000	74.779
VIII	Mekong river (within Myanmar territory)	28 600	7.054
Total average: (1980–1993)		737 800	494.713

1.3 Water resources use and key institutions

The agricultural sector is the basis of the economy and the main source of livelihood of the rural areas, where about 70 percent of the population lives. Hence, the state has laid down and implemented five rural development tasks to bring progress to the whole nation. One of these is adequate supply of water for irrigation and for drinking; others are development programmes for agriculture, livestock breeding and fishery.

In Myanmar, rural water supply activities were started in 1952 to provide safe drinking water and carry out environmental sanitation works for the rural populace. At present, with the assistance of international organizations, several water supply and sanitation projects are being implemented.

Urban water supply, including for industrial use, is implemented by city development committees (CDC), notably in Yangon (YCDC) and Mandalay (MCDC). The total volume of water for domestic use is estimated to amount to 3.0 km³/year and 1.5 km³/year for industrial use.

The state is systematically disseminating advanced techniques and supports to develop the nation's economy. A large number of irrigation facilities have been built within a short span of time. By the end of April 2003, 145 dams were irrigating over one million hectares of cropland.

In addition to the dams, various means have been applied to supply water for agriculture. River water pumping stations, underground water tapping stations and mini dams have been built throughout the nation. A total of 265 river water pumping projects have been implemented in 12 states and divisions, irrigating some 150 000 ha of cultivated land. In addition 7 478 tube wells are used to irrigate 36000 ha of farmland. Urban and rural development tasks are carried out by 285 township committees and 42 urban development affairs committees under the supervision of the Department of Development Affairs of the Ministry for the Progress of Border Areas and National Races and Development Affairs. Measures have also been taken to ensure water supply for 4 023 villages (in 2000/01 to 2002/03) out of the targeted 8042 villages in Sagaing, Mandalay and Magway Division under a ten-year project. With the cooperation of Japan International Cooperation Agency, the Department of Development Affairs has been carrying out water supply projects in the Northern Shan State. Bridge Asia Japan and UNICEF are helping sinking tube wells in the arid zone. NGOs also cooperate in rural water supply projects and well-wishers have also contributed to the water supply tasks.

The Dry Zone Greening Department of the Ministry of Forestry has implemented greening projects in 13 districts of the dry zone to conserve nature and watershed areas. To prevent environment degradation, forest depletion, loss of soil and change of weather, the government formed the Highland Reclamation and Cultivation Committee in 2002 to carry out highland reclamation and cultivation projects in which slash-and-burn shifting cultivation will be replaced by terrace farming.

In the fishery sector, the state has given high priority to providing adequate support and assistance for further development of the fishery industry, and efforts have been made to enhance food security while protecting the environment and conserving natural resources. A mangrove-friendly aquaculture system was introduced a couple of years ago.

In addition to the adequacy of drinking water, water quality is given priority by the stakeholders in this sector. In harnessing resources, the Irrigation Department not only focuses on providing efficient increased irrigation for the development of agriculture, but also embraces objectives pertaining to the adequacy of drinking water, the protection of the environment and the generation of hydroelectricity.

The Water Resources Utilization Department also takes part in developing water resources, both surface and groundwater, for socio-economic development through the provision of irrigation and drinking water.

The Department of Hydroelectric Power, the primary user of water for power production, has been involved in planning and using water for its own needs without adverse effects on other users.

Under the Ministry of Forestry, the Forest and Dry Zone Greening Departments established watershed plantations and constructed small check dams and ponds and dug artesian wells to have safe and adequate water for domestic use in villages and forest nurseries.

The Department of Public Works, the Department of Development Affairs, city development committees and the Department of Human Settlement and Housing Development are responsible for domestic water supply and sanitation works in urban areas and underground water controlling works in the capital.

After 1988, private construction companies were developed, and both surface and ground water were tapped for industrial and domestic use. The Department of Meteorology and Hydrology is responsible for measuring discharge of the Ayeyarwaddy, Chindwin, Sittoung and Thanlwin rivers yearly to compute runoff data for each station. It also monitors water quality at some places along the main rivers.

2. NATIONAL ECONOMIC AND SOCIAL DEVELOPMENT CONTEXT

2.1 Country overview

Myanmar is situated in Southeast Asia between North Latitude 9°32' to 28°31' and East Longitude 92°29' to 101°10'. Its total land area is 676565 km² (167.186 million acres). Its population of about 52.434 million has an annual growth rate of 2.02 percent and it is estimated to reach 61 million by 2010 and 83 million by 2025. About 70 percent of the population resides in rural areas, about 80 percent of which are engaged in agricultural work.

Myanmar has many ethnic groups with different cultures, customs and beliefs, and this variety is the source of many issues and problems that hinder the implementation of the government's strategy of equitable socio-economic development. Nevertheless, Myanmar has a high socio-economic potential as a result of its abundant natural, especially water, resources, which are underused.

a. Overall aspects of economic development

Agriculture, comprising crop production, livestock, fishery and forestry, is the most important sector of the economy. It is the main source of livelihood for about 70 percent of the population and it accounts for about 64 percent of the employment of the labour force. It also contributes about 41 percent of export earnings and accounts for about 42 percent of the gross domestic product. Thus, the government has given high priority to agricultural development and views it as the base for all-round economic development.

The Government of the Union of Myanmar formed the National Commission for Environmental Affairs in 1990 to look after nature and environmental conservation. The National Commission for Environmental Affairs is the focal point for communication and collaboration with international organizations on environmental matters. In 1997, the commission formulated *Myanmar Agenda 21*, which provides guidelines for the protection of nature and for sustainable development.

b. Brief summary of economic development in the past decade

During the past decade, the economy has depended mainly on agricultural production and agriculture remains the main engine of economic growth. Table 4.4 shows the evolution of GDP from 1991/92 to 2000/01.

In the past decade, a number of projects were implemented throughout the country for the sustainable development of the economy and natural resources. The greening project in the central dry zone covered 13 districts. Watershed management projects were implemented with the assistance of UN agencies in some major watershed areas such as the Kinda Reservoir's catchment area. Wildlife area reservations, establishment of ecotourism sites and sanctuary parks have been developed. Between 1980/81 and 2000/01, some 624533 ha of forest plantation, including 79197 ha of watershed plantation, were established by the Forest Department.

Table 4.4 Myanmar GDP (at 1985-86 constant producer prices)

(Billion Kyats)

Year	National GDP	Agriculture GDP					
		Crop	Livestock and fisheries	Forestry	Total	Share in GDP (%)	Growth rate
1991/92	49.9	18.7	3.8	0.9	23.4	47	-2.5
1992/93	54.8	21.0	4.0	0.9	25.9	47	10.7
1993/94	58.1	22.0	4.2	0.9	27.1	47	4.6
1994/95	62.4	23.5	4.4	0.8	28.7	46	5.9
1995/96	66.7	24.8	4.6	0.7	30.1	45	4.9
1996/97	71.0	25.7	5.1	0.8	31.6	44	5.0
1997/98	75.1	26.5	5.4	0.8	32.7	44	3.5
1998/99	79.5	27.4	6.0	0.8	34.2	43	4.6
1999/2000	88.2	30.3	7.0	0.8	38.1	43	11.4
2000/01 (provisional)	100.1	33.2	8.2	0.9	42.3	42	11.0

Source: *Statistical Yearbook*, CSO 1999, 2000, 2001.

The aquatic ecosystems, including wetlands, are basic components of the global life-support system. They include rivers, freshwater lakes, deltaic and coastal areas. Wetlands are formed by the flooding of rivers during the monsoon and remain after the floods subside, especially downstream. Rivers and their tributaries provide waterways for transportation, fertile agricultural land, and feeding and breeding grounds for numerous aquatic and bird species.

Freshwater lakes in Myanmar are also of substantial economic importance. Indawgyi, Inle and Moyingyi lakes are the three main wetlands, which are rich in aquatic and bird life and provide significant waterways and recreational areas for tourists. There are also more than 100 reservoirs, either natural or man-made, throughout the country, providing drinking water and water for agriculture.

The 1500-miles-long coast, the shallow water and of fshore islands, and the Ayeyarwaddy deltaic region form the most important aquatic ecosystems of the country. Deltaic and coastal mangroves, which account for one percent of the total forested area of the country, are breeding grounds for numerous aquatic species and supply the local inhabitants with food and shelter. Many of these aquatic ecosystems are under pressure from settlement, economic development and overuse. The river systems are disturbed by navigation, sedimentation and activities such as gold prospecting and sand mining. There is no information on wetland pollution from toxic waste or insecticides.

Injudicious agricultural practices such as careless use of pesticides and fertilizers resulting in nutrient and toxic runoff and overharvesting are some of the most unsuitable uses of inland wetlands in Myanmar. The percentage of people covered by safe water facilities is still very low by any standard. Access to safe drinking water and adequate sanitation coupled with personal and environmental hygiene should receive high priority, as they are essential to public health and economic development. According to the 1995 survey, drinking water supply coverage was 60 percent countrywide and 50 percent in the rural areas.

2.2 Poverty

Rural development aims to enhance the quality of life of the people in rural areas by increasing their access to resources. It is based on the belief that all economic activities are interrelated and therefore

must be developed together. Agricultural production alone is not enough, and must go hand in hand with the provision of human services and economic opportunities. Rural development focuses on poverty and strengthening the production capacity of the rural poor to increase their incomes.

The primary aims are:

- (a) Improvement of the living standard and the quality of the people through productive and social investment; and
- (b) development and use of productive resources.

One way agricultural development is implemented is by making resources available to increase farm productivity. The most common resources are irrigation water, improved seeds, fertilizers and agricultural credit. Such inputs are intended to increase the productivity of farm households.

a. People living below the poverty line

The Central Statistical Organization has estimated that at least 22.4 percent of the rural people and 23.9 percent of the urban people live below the poverty line.

