Approaches for Systematic Planning of Development Projects 〈Water Resources〉

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Since FY2002, the Japan International Cooperation Agency (JICA) has referred to scheme types such as Project-Type Technical Cooperation, Individual Expert Team Dispatch, and Research Cooperation collectively as Technical Cooperation Projects. However, since there is a possibility of confusion with the original names of scheme types, this report also uses the current team Technical Cooperation Projects with reference to projects that were started prior to FY2001 for consistency.

Similarly, collaborative projects with other entities such as NGOs have been