(1) Poverty indicators

The poverty level can be indicated by income and expenditure data. Development indexes are also derived from health data, ownership data and education data. Water consumption data should also be collected and evaluated to relate to other poverty indicators. The water quality and use should be considered in expressing water consumption data.

i. Food security

People in Myanmar spent 60 to 70 percent of their income on food and beverages, and only 30 to 40 percent on non-food items. People who are unable to purchase sufficient food to meet the household requirements are defined as 'poor'. If their income can be increased, the food security problem at the household level can be resolved.

ii. Economy

The lack of assets such as land or livestock is a strong indicator of rural poverty. The 1997 HDIBS of 20000 rural households found that one-third owned no land, 40 percent owned no livestock and a quarter owned neither. Many families who do have land are also poor. Over 60 percent, or 2.8 million of all landholding households had less than five acres, which is roughly the minimum size for subsistence at current levels of technology and input use. The size of a subsistence plot may vary, of course, depending on agro-climatic conditions. In the upper dry zone a farm of three acres can be sufficient for multiple cropping, but a farm of that size is inadequate in single-crop rice-growing areas.

iii. Health

Health conditions are much worse for those living in rural areas. Infant and child mortality rates and malnutrition levels are worse in rural areas and access to health services, including trained birth attendants, is generally lower in rural than urban areas. However, vaccination coverage and treatment rates for acute respiratory infections are fairly similar between rural and urban areas, though they are likely to be worse in remote areas.

iv. *Education*

In Myanmar, poor households have lower levels of education attainment. Education level of household head by poverty status is shown in Table 4.5.

Table 4.5 Education status in Myanmar (%)

	Poor	Non-poor	Total
Illiterate	1.1	1.3	1.2
Grades 1-4	73.1	69.4	70.2
5-8	13.0	15.4	14.7
9-10	9.7	10.8	10.6
University	2.9	3.2	3.1

The 1997 Human Development Index Baseline Survey found that among families with children of 5-9 years of age, 28.8 percent of families defined as 'poor' had children who had never been to school, compared with 18.7 percent for non-poor families.

(2) *Poverty profile*

An estimated 70 percent of the country's poor live in rural areas with most living in Sagaing, Bago, Magway, Ayeyarwaddy and Mandalay divisions, which cover the country's most populated rice-growing region and the dry zone region.

Rural poverty rates vary considerably by region. Chin State has the highest rural poverty rate, with 47 percent of the state's rural households being classified as poor, more than double the national average of 22.4 percent. Kayah State and Magway Division also have very high rates of rural poverty, with over 36 percent of rural households being classified as poor, or over 1.5 times the national average. Saging, Bago and Mandalay Division also have rural poverty rates above the national average (Table 4.6).

Table 4.6 Estimated poverty rates by state and division (%)

Location	Urban	Rural	Total
Union	23.9	22.4	22.9
Kachin State	4.6	11.9	10.1
Kayah State	30.8	37.4	35.4
Kayin State	11.8	12.8	12.7
Chin State	19.8	47.1	42.1
Sagaing Division	27.6	24.3	24.9
Taninthary Division	9.8	7.4	8.1
Bago Division	26.6	25.4	24.7
Magway Division	44.9	36.3	37.9
Mandalay Division	18.8	23.9	22.3
Mon State	27.1	16.1	19.9
Rakhine State	34.5	19.2	22.0
Yangon Division	16.6	16.7	16.7
Shan State	7.1	13.4	12.0
Ayeyarwaddy Division	47.0	17.3	22.7

(3) *Gender disparities*

There is a low degree of gender bias in Myanmar compared to some South Asian countries. The gender issue is not a significant problem in Myanmar, as men and women have equal status in society. Women have been accorded equal opportunities in education, employment and other economic activities, as shown by the large percentage of women enrolled in school and universities and employed in both public and private institutions.

b. Previous poverty reduction efforts

Rural poverty and agriculture are closely linked in Myanmar. To reduce poverty, agricultural incomes must be raised. Since the country gained independence from the British in January 1948, the government has consistently accorded high priority to increasing rice production, which is the staple food and main export crop. During the British colonial era (1824–1941) the rice area reached 5.1 million ha, with total paddy production of about 8 million metric tonnes. At the time, Burma was a major rice exporting country.

Under the eight-year Pyidawtha Plan (1952/53–1959/60) the irrigation facilities built in the colonial era and destroyed during the Second World War were rehabilitated and improved. By 1960/61 about 536000 ha or seven percent of the total sown area could be irrigated.

Under the all-township paddy production programme, the government undertook large-scale dissemination of Green Revolution technologies in 82 townships, covering a total of 2.5 million ha. Under this programme, high-yielding varieties, improved technologies (proper tillage, application of chemical fertilizers and control of pests with pesticides), other farm inputs, and credit were made available to thousands of farmers. Starting 1992/93, the government launched a summer rice production programme in which farmers in irrigated areas were encouraged to grow two crops of rice a year. During this period, the government invested massively in irrigation development. These activities to increase paddy production were meant to increase agricultural production and were related to poverty reduction.

c. Existing activities related to water resources management for poverty reduction

Growth in agriculture productivity raises real incomes of the rural poor and thus reduces poverty. The agriculture sector could significantly contribute to overall poverty reduction. The strategy to improve agricultural production consists in putting more land under cultivation and practising crop diversification through greater cropping intensity thanks to better irrigation and drainage and flood protection works.

The development of water resources plays a major role in agricultural development. However, only 1.14 million ha of the total net sown area of 8.96 million ha (12.7 percent) were irrigated in 1992/93. Measures were taken in accordance with annual investment plans under the guidance and supervision of the Ministry of Agriculture and Irrigation to expand irrigated agriculture to promote further agricultural expansion, and they resulted in remarkable progress: in 1994/95 there were 1.6 million irrigated ha out of the total cultivated area of 9.2 million ha (17.4 percent).

The measures undertaken to expand the area under irrigation were:

- The construction of small and medium dams and weirs — these presented quick-yielding solutions for low yields and low cropping intensities and the benefits reached a large number of farmers in selected poverty-stricken areas;
- proper management for the storage and use of runoff water from the watershed areas;

- rehabilitation and renovation of existing government-maintained and village irrigation works requiring improvement for efficiency and economy in water use — greater emphasis given to on-farm water management;
- construction of dams and sluices to impound backwater of the Ayeyarwaddy and Chindwin rivers during floods for late-rain cropping;
- irrigation by pumps from rivers; and
- tapping groundwater for irrigation.

(1) *Availability of water*

Only about five percent of the nation's water resources is utilized for irrigation, town water supply etc. In terms of the nation's potential this amount is very small and therefore irrigation is still far from reaching saturation point. The total irrigated area (government and private) is 3.79 million ha and the total multiple cropping irrigated area is 0.73 million ha. Estimated total water used is 30.0 million acre-feet, or 37 km³.

The regional distribution of water utilization is shown in Table 4.7.

Table 4.7 Share of water resources used in river basins (km³)

River	(1980-93 mean)	In 2005 (Projected)
Chindwin	2.108	2.774
Upper Ayeyarwaddy	8.905	10.696
Lower Ayeyarwaddy	13.241	16.397
Sittoung river	2.739	3.602
Rivers in Rakhine	0.953	1.245
Rivers in Taninthary	0.426	0.561
Thanlwin from Myanmar boundary to its mouth	2.600	3.414
Mekong river	0.107	0.141
Total	31.079	38.830

(2) *Provision of sufficient irrigation water*

After 1988 the government continued the construction of dams and reservoirs throughout the country using large capital investments, large amounts of manpower and heavy machinery, and making use of available domestic resources and expertise. As a result, irrigation facilities now exist in groups in localized zones throughout the country.

A total of 145 irrigation projects was completed between 1988/89 and 2003 (April), further increasing the irrigable area by 2.07 million acres. Another 41 irrigation projects are underway.

In parallel with the irrigation projects, 265 pump irrigation projects from main rivers, consisting of 83 electric-pump and 182 diesel-pump irrigation projects, and groundwater resources utilization projects were undertaken. The irrigation area increased from 12.5 percent of the sown area in 1988/89 to 18.2 percent in 2000/01 (Table 4.8). Rural water supply by the Water Resources Utilization Department reached 15.5 million of the 32.5 million rural people.

Table 4.8 Growth of irrigated area (1900-2001)

Year	Irrigated area (million ha)	Increased irrigated area (million ha)
1900	0.35	-
1948/49	0.56	0.21
1988/89	1.05	0.49
1999/2000	1.90	0.85
2000/01	1.97	0.07

2.3 Developments in the agricultural sector

Besides being the main source of livelihood for the majority of the people, agriculture is a growing market for domestic manufacturing. Thus, the government has accorded high priority to agricultural development as the basis of all-round economic development.

Since 1988, the government has liberalized the agriculture sector by reducing the role of public procurement, loosening restrictions on the distribution of fertilizers and pesticides, permitting export of agricultural produce (except rice) by the private sector, and inviting large private-sector investors to assist in the development of fallow and cultivable wasteland. These reforms have resulted in more rapid economic progress than in the past. This agriculture sector assessment study examines the performance of the sector from 1990/91 to 2000/01 with a view to identifying critical issues and constraints to sustainable agricultural growth, and identifying investment needs on the basis of a sector roadmap. This assessment focuses on the identification of issues and investment priorities in the crop subsector (including irrigation development, rural finance and rural development) since this subsector is the largest in the country, accounting for about 42 percent of GDP, compared to about eight percent for livestock and fishery and one percent for forestry. To increase crop yields and cropping intensity, the government has given high priority to irrigation development, as reflected in the large share of the development budget allocated for the construction and maintenance of irrigation schemes under current and proposed plans for the agriculture sector. During the past 12 years, the Irrigation Department and the Water Resources Utilization Department were able to complete gravity schemes and pumping schemes at the impressive rate of about 0.2 million acre/year (8 000 ha/year). As a result, the irrigated areas have doubled, from 2.47 million acres (1.0 million ha) to 4.94 million acres (2.0 million ha). About 20 percent of the total cultivated area is now provided with irrigation facilities, indicating that 80 percent of the cultivated area is still subject to unreliable and insufficient rainfall.

a. Economic development and nature conservation in the agricultural sector

During the last decade, the Government of the Union of Myanmar emphasized the extension of cultivated land and the promotion of yield and the production of crops by constructing large, medium-sized and small-scale water resources development projects. The aim was to open up as much irrigated land as possible, to guarantee a sufficient quantity of water and reduce the risk of water shortages for multiple crop cultivation. In addition, the government is providing assistance in all possible ways and means to rural people to raise their living standard and increase their incomes, to ensure regional self-sufficiency in rice and an adequate supply of water for domestic use, as well as to protect and green the environment. The government is also emphasizing reclamation work in highland and main watershed areas to prevent deforestation and soil erosion. One of the projects currently underway is designed to change the practise of shifting cultivation in the hilly region to terrace farming.

Table 4.9 Production of selected crops

(Thousand tonnes)

Crop	1980/81	1985/86	1990/91	1994/95	1995/96	1996/97	1997/98	1998/99	1999/2000	2000/01
Cereals										
Paddy	13 107.1	14 090.9	13 748.3	17 907.7	17 669.6	17 397.0	16 391.2	16 807.8	19 808.0	20 986.9
Maize ^a	163.7	294.1	184.1	279.9	270.4	281.4	303.4	297.9	343.6	358.9
Oilseeds										
Groundnut	430.7	551.2	464.6	492.8	583.4	550.5	531.3	552.9	623.8	719.5
Sesame	154.6	244.3	212.4	299.3	298.8	338.7	258.7	160.0	253.2	375.8
Pulses										
Fibre	401.5	611.1	543.6	1 092.5	1 316.3	1 308.0	1 540.8	1 597.2	1 716.0	2 112.9
Cotton	72.8	98.2	61.3	84.8	162.4	165.3	161.1	155.6	172.8	150.3
Jute	97.1	49.0	24.0	34.1	42.9	38.9	32.6	32.9	32.9	41.2
Miscellaneous										
Rubber	15.6	14.8	14.3	27.1	25.3	25.6	26.6	22.6	26.2	35.1
Beverages										
Sugarcane ^b	1 899.9	3 668.1	1 930.1	2 218.5	3 199.2	3 978.7	5 055.9	5 343.9	5 363.2	5 800.5

Source: *Statistical Year Book*, CSO 2001.

^a Only for seeds; ^b Only for sugar production

Table 4.9 shows the increase in production of selected crops in the last two decades (1980/81 to 2000/01).

b. Economic development and nature conservation in the fishery sector

National waters, with their abundant marine and freshwater aquatic resources both renewable and non-renewable, support a variety of important economic activities, including fishery. Over 700 common marine and freshwater species have been identified so far, and a number of other aquatic animals and plants with high economic value such as seaweed are also thriving.

Myanmar is increasingly exploiting its water resources to enhance development, food security, employment opportunities and recently as a source of foreign exchange earnings.

The production of fish and prawns by nature of catch since from 1980/81 to 2000/01 (provisional) is shown in Table 4.10.

So far there have been no reports of severe adverse effects on the water quality of main streams by industrial effluents, agriculture runoff and aquaculture discharge into the aquatic environment.

2.4 Economic development in other water-related agencies

According to field studies and reports (including by the UN) the hydropower potential in Myanmar is estimated to be 40 000 MW. By 2002, 35 hydropower stations, including 15 medium-sized projects had been completed. The total generated power is estimated at 382 MW, which is nearly one third of the power generated in Myanmar. Electric power installation in the last decade is shown in Table 4.11.

Table 4.10 Production of fish and prawns by nature of catch

(Thousand viss)

Particulars	1980/81	1985/86	1990/91	1994/95	1995/96	1996/97	1997/98	1998/99	1999/2000	2000/01
Freshwater fisheries	91 275	92 716	88 971	134 756	133 503	141 959	141 615(r)	153 625(r)	182 782	215 054
1. Fish culture	1 749	3 576	5 400	43 909	43 791	50 670	50 197(r)	55 797(r)	62 793	70 911
2. Lease fisheries	45 518	40 509	32 157	39 649	37 359	38 319	38 347	41 539	50 834	55 660
3. Open fisheries	20 509	24 364	26 210	51 198	52 353	52 970	53 071	56 289	69 155	88 483
4. Flood fisheries ¹	23 499	24 267	25 204							
Marine fisheries	272 806	327 728	360 079	369 204	278 882	386 560	416 942	465 215	549 046	570 441
1. Onshore fishing ²	95 133	113 092	126 187	-	-	-	-	-	-	-
2. Inshore fishing	136 505	177 159	189 892	135 700	103 186	143 027	154 269	172 130	203 147	211 063
3. Offshore fishing	41 168	37 477	44 000	233 504	175 696	243 533	262 673	293 085	345 899	359 678
TOTAL	364 081	420 444	449 050	503 960	412 385	528 519	558 557(r)	618 840(r)	731 828	785 495

Source: Department of Fisheries¹ "Flood fisheries" has included lease fisheries and open fisheries since 1994/95.² "Onshore fishing" has included inshore and offshore fishing since 1994/95.**Table 4.11 Electric power installation by type and location**

(Megawatt)

Year	Electric power installed							
	By type				Total	By location		
	Thermal	Diesel	Hyd'el	Gas		Yangon	Lawpita	Other
1980/81	74	81	169	177	501	102	168	231
1985/86	80	79	225	300	684	107	168	409
1990/91	92	97	258	357	804	164	168	472
1994/95	61	78	299	399	837	192	196	449
1995/96	61	81	317	524	982	316	196	470
1996/97	96	86	327	523	1 033	351	196	486
1997/98	96	82	328	530	1 036	350	196	490
1998/99	96	65	340	530	1 031	345	196	490
1999/2000	216	66	360	530	1 172	465	196	511
2000/01	216	66	360	530	1 172	465	196	511

Source: Myanmar Electric Power Enterprise.

For tourism development, water-based transport, water sources and water supply systems are important items. The planning of hotels and integrated resorts includes:

- Protection of water sources;
- assurance of supply from the sources; and
- appropriate treatment of water from the sources, careful maintenance of water storage facilities, selection of sources well away from waste discharge and built-up areas.

Conservation does not only protect nature, but also is important for economic development. In Myanmar, tourism has become a vital sector for economic development and the number of visitors is increasing yearly, as shown in Tables 4.12 and 4.13.

Table 4.12 Overseas visitors

Year	Total	Tourists ¹				Other visitors ²
		Total	By air	By sea	By land	
1980/81	27 587	27 587	27 587	-	-	-
1981/86	35 948	35 948	35 948	-	-	-
1990/91	25 261	8 806	8 446	360	-	16 455
1994/95	132 257	95 616	47 230	2 826	45 560	36 641
1995/96	170 143	120 205	81 428	1 978	36 799	49 938
1996/97	310 298	251 501	110 038	1 603	139 860	58 797
1997/98	329 379	265 122	117 490	3 288	144 344	64 257
1998/99	345 829	287 394	119 159	1 116	167 119	58 435
1999/2000	309 418	246 007	113 940	387	131 680	63 411
2000/01	272 880	208 676	120 317	61	88 298	64 204

Source: Immigration and National Registration Department.

¹ Visitors with tourist visa only.

² Includes visitors with entry visa, business visa and multiple-journey visa.

Table 4.13 Hotels, motels and inns/guesthouses by type of ownership

Particulars	1992/93			1993/94			1994/95			1995/96			1996/97		
	No.	No. of rooms	No. of beds	No.	No. of rooms	No. of beds	No.	No. of rooms	No. of beds	No.	No. of rooms	No. of beds	No.	No. of rooms	No. of beds
State-owned	46	1 467	3 141	46	1 477	3 161	46	1 477	3 161	46	1 477	3 161	28	1 096	2 192
Private-owned	19	370	698	115	1 611	2 968	92	2 033	4 066	96	1 603	3 206	402	6 955	13 910
Particulars	1997/98			1998/99			1999/2000			2000/01					
	No.	No. of rooms	No. of beds	No.	No. of rooms	No. of beds	No.	No. of rooms	No. of beds	No.	No. of rooms	No. of beds			
State-owned	33	1 554	3 108	32	1 585	3 170	32	1 585	3 170	27	1 235	2 470			
Private-owned	447	8 472	16 944	439	8 717	17 434	463	9 277	18 554	463	9 846	19 692			

Source: Directorate of Hotels and Tourism.

Various ecotourism sites have been defined in conjunction with the Forest Department. There are some 34 sanctuaries for wildlife species, 17 of which were enlarged in the last ten years.

3. WATER RESOURCES MANAGEMENT: POLICIES AND EMERGING ISSUES

3.1 National policy on water resources management

The main policies on water and water resources aim to increase water use efficiency and to ensure environmental sustainability. Coordination systems will be established among the water and water resource subsectors. Water resource development projects and water resource management plans will be coordinated with land and forest management plans. The environmental impact of implementing plans will be assessed. Public involvement in the management, development and protection of water and water resources will be promoted.

Each subsector will encourage direct private and foreign investment to reduce demand on limited public funds and state budget. In the case of the state budget, the source of funds for operation and maintenance

and level of contribution by beneficiaries to the projects will be clearly identified. Water allocation plans will take into account domestic uses, cultural and social activities, environmental protection, transportation and existing water users. The plans will also link with land and forest use management plans.

To improve data and information, collection methods, data analysis, exchange and management will strive for accuracy and reliability. All relevant institutions, capacity building efforts and public participation will be strengthened, with special emphasis on women. To ensure ecological balance and environmental stability in watershed areas, soil, water, wildlife, biodiversity and the environment will be protected.

The National Health Committee, a high-level policymaking body for health, has laid down the following policies with a direct bearing on the water sector: ‘to intensify and expand environmental health activities including the prevention and control of air and water pollution’ and ‘to foresee any emerging health problem that poses a threat to the health and well-being of the people of Myanmar, so that preventive and curative measures can be initiated’. The mitigation of arsenic in water is in progress.

Based on the National Policy for Rural Development, the Rural Health Development Plan was formulated under the Ministry of Health. It includes water quality surveillance and control and communication for behavioural change.

3.2 Water-related national policies for economic development

In 1988 the then State Law and Order Restoration Council (SLORC) ended the socialist economic system and introduced a market-oriented economy. The government laid down four economic objectives to improve the country’s economy:

1. Development of agriculture as the economic base and for all-round development of the economy;
2. proper evolution of the market-oriented economic system;
3. development of the economy through technical know-how and financial investment from sources within the country and abroad; and
4. the initiative to shape the national economy must be kept in the hands of the state and the nation’s peoples.

According to these objectives entrepreneurs are encouraged to participate in almost all economic fields, including agriculture, livestock, fishery and forestry.

The fishery sector has been charged not only to play a vital role in the current economic development plan, but also to conserve and optimize the use of resources in a sustainable manner for future generations.

The government adopted the Myanmar National Environment Policy in 1994 to establish sound management and conserve the environment. It says: ‘The wealth of a nation is its people, its cultural heritage, its environment and its natural resources. It is the responsibility of the state and every citizen to preserve its natural resources in the interest of present and future generations. Environmental protection should always be the primary objective in seeking development.’

3.3 Status of water resources development in Myanmar

The development of water resources plays a major role in agricultural development. Waterworks for irrigation existed in Burma before the Bagan era and successive monarchs protected and maintained

irrigation facilities. Before independence, from 1902 to 1906, the crib diversion weirs established by the Burmese kings were replaced by the British colonial administration with more stable, permanent concrete diversion weirs. However, the diversion weirs were functional only when the feeder rivers were in full flow, thereby warranting irrigation for only one crop.

The types and number of irrigation facilities, established by the Myanmar kings, together with those constructed before independence, and maintained by the Irrigation Department, are shown in Table 4.14.

Table 4.14 Pre-independence irrigation facilities

Type	Number	Command area in ha
Reservoirs & tanks	10	52 540
Diversion weirs	13	339 720
Total	23	392 260

A five-year agriculture development programme was formulated to irrigate more than 200000 ha annually by building dams and weirs and installing pumps. The introduction of a system of regulating dams according to the gradient of the Ayeyarwaddy river in order to increase the efficiency of water resources development and management has been under consideration for some time.

The tempo of irrigation works continued after independence. Works undertaken since independence are shown in Table 4.15.

Table 4.15 Post-independence irrigation facilities

Type	Number	Command area in ha
Dams, weirs & pump irrigation (mostly dams)	214	1 050 000
River pumping stations	265	120 000
Tube wells	7 478	40 000

Efforts have been made to balance development. Irrigation works and river water pumping systems have been installed without creating any problems related to the adequacy of water supply to downstream areas or in terms of navigation or ecological sustainability.

In Myanmar, rural water supply activities were started in 1952 to provide safe and clean drinking water and to implement environmental sanitation works for rural production. Up to 1977 they were carried out with the government's own resources. Since 1978, rural water supply and sanitation projects have been assisted by multilateral and bilateral donors. Up to the end of August 1995, the government implemented various rural water supply activities for some 12.5 million people. A total of 35 hydropower stations have been completed with total capacity of 382.04 MW (about one percent of the total hydropower potential), as shown in Table 4.16.

Table 4.16 Completed hydropower stations

Name	Location	Capacity (MW)	Year completed
Baluchaung (2)	Kayah	168	1973
Kinda	Mandalay	56	1985
Sedawgyi	Mandalay	25	1989
Mogoke	Mandalay	4	1991
Galainggyaung	Kachin	1.26	1991
Baluchaung (1)	Kayah	28	1992
Chingkramhka	Kachin	2.52	1993
Nammyao	Shan	4	1994
Namwop	Shan	3	1994
Zawgyi (1)	Shan	18	1995
Namkhamkha	Kachin	5	1996
Namsaungngaung	Shan	4	1996
Zi Chaung	Sagaing	1.26	1996
Zawgyi (2)	Shan	12	1998
Zaungtu	Bago	20	2000
Thaphanzeik	Sagaing	30	2002
Total		382.04	

3.4 Overview of water resources and of current water resources management activities

a. Water resources and current water resources management activities

Myanmar is endowed with abundant water resources, with available yearly surface and ground water of about 1 082 km³ and 495 km³ respectively. The bulk of the water resources is used for agriculture (about 91 percent of total consumption). Numerous irrigation facilities have been implemented during the present decade for irrigation and water supply to develop rural and urban areas. Several government agencies and departments are engaged independently in using both surface and ground water, but the extent and type of water use differ.

Long taken for granted, water must be seen as a finite resource that has to be used rationally. As population and economic activities grow, the water demand increases rapidly. Up to now, there have been no water-sharing policies and riparian rights and environmental impact assessment have not been defined in the country.

The rising water requirements of the country's rapidly expanding urban and industrial centres and the contamination by pollutants from industrial, municipal and agricultural effluents (the latter associated with the uncontrolled use of pesticides and fertilizers) have lead to the decreasing availability of freshwater. Moreover, salinity intrusion has been reported in the inland areas along the tidal reaches of the Ayeyarwaddy river system, and monitoring of the Ayeyarwaddy in the dry zone shows excessive pollution, particularly in summer. All of this calls for the integrated management and planning of water resources and higher investment in water conservation and resources protection, as well as the promotion of healthy behaviour among users.

Up to February 2003, Myanmar had built 280 dams and reservoirs, 127 of which were operational, with plans for protection and restoration of the watersheds by the Ministry of Forestry. Furthermore, 68 dams and reservoirs had established 163823 ha of watershed plantation up to 2002.

The rapid construction of irrigation facilities such as dams, reservoirs, weirs and river pumping stations may lead to contamination and depletion of water resources rapidly.

As the water supply agencies established various facilities according to their own policies and practices and as they were as a result uncoordinated, in 1990 the government established the National Commission for Environmental Affairs, comprising all concerned departments' representatives, to offer systematic guidance in environmental management. Water conservation was seen as a key area to be addressed and laws and regulations to prevent water-related environmental degradation were seen as being essential.

With the increase of population and a greater need for water for economic activities, there is increasing pressure on groundwater extraction. Control and management of groundwater is therefore necessary. Unrestricted groundwater extraction could result in land subsidence and saltwater intrusion. Besides, in order to ensure the recharge of groundwater aquifers, surface water has to be managed along with groundwater in an integrated way.

Traditional water management systems can no longer meet the requirements of the market economy. Thus, the water management system must be reformed soon, and the function of the management agency strengthened. An important problem for water resource planning is insufficient information and data on watershed resources.

b. Law and administration

The legal enactments concerning water resources development in Myanmar are found either in special laws relating to one or more uses of water or in other acts, sections of which relate to specific aspects of water use. The water laws or other provisions are shown in Annex 4.1.

However, there is a need to take action to make polluters pay in both the water and the environment sectors.

c. Technical measures for water conservation

Water supply development is essential in Myanmar and the sustainability of water resources is imperative for perpetual usage. Thus, water conservation through proper management and planning is vital. The most widely accepted mechanism for water conservation is demand management, which is achieved through a combination of economic and non-economic means. Chief among economic measures is water pricing, including reduction and elimination of direct or indirect subsidies, based on the belief that water is an economic good whose value should be determined by market mechanisms. Other measures such as the use of water-saving devices, the enhancement of irrigation efficiency and watershed management are also needed. Installation of water-saving devices such as flow regulating valves and self-closing valves at public buildings should be encouraged. An awareness campaign on water conservation should be given priority.

d. Use of water-saving devices

Water-saving devices are an essential element of managing water demand and should be part of a large water conservation strategy of economic benefit to users. The use of sprinkle and drip irrigation systems is being introduced in some government-owned farms for frugal water consumption. However, due to its technical complexity and the high investment required, farmers are still reluctant to use such a technology. Skills-based training and technology transfer on water saving should be introduced in the formal and informal education sector.

e. Use of water-pricing policies

Water pricing plays an important part in the management of urban and rural water supply systems; some data on water pricing is shown in Annex 4.2. Existing pricing systems need to be reviewed with the help of user communities.

Taxing water providers, users and polluters, with exemptions for the needy on social (e.g. health and education) grounds should be established.

f. Reuse of water

The use of wastewater in irrigation is rarely practised in some parts of the country. Wastewater, though degraded, can be suitable for irrigated agriculture. For example, the Yayni Paper Mill is using wastewater for irrigation purposes after treating the effluent through oxidation ponds, and most newly constructed industries are following suit. So far, there has been no significant negative impact in using wastewater for irrigation purposes, but research and studies in that area are needed.

g. Enhancement of water supply efficiency

Improvement of water use efficiency is very important for water conservation in the irrigation sector to reduce both water consumption and pollutant discharge by enterprises (point sources) and farmland (non-point source).

h. Improvement of urban water supply efficiency

The Yangon City Development Committee has enacted Law No. 6/99 to improve water distribution systems, including leak detection, construction, repair and maintenance of city water mains, charges in plumbing codes and prosecution of illegal connections.

In order to improve the efficiency of the urban water supply system both in design and in implementation, a code of practice for water service and drainage that is suitable and applicable for Myanmar should be established and enacted. Capacity building of personnel at various levels is also essential.

i. Improvement of irrigation efficiency

Some effective measures have been taken to save agricultural water, such as adjustment of cropping patterns, water supply scheduling, improvement of irrigation facilities and management, land levelling, water pricing, canal lining, and initiation of sprinkler and drip irrigation systems. Rehabilitation works for existing irrigation facilities have been carried out for efficient use of water instead of building new structures. Programmes that promote irrigation efficiency directly equate increased efficiency with savings for farmers (reduced energy, labour or cost) or improved productivity.

Under the technical cooperation programme between JICA and the Irrigation Department, Irrigation Technology Centre Project Phase II has been implemented since April 1999 to upgrade irrigation water management and efficiency.

j. Water quality protection and standards

The main sources of deteriorating water quality are sewage, solid waste, industrial waste and agrochemical waste. Water conservation through water quality protection is undertaken by the relevant city development committees. Actually, the control of wastewater is both a municipal and an industrial problem. In cities undergoing rapid industrialization, the municipal treatment issue is complicated by

the addition of untreated or semi-treated industrial discharges into the municipal sewage system, thus a stricter law to control water quality should be imposed. In the agricultural sector, the government has banned the import of some toxic pesticides and encourages the use of conventional bio-fertilizer as a substitute for chemical fertilizer to mitigate water quality deterioration. At present, control of water quality for various purposes is based on the WHO standards. Deforestation in catchment areas and around water sources causes a serious problem of degradation in water quality and quantity. The resulting topsoil loss and land degradation by gully and sheet erosion leads to excessive levels of turbidity in incoming water and to offsite ecological and physical impact from deposition in rivers and lakebeds. The silt and clay fractions, which carry absorbed chemicals, are transported by the sediments into the aquatic system.

In order to control the quality of water resources the following standards should be established:

- Effluent quality standard of domestic wastewater discharged onto the landmass or into water bodies.
- Effluent quality standard of industrial wastewater discharged onto the landmass and into water bodies.
- Quality standard of receiving landmass.
- Quality standard of receiving water bodies.

The Ministry of Health has organized a forum of experts on water quality issues. The WHO standards were adopted as a reference. Water quality control measures are implemented case by case, especially for bottled drinking water production. Arsenic detection and other parameters have been tested in collaboration with Water Resources Utilization Department, Department of Development Affairs, and UNICEF.

The Department of Meteorology and Hydrology is also monitoring the water quality of the main rivers yearly.

k. Public awareness of water use efficiency and conservation

Public awareness through community involvement is a key issue on the subject of water use efficiency and conservation. Social development and public education and information programmes lead to an increasingly knowledgeable public that wants to be involved in government decision making.

Training in nurturing forests, producing firewood substitutes and distributing leaflets on reforestation technology are provided to educate the local people in forest conservation practices. The government has designated July as the Month of Planting Trees for communities countrywide. It launched an annual National Sanitation Week annually in 1998 and in 2001 a World Water Day to generate public awareness of water and environmental conservation.

The Central Health Education Bureau and the Environmental Sanitation Division of the Ministry of Health, Information and Public Relations Department, UN agencies such as UNICEF, UNDP, UNCHS, and NGOs such as Save the Children Fund (UK) and Bridge Asia Japan have been conducting several kinds of educational programmes on health, water and sanitation.

Social mobilization for safe water along with sanitation and hygiene, in addition to community-based health promotion on water supply and sanitation, has covered two thirds of the townships countrywide in the past twenty years. Despite such efforts, it is very hard to change deeply rooted behaviours related to water. Water contamination has resulted in several disease outbreaks. The presence of arsenic, fluoride and other chemicals in groundwater reduces the availability of safe water.

l. Institutional arrangements in the water sector

A number of agencies are responsible for implementing water supply and sanitation schemes. Public Works 'has its own training school where engineers and other personnel participating in the water supply and sanitation sector are trained. The school undertakes seminars or workshops and refresher and other courses related to the water supply and sanitation sector. Although it has no code of practice of its own, a code of practice for water services and drainage is under review'. However, the establishment of a department with full responsibility for water supply would facilitate the provision of safe drinking water to the whole population. Water supply and sanitation should generally go together. Coordination mechanisms among the various agencies should be strengthened for effective management of the programme.

The various agencies and departments involved in the water use sector are listed in Annex 4.3, along with a list of agencies with water-related activities.

3.5 Emerging and persisting issues and trends in water resources management in the country

Given the steady growth of the population, water resources management will remain critical. From 1988 up to March 2003, 144 dams and sluice gates have been constructed countrywide, servicing some two million acres (0.81 million ha) of farmland. The government has formulated a 30-year plan of promotion of agriculture and irrigation.

The provision of agricultural water is the first priority in water resources management for the country now and in the foreseeable future. Installed hydropower capacity (382 MW over 382 sites) is less than one percent of the estimated potential. Thus, the provision of water for hydropower generation may be the second priority in water resources management.

The provision of water for industrial and domestic uses by comparison is small (three percent and about seven percent, respectively). There is no official water allocation for navigation and other uses at present.

Due to the construction of dams, water-logging problems are encountered in some irrigated areas in both upper and lower Myanmar. There are also some salinization problems in the central dry zone, where water of poor quality is used for domestic or agricultural purposes. An environmental impact assessment is necessary for all water resources development and management works to be sustainable. Health or ecological hazards resulting from water resources development could be avoided by proper planning with vision.

4. NATIONAL WATER VISION

4.1 Factors in the formulation of the national water vision

Currently, Myanmar can be identified as a low water stress country. There are no serious conflicts related to the allocation of water to different sectors for their respective uses, but in the near future it might be necessary to arbitrate the sharing of water for conservation, domestic use, hydropower, irrigation water and inland water transportation. It might also be necessary to limit the extracting of water from the lower reach of river basins to protect against saltwater intrusion from the sea. Therefore short-term and long-term plans are needed to legislate the sharing of water between users and to introduce modern technology to exploit and manage water resources and their management with the help of international agencies. Information and data sharing among the different sectors is essential if a combined database is to be established.

Community involvement along with the involvement of the Ministry of Health has been part of Myanmar's national water vision process since its inception.

4.2 Vision for poverty reduction

a. National policy on poverty eradication

Myanmar is gradually shifting from subsistence farming to a more diversified economy. However, poverty is still widespread. More than 65 percent of the population lives in rural areas, forming large agricultural communities. Poverty eradication is the first priority of the economic policy agenda and it will be speeded up by broad-based socio-economic progress.

b. Vision for poverty reduction

There is growing agreement worldwide that water and water services are essential because they touch on almost all millennium development goals. Investment in water infrastructure to protect against droughts and floods, produce renewable energy and provide water supply to cities and rural areas, and water to grow food is basic for economic growth and poverty reduction in Myanmar. The following are the vision components for poverty reduction:

- (a) Enhancing the endowment of productive assets for local communities;
- (b) ensuring clear benefits for local communities from infrastructure development schemes; and
- (c) creating income-generating opportunities for local communities.

c. Roles of water resources management and poverty reduction

In Myanmar, the forest cover has been steadily declining during the past thirty years of economic growth. The rivers are still there, but first or second order streams are harnessed with irrigation facilities such as dams, which are taxed by the demand for irrigation and hydropower production. Water resources management seeks to maintain clean water, healthy soils, stable climate, timber, fish and other natural products, and recreation. Most of the watershed areas are protected, such as reserved forests, national park or wild life sanctuaries, although in many cases funds and staff are not readily available to ensure management in support of the stated goals.

Water resources management and development is central to responsible growth and poverty reduction and is, therefore, of central importance to the local community.

d. Vision on water resources management for poverty reduction

A series of national protected areas and compatible use areas could be developed to ensure a steady supply of income through tourism, sustainable resource extraction, and well functioning development projects for local communities. The water resources projects are clearly necessary for the development of the national economy and the communities. In the case of major water resources projects, impact should be assessed for the entire ecosystem being affected to ensure that essential ecological processes are not lost. Guidance on the management of increased opportunities for resource extraction should also be provided. Impact should be comprehensively assessed during the planning and design process. Problems can be avoided in the future if assessments are carried out comprehensively rather than at a narrow project level.

There are several areas where forests, rivers and wetlands are still virtually pristine. However, many or most of these areas are in the path of proposed water resources projects. The nation should take

a proactive approach to maintain these valuable areas by identifying biodiversity hotspots and instituting appropriate resource management measures together with development decision-making.

The vast forests and rivers of the country have provided a home to people for millennia and these people have carried out burning and grazing in these forests to create the ecosystems we see today. Now, as populations are expanding and technological opportunities are more widespread, new ways for local inhabitants to benefit from their resources need to be found. This is especially the case in protected areas where these benefits need to come from rule-based, non-destructive and sustainable extractive methods such as ecotourism, sustainable forestry and bio-prospecting that are appropriate to the site. For this to happen, the nation will need to design programmes in such a way as to ensure that benefits accrue to communities in the vicinity of protected areas.

The vision on water resources management for poverty reduction includes the following:

- (a) Expanding the identification of biodiversity hotspots and preparing protection strategies for them;
- (b) practising water resources management in such a way as to ensure that benefits accrue to communities in the vicinity of protected areas;
- (c) providing the basis for overall regional development and associated economic opportunities for the poor; and
- (d) providing targeted benefits to the poor who are resettled or otherwise affected by the project or who live in the vicinity of the project, and generate revenues that are shared in a way that directly benefits poor people.

4.3 Vision for economic development

The sustainability of fresh water resources is a vital requirement for human survival and essential for the development of agriculture, industry and other economic activities. With an increasing population and a growing need for water for economic activities, there is increasing pressure on water resources from various quarters. Programmes need to be set up to maintain existing water sources and promote the activities of management and coordination.

As the agricultural sector contributes the major portion of the country's GDP, water resources management is vital for the development of the national economy.

In the agricultural sector, the government has endeavoured to replace conventional methods with modern agricultural methods. As cultivation changes from single to multiple cropping patterns, the role of irrigation becomes vital not only for supplying sufficient water for cultivation, but also for extending farmlands and boosting crop yields.

Table 4.17 shows the increase in irrigated area in Myanmar from 1980/81 to 2000/01.

Since Myanmar is rich in water resources and given the present rate of water utilization, the country could share its water resources by selling power and distributing drinking water if there is a consensus for establishing a global or regional water partnership.

At present, less than ten percent of total water resources are being utilized and about 20 percent of the total cultivated land is now provided with irrigation facilities; 80 percent of the cultivated area is still subject to unreliable and insufficient rainfall. Even though the country is naturally endowed with abundant water resources, there is an urgent need to establish water conservation with appropriate management and planning practices given the rapid socio-economic development of the country. Annual surface and ground water potentials are shown in Table 4.18.

Table 4.17 Increase in irrigated area

(Thousand ha/yr)

Year	Total irrigated area	Year	Total irrigated area
1980/81	1 105	1996/97	1 603
1985/86	1 090	1997/98	1 639
1990/91	1 033	1998/99	1 743
1994/95	1 601	1999/2000	1 896
1995/96	1 809	2000/01	1 967

Source: Settlement and Land Records Department.

Table 4.18 Annual surface and groundwater potential in Myanmar

River basin number	Name of principal river basin	Catchment area for each stretch (km ²)	Average annual surface runoff (km ³)	Groundwater potential (km ³)
I	Chindwin river	115 300	141.293	57.578
II	Upper Ayeyarwaddy river (up to its confluence with Chindwin river)	193 300	227.920	92.599
III	Lower Ayayerwaddy River (from Chindwin confluence to its mouth)	95 600	85.800	153.249
IV	Sittoung river	48 100	81.148	28.402
V	Rivers in Rakhine State	58 300	139.245	41.774
VI	Rivers in Taninthary Division	40 600	130.927	39.278
VII	Thanlwin river (from Myanmar boundary to the river mouth)	158 000	257.918	74.779
VIII	Mekong river (within Myanmar territory)	28 600	17.634	7.054
	Total average (1980–1993)	737 800	1 081.885	494.713

4.4 Statement of the national water vision

Water is a fundamental natural resource and there has been growing recognition that its use and management must be improved if a water crisis is to be avoided. The role of water in contributing to alleviating poverty, securing livelihoods, strengthening the economy and sustaining environmental and ecological systems is central to all development goals.

Based on the vision for Southeast Asia prepared under the guidance of the World Commission for Water in the 21st century and an initiative of the World Water Council, the National Water Vision has been formulated as follows:

‘By the year 2030, the country will have attained sustainability of water resources to ensure sufficient water quantity of acceptable quality to meet the needs of the people of the country in terms of health, food security, economy and the environment.’

5. FRAMEWORK OF NATIONAL WATER VISION TO ACTION

The national water vision starts with the concept of the integrated and sustainable use of water resources (of both surface and ground origins) being protected by precautionary measures from unexpected harms and disturbances generated by water.

Soon after the proposed National Water Vision of Myanmar is approved and accepted, it is of prime importance to proceed by officially establishing the national water commission that can function as the summit organization, responsible for the overall management of water resources in Myanmar.

5.1 Targets in economic development

At the moment, about 2.0 million ha of land is irrigated, or 20 percent of the cultivated area. The target is to extend the irrigated area by 1.3 million ha by 2005. For non consumptive use and for hydropower generation, it is planned to develop 1863.2 MW by 2005 by implementing 12 projects (Table 4.19).

Table 4.19 List of hydropower and thermal power projects of the first five-year plan

Project	Installed capacity (MW)	Average generation (GWh)	Targeted completion
Mone	75	330	June 2003
Paunglaung	280	911	June 2004
Yenwe	25	123	June 2004
Shweli	400	3 022	June 2006
Yeywa	780	3 550	June 2007
Kabaubg	30	120	June 2005
Kun	60	190	June 2005
Phyu	65	260	June 2005
Shwegyin	90	230	June 2006
Kengtawng	54	472	June 2006
Pathi Chaung	2	10	June 2004
South Nawin	2.2	10	June 2004
Total	1 863.2	9 228	
Tigyit coal-fired power station	120	960	June 2003

Several departments and agencies are involved in water management. Coordination and collaboration among them is essential for policymaking, planning, amendment of existing laws and regulations and for issuing new laws relevant to water resources. Hence, a high-level body such as a national water commission should be established as soon as possible.

5.2 Key objectives and targets of the vision

The key objectives of the vision are as follows:

1. To ensure access to water for the people of Myanmar: All have access to safe, adequate and affordable water supply, hygiene and sanitation.
2. To provide water for food and rural development: Provision of sufficient water that will ensure national food security and promote rural development.

3. To provide water for economic development: Provision of sufficient water to spur and sustain economic growth within the context of a knowledge-based economy.
4. To protect water for the environment: Protection of the water environment to preserve water resources (both surface and groundwater) and natural flow regimes, biodiversity and cultural heritage, and mitigation of water-related hazards.

Other objectives are:

- To promote community participation and to extend the formation of water user associations. To educate water users for effective use of water resources.
- To develop capacity building for the efficient use of water and the sustainability of water resources.

The target for 2030 is for the government and the private sector to increase the irrigated area by 3.7 million ha. Total consumption of water by 2030 should be 74.18 million m³, including industrial use and domestic use for urban and rural areas. The target for hydropower generation is 22 896 MW by 2030.

Pump irrigation projects in the thirty-year master plan for promoting the irrigation water supply sector are shown in Table 4.20.

All villages will have access to safe and sufficient potable water in 2009/10.

**Table 4.20 River water pumping irrigation projects
in thirty-year master plan**

State/Division	No.	Irrigation area (ha)
Kachin	3	4 940
Kayah	1	210
Kayin	5	2 790
Sagaing	10	35 860
Taninthary	2	80
Bago	42	24 560
Magway	6	9 060
Mandalay	6	4 170
Rakhine	2	80
Yangon	11	7 980
Ayeyarwaddy	15	20 000
Total	103	109 730

5.3 Key components of the vision

The key components of the vision are as follows:

- (a) Water for the people of Myanmar: All have access to safe, adequate and affordable water.
- (b) Water for food and rural development: Provision of sufficient water that will ensure national food security and promote rural development.
- (c) Water for economic development: Provision of sufficient water to spur and sustain economic growth within the context of a knowledge-based economy.

- (d) Water for the environment: protection of the water environment to preserve water resources (both surface and ground water) and natural flow regime, biodiversity and cultural heritage, and mitigation of water hazards.
- (e) Detailed survey of resources and demand, formulation of long-term plan and implementation, identifying needs in terms of method and technology.

5.4 Vision for basin management

As several agencies are involved in water resources management, the sector suffers from jurisdictional conflicts and coordination problems. An integrated planning and management system is required to effectively manage the water resources.

The programme areas for basin management should reflect the concepts mentioned in *Myanmar Agenda 21*, which would encourage sustainable development. They are:

- (1) Strengthening integrated water resources policy, planning and management systems;
- (2) improving water supply and environmental sanitation; and
- (3) improving management of the aquatic ecosystem including wetlands.

a. Changes in basin management practices

Water resources facilities countrywide are developed in accordance with the systematic work programmes included in the master plan. All water resources development projects in Myanmar are carried out with sustainable ways and means and any side effect or lateral impact to the environment is ignored.

Moreover, most water-impounding facilities are sited on tributaries and streamlets of main river systems and are no hindrance to the main river flow. Thus, the impact of dams on the environment is negligible. To ensure the sustainability of the country's water resources, forests and other vegetal covers should be conserved and safeguarded against any harm.

Shifting cultivation and slash-and-burn practices often result in forest loss and may cause soil erosion and degradation, deforestation and rapid siltation of reservoirs, etc. The Ministry of Agriculture and Irrigation is currently introducing effective hillside farming techniques such as contour planting and sloping agriculture practices. Furthermore, in collaboration with the Forest Department, the Irrigation Department is participating in the conservation of forests, the prevention of deforestation and the creation of forest plantations in the watersheds of important reservoirs throughout the country. Proper emphasis should be placed on watershed management activities to enhance soil and water conservation.

b. Selection of a pilot basin for integrated water resources management

Out of the eight main river basins, the Sittoung River basin should be selected as pilot river basin, based on the following criteria and prevailing conditions:

- 1. Accessibility of the area — good transport and telecommunication links from important towns, especially the capital;
- 2. the availability of raw or processed climatic and hydrological data at several locations within the river basin — data should cover a sufficient period and be of reliable quality;
- 3. the presence of completed and ongoing multipurpose water resources projects within the river basin — important stations such as RS and GIS should be installed at these locations so that reliable data can be obtained;

4. the presence of reserved forests, a sanctuary, wetland and parks within the river basin; and
5. the whole river basin is situated within the country.

c. *Role of water resources management in basin management*

Many weirs and dams have been built throughout the country. Some of the dams provide hydroelectricity to the nation. To maintain the design lifespan of these dams, prudent and intensive management of the water resources is required. Sustainable development of agriculture and sustainable forest management depend on the country's environmental and ecological stability, which is influenced by how well water resources are managed. With the aim of ensuring sustainability of water resources of the country, forests are well conserved and safeguarded. They cover 50 percent of the territory and will continue to fulfil human needs.

The dry zone in central Myanmar is the most critical region in terms of degradation of water and land resources, because of continued deforestation compounded by severe climatic conditions. In recent years a special programme has been launched by the Dry Zone Greening Department for greening 13 districts in the central dry zone affecting 12 percent of the dry area and 20 percent of the population.

d. *Vision on water resources management for basin management*

It is obvious that there exists a strong correlation between water resources management and basin management. For water resources management, the development of a system and framework for environment impact assessment is a vital and necessary tool for integrating the environment and development. Such an assessment should be carried out not only for projects funded by international institutions, but also for local multipurpose projects.

6. FORMULATION OF WATER VISION TO ACTION

On the basis of the experiences related to the establishment of the framework for action in association with the Southeast Asia Technical Advisory Committee of the Global Water Partnership as well as the detailed preparation of the working group established under the leadership of the Ministry of Agriculture and Irrigation, four themes were adopted for detailed study of priority elements and activities required for the realization of the Myanmar National Water Vision:

- Water for people: Poverty reduction and rural development.
- Water for economic development and nature conservation.
- Pilot river basin management.
- Establishment of a framework to turn the national water vision into reality.

These themes were adopted for detailed discussion by four working groups of the round-table workshop on the formulation of the national water vision to action, jointly organized by the Ministry of Agriculture in cooperation with UNESCAP and FAO in Yangon on 25-26 June 2003. The workshop was attended by 33 senior officials, and the results of the discussions are summarized below.

6.1 Water for the people: poverty reduction and rural development

6.1.1 *Priority objectives, issues, actors and strategic approaches*

Agriculture, including livestock, fishery and forestry, is the most important sector of the national economy. Agriculture and rural poverty are closely linked. Development of the agriculture sector is the

key factor in poverty reduction, and water is the most fundamental requirement for agricultural development.

(a) Priority objectives

Members of the working group discussed many topics and basic concepts reflecting the importance of water resources management for poverty reduction. After discussion and identification, the following priority objectives for water resources management for poverty reduction were selected for further discussion:

- (1) To improve the quality of life of the people by developing and using the productive resources and social investment.
- (2) To provide water resources for the rural population ensuring an adequate quantity and appropriate quality for sustainable development.
- (3) To protect the water environment so as to preserve water resources (surface and groundwater) and natural flow regimes, biodiversity and cultural heritage, and to mitigate water related hazards.

(b) Priority issues

With respect to the first objective, the following issues were identified as priority issues requiring special attention: Inadequate investment, inadequate technical know-how and inadequate infrastructure.

Regarding the provision of an adequate amount of safe water, the priority issues include: Inadequate water supply infrastructure, lack of public awareness, and lack of water quality surveillance and monitoring system.

Concerning the protection of water resources, the working group proposed the following priority issues: Lack of public awareness, improper water resources management and lack of effective participation of stakeholders.

(c) Principal actors

The principal actors responsible for each of the above-mentioned issues would include:

- (i) Department of Agriculture Planning, Irrigation Department, Myanmar Agriculture Services.
- (ii) Department of Health, Ministry of Industry, General Administration Department.
- (iii) Irrigation Department, Department for Progress of Border Areas and National Races and Development Affairs.
- (iv) Irrigation Department, Water Resources Utilization Department, General Administration Department.
- (v) Department of Health, Department of Health Planning, Department of Development Affairs; General Administration Department, Ministry of Industry.
- (vi) Irrigation Department, Water Resources Utilization Department, General Administration Department, Ministry for the Progress of Border Areas and National Races, and Development Affairs.
- (vii) Irrigation Department, Water Resources Utilization Department.
- (viii) Ministry of Industry, General Administration Department, Yangon City Development Committee, Mandalay City Development Committee, Department of Development Affairs.

- (ix) Irrigation Department, Water Resources Utilization Department, Department of the Progress of Border Areas and National Races, Department of Development Affairs.

From the nine principal actors mentioned above, the working group identified the Irrigation Department, the Water Resources Utilization Department and the Department of Development Affairs as the three key agencies in the achievement of the objectives identified earlier.

(d) Possible strategic approaches

Possible strategic approaches recommended under water resources management for poverty reduction would include the following:

- (1) Extension of irrigated land;
- (2) proper operation and maintenance of existing irrigation facilities;
- (3) improvement of technology (tillage, seeds, mechanization etc.);
- (4) improvement of the economies of rural areas;
- (5) facilitation and formulation of related laws and regulations;
- (6) community participation and involvement; and
- (7) using an integrated approach.

6.1.2 Framework of a strategic plan

The working group identified the three top indicators as income generation, water consumption, and water conservation through water quality.

Regarding income generation, it was proposed that attempts be made to reach 1 million Kyat per household by 2005 through various economic measures, including an increase of irrigated area from 2 million ha in 2000 to 2.45 million ha in 2005 and an increase in yield from 66 baskets/acre to 100 baskets/acre in 2005. Implementation agencies: Ministry of Agriculture and Irrigation, Ministry of Home Affairs, Ministry of Labour, Ministry of Industry.

In addition, promotion of model villages with safe and adequate water supply will be carried out in order to reach 65 000 villages by 2030. Water quality monitoring and surveillance systems will be established to cover all townships from the current level of 200 townships. Responsible agencies: Ministry of Health, Ministry of Agriculture and Irrigation, Ministry of Home Affairs.

Concerning water conservation, the working group proposed the establishment of a national water commission by 2005 to unify all laws and regulations related to water resources utilization and protection and to improve law enforcement. Responsible agencies: Ministry of Agriculture and Irrigation, Ministry of Home Affairs, Department of Development Affairs, Ministry of Industry.

6.1.3 Priority action programme

1. Establish model villages;
2. increase yield and quality; and
3. establish a water quality monitoring and surveillance programme.

6.1.4 *Expected role of the national water commission*

1. Coordination of water-related departments and agencies;
2. mobilization of funds for water resource development programmes;
3. development and enforcement of water and wastewater standards;
4. training programmes for efficient and effective water use to generate income — initiation of regulations and rules for user pay programmes; and
5. initiation of workshops related to water users at village level.

6.2 Water for nature and economic development

6.2.1 *Priority objectives, issues and strategic approaches*

The working group included representatives from the following national agencies: Department of Fisheries, Department of Planning, Department of Population, National Commission for Environmental Affairs of Myanmar, Central Statistical Organization, Foreign Economic Relationship Department, Directorate of Hotel and Tourism, Office of the Attorney, Department of Agricultural Planning.

a. Priority objectives

The working group considered different opportunities, the rich resources and strategic geographical location of the country and recommended the following priority objectives for economic development and nature conservation:

1. To increase per capita incomes and link nature conservation with potential economic activities such as ecotourism, hydropower and fisheries.
2. To strengthen private and public participation in economic development activities.

b. Priority issues

The main obstacles to increasing per capita income include: Insufficient capital investment and advanced technical know-how and lack of access to the international market.

The key issues to link nature conservation with potential economic activities would include: Lack of public awareness, insufficient financial resources, and weakness of conservation activities.

The priority issues that need to be tackled in order to strengthen private and public participation in economic development activities would include: Lack of public-sector participation, weakness in information and education programmes, and low incentives for private-sector participation.

c. Possible strategic approaches

1. Identify and formulate feasible projects and negotiate with financial institutions for loans and grants;
2. create a conducive investment environment to attract foreign direct earnings;
3. identify potential ecotourism sites and coordinate integration of activities;
4. foster public awareness and set up an educational programme for nature conservation; and
5. develop a market information system and reinforce existing trade laws and regulations.

6.2.2 Framework of a strategic plan

a. Water-related indicators and targets

- National GDP and growth rate;
- income from tourism;
- multipurpose dam projects; and
- ratio of water-related sector to GDP.

b. Monitoring Mechanisms

Monitoring mechanisms should cover the following:

- Environmental conservation;
- effectiveness and efficiency of activities; and
- education, communication and information.

c. Target and time frame

Projects and implementation programmes have been set up in line with national planning.

- To extend irrigated area by 3.7 million ha by 2030.
- To construct up to 191 irrigation projects by 2025 and 275 by 2030.
- To develop up to 1863 MW of hydropower generation by 2005 and 23000 MW by 2030.
- To increase fishery products by up to 1.6 million metric tonnes.

d. Priority activities

- Extension of irrigated land;
- technological upgrade;
- timely implementation of target projects;
- adequate funding;
- coordination and collaboration among related agencies; and
- extension of trading.

6.2.3 Role of the national water commission

The working group proposed to establish the national water commission with the following roles:

1. Formulation of policy on water resources management;
2. formulation and implementation of the master plan for the water vision;
3. provision of guidelines on pollution control and conservation; and
4. fundraising.

The proposed coordination organization would undertake the key coordinating functions in water resources management, including distribution of works among agencies, and environmental conservation. The principal activities would include the following:

1. Approval for implementing water-related projects;
2. decision making for sharing of water;
3. issuance and amendment of laws and regulations for river systems;
4. issuance and amendment of laws for water pollution control;
5. solving problems of water sharing in border rivers;
6. international communication; and
7. water taxation.

6.3 Pilot river basin management

6.3.1 Priority objectives, issues and strategic approaches

a. Priority objectives

The working group identified 13 objectives and after thorough discussion recommended the following priority objectives for Strategic Planning and Management exercises:

1. Mitigate floods for better socio-economic conditions in the basin;
2. enhance economic development through increased irrigated area;
3. promote industrial development; and
4. develop the management of the Sittoung River basin as a river basin management model for Myanmar.

b. Priority issues

The priority needs for flood mitigation were discussed and the following issues were recommended for urgent consideration:

1. Basin management authority;
2. construction of training works, including flood storage in the Sittoung river basin;
3. collection and dissemination of information; and
4. early flood warning system.

To increase the irrigated area, the working group proposed to focus on the following priority issues:

1. The mobilization of technical and financial support;
2. the supply of inputs to farmers; and
3. the mobilization of stakeholders.

For economic development, the following issues were identified as priorities:

1. The need to improve energy availability;
2. the need to enhance investments; and
3. the promotion of suitable types of industries.

c. Strategic approaches

In order to achieve the above mentioned priority objectives, the working group identified six strategic components to be included in the strategic plan of the pilot river basin:

1. Data collection/dissemination and river basin training activities: To issue forecasts and warnings, and to upgrade information and media dissemination for decision making using information and communication technology, including remote sensing and geographical information systems.
2. Establishment of the river basin management committee: To coordinate activities and promote cooperation among all related agencies and local authorities.
3. Improvement of flood plain management: To promote systematic infrastructure development within the basin and promote the use of remote sensing techniques.
4. Extension programme: To build up the institutional capacity of key stakeholders and to undertake a systematic human resources development programme.
5. Promotion of energy management: To initiate a programme on demand management of electricity, develop an energy regulation programme and exploit the hydropower potential of the basin, including promotion of localized power generation facilities.
6. Promotion of industrial development: To explore financial mobilization, promote investment opportunities and enhance transparency of associated returns.

d. Priority action programmes

The action programme for flood mitigation would include establishment of the basin management committee, formulation of a master plan for basin management and promotion of integrated watershed management activities.

The programme to increase irrigated land would include flood plain management activities, such as flood protection structures, introduction of multiple-cropping patterns and construction of pump irrigation, and extension activities, such as diversified crops and model farming.

The programme on economic development would include electricity demand and supply management, including types and sources of energy and expansion of transmission system, and development of hydropower potential.

6.3.2 Framework for a strategic plan

a. Indicators for pilot basin management

The working group identified several indicators and agreed on the following priority indicators to measure the success of the pilot basin management:

1. Reduction in annual flood damage;
2. improvement of living conditions;
3. increased investment; and
4. participation of people in basin management.

b. Top priority activities

1. Establishment of a basin management committee; and
2. formulation of a master plan.

6.3.3 Roles of the national water commission

The working group recommended the following roles for the national water commission in relation to the pilot basin management:

1. To establish policies on sharing water resources with other river basins.
2. To explore external financial assistance.
3. To seek technical know-how.
4. To assign duties and functions among water-related agencies.
5. To act as the national coordinator on international rivers.

In this connection, it was expected that the national water commission would carry out the following activities:

1. Undertake regular coordination and organize cooperation meetings;
2. establish e-government activities; and
3. promote exchange of know-how and experience.

6.4 Framework to turn the national water vision into reality

6.4.1 Priority objectives, issues and strategic approaches

a. Priority objectives

In recognizing the importance of acceptance of the national water vision by all key stakeholders and the creation of an effective mechanism to promote, implement and monitor priority activities to turn the national water vision into reality, the working group recommended the following priority objectives:

- (1) To establish a national water commission.
- (2) To provide safe and adequate water to the public as the foundation for water resources management.
- (3) To ensure adequate availability of water for development.

b. Key conditions

- (1) Key conditions in the establishment of an effective national water commission would include the commitment of the government and acceptance by the agencies concerned.
- (2) Key conditions to the provision of safe and adequate water to the public would include reliable accessibility and convenience for the communities, and effective water quality control.
- (3) Important factors to ensure adequate availability of water for development would include clear action programmes of concerned agencies, and promotion and enforcement of water policies and action programmes for sustainable development.

c. Priority issues

- (1) National Water Policy;
- (2) initiative of the government;
- (3) coordination of agencies concerned;

- (4) water quality control;
- (5) public participation;
- (6) financial support;
- (7) economic development;
- (8) integrated activities among the agencies; and
- (9) water policy and action programmes for sustainability.

d. Possible courses of action

1. By Ministry of Agriculture and Irrigation and Ministry of Electric Power
 - a. Provision of a framework for a national water commission; and
 - b. establishment of a national agency for water resources management.
2. By Ministry of Finance and Revenue
 - a. Support for water resources projects; and
 - b. support for operation and maintenance.
3. By Ministry of Planning and Economic Development
 - a. Long-term planning for economic development; and
 - b. development of natural resources.

e. Possible strategic approaches

- (1) Promotion of the national water vision; and
- (2) establishment of a national water commission.

6.4.2 Framework for a strategic plan

a. Indicators

- Adoption of the national water vision by the government;
- establishment of a national water commission;
- promotion of water resources investment; and
- improvement of community living standards.

b. Mechanisms

- DAP, MOAI: To coordinate the adoption of a national water vision.
- MOAI: To formulate a plan for the establishment of a national water commission and coordinate its activities.
- All the water-related departments and agencies need to carry out planning, prioritization and implementation of water resources projects.
- Information, education and communication through capacity building in cooperation with relevant institutions.

c. *Time frame*

- For Target 1: The national water vision should be adopted within one year.
- For Target 2: The national water commission should be established soon after adoption of the national water vision.
- For Target 3: Water resources investment projects should be planned with a short term of 5 years and a long term of 10 years.
- For Target 4: The rural poverty line will be improved in parallel with the implementation of short- and long-term plans.

d. *Possible courses of action*

1st objective

- Coordination of concerned agencies;
- submission of the proposed national water vision to the competent authority; and
- collection of data and information on resources.

2nd objective

- Effective utilization of safe water;
- public awareness on education of water related diseases; and
- exploitation of new water resources.

3rd objective

- Short-term and long-term master plan(s);
- clear action programmes of concerned agencies; and
- sustainable financial support.

e. *Recommended immediate action*

- Interim authority should be held by MOAI.
- Interim authority should proceed to promote adoption of the national water vision.
- Interim authority to assign functions and duties to various departments and agencies.

6.4.3 Possible mechanism of the coordination body and priority functions

The working group also reviewed the functions of key agencies, to be coordinated by the proposed national water commission. The key agencies were identified as the Ministry of Agriculture and Irrigation (Department of Agricultural Planning and departments and agencies concerned with water resources), Ministry of Electric Power, Ministry of Industry, Ministry of Livestock, Breeding and Fisheries, Ministry of Forestry, Ministry of Progress of Border Areas and National Races and Development Affairs, Ministry of Construction, Ministry of Health, private sector and city development committees (Yangon and Mandalay). It was envisaged that they would perform the following functions: formulation of a plan for a national water commission including formulation of proper water policies, authorization of water resources development activities, identification of focal agencies, long-term supply and demand planning and management of effective use of water resources (irrigation, industrial, domestic); formation of

integrated water user groups at various levels; establishment of capacity building for human resources in cooperation with international organizations; development of a national water quality standard; water quality surveillance and control; information exchange, education and communication to raise awareness and develop skills related to the national water vision, and water and sanitation for health; and promotion of a national sanitation standard.

All of the above functions should be undertaken by the relevant agencies under the guidance of the proposed national water commission with the following priority activities:

1. Establishment of a national-level commission for water resources management to develop national policies, master plans, legal and market instruments and guidelines;
2. ensure long-term supply and demand planning and effective use of water resources including groundwater resources in a complementary manner and with water quality control; and
3. promote better coordination among water users and the agencies dealing with water resources development, sustainable water supply, capacity building for human resources and environment impact assessment.

7. RECOMMENDATIONS

Working-group members recommended the following actions to indicate a commitment to achieving the priority objectives of the national water vision.

1. A national-level water authority should be instituted to adopt the policies regarding the control, conservation, development, use and protection of water resources of the country.
2. All existing laws, rules and regulations should be reviewed with a view to enacting a unified water resources law so as to promote a more effective legal framework for coordination and management of water resources.
3. Resources for the development and management of water resources for socio-economic development of the country should be mobilized.
4. An integrated water resources management plan should be formulated to guide and coordinate development activities.
5. Effective measures should be taken on the basis of community participation through educational programmes and support programmes to meet the basic needs of the communities.
6. Specific responsibilities of the focal agencies, especially in developing national water quality standards and control should be clearly identified.

ANNEX 4.1

Water Laws in Myanmar

(a) For urban water utilization

The Rangoon Water Works Act (1885)

The Burma Municipal Act (1898)

The Burma Canal Act, 1905, as amended by the Burma Act of 1914, 1924, 1928 and 1934

The Burma Embankment Act, 1909, as amended by the Burma Act of 1923 and 1931

The City of Rangoon Municipal Act (1922)

The Underground Water Act (1930), (Burma Act IV 1930) 21 June 1930

The Burma Water Power Rules (1932)

The Rangoon Municipal Act (1941)

Section 114: Water supply

Section 115: General powers for supplying the city with water

Section 116: Power of access to municipal waterworks

Section 117: Prohibition of erection of any building which damages sources of water supply

Section 118: Prohibition of bathing in or polluting water

Section 119: Occupiers of premises to be primarily liable for certain offences against the Act

The City of Yangon Development Law, 14 May 1990 (Law No. 11/90)

(10) The City of Yangon Development Law, 17 December 1999 (Law No. 6/99)

Most of the above laws are related to urban water supply. For groundwater use, the laws are still being processed, and some may introduce new concepts.

(b) For water supply for irrigation

Canal Act, 1905 (Amendment Canal Act in 1998)

Myanmar Embankment Act, 1909 (Amendment Embankment Act in 1998)

Myanmar Irrigation Manual, 1945 (Revised: Edit)

ANNEX 4.2

Water pricing in Myanmar

(a) Domestic water supply

Urban water supply: Yangon CDC's current domestic water tariff structure

Water use	Water rate	Remark
Domestic	30 Kyats/1 000 gallons	metered
	120 Kyats/month/household	un-metered
	Free	public water station
Commercial/Industrial	130 Kyats/1 000 gallons	metered
Government/Military	20 Kyats/1 000 gallons	metered
Foreign/Diplomat/Investor	US\$4/1 000 gallons	metered
Commercial	US\$2/1 000 gallons	metered
	US\$-25/month	un-metered
Pagoda/Temple/Religion	Free	

Rural water supply

Water use	Water rate	Remark
Surface water	Variable	Variable with respect to localized scarcity of water and cost of energy
Groundwater	Variable	-ditto-

(b) Water supply for irrigation

Water Resources Utilization Department's water tariff (per acre)

Water source system	Water supply paddy	Summer	Rainy paddy	Other crop
Surface water	Electric pumping	Ks. 1 500	Ks. 1 200	Ks. 750
Surface water	Diesel engine pumping	Ks. 3 000	Ks. 2 500	Ks. 1 500
Groundwater	Electric pumping	Ks. 1 500	Ks. 1 200	Ks. 750

Irrigation Department's water tariff:

Ks. 10/acre for irrigation and Ks. 5/acre for flood protection

ANNEX 4.3

Various agencies and departments engaged in water use sector

Agency/Department	Ministry/City/Other	Duty and function
Irrigation Department	Agriculture & Irrigation	Provision of irrigation water to farmland
Water Resources Utilization Department	Agriculture & Irrigation	Pump irrigation and rural water supply
Directorate of Water Resources and Improvement of River System	Transport	River training and navigation
Myanmar Electric Power Enterprise	Electric Power	Electric power generation
Department of Hydroelectric Power	Electric Power	Hydropower generation
Factories under the Ministry of Industry	Industry (1) and Industry (2)	Industrial use
Myanmar Fishery Enterprise	Livestock, Breeding & Fishery	Fishery works
City Development Committee	Yangon/Mandalay	City water supply and sanitation
Department of Development Affairs	Progress of Border Areas & National Races and Development Affairs	Domestic and rural water supply and sanitation
Private users	UN agencies, NGOs & private entrepreneurs	Domestic water supply navigation & fisheries
Department of Meteorology and Hydrology	Transport	Water assessment of main rivers
Forest Department	Forestry	Reforestation and conservation of forest
Public Works	Construction	Domestic & industrial water supply and sanitation
Department of Human Settlement and Housing Development	Construction	Domestic water supply
Department of Health	Health	Environmental health, water quality assessment and control
Central Health Education Bureau Dept. of Health Planning	Health	Social mobilization, health promotion, behaviour research
Yangon Technological University	Science and Technology	Training and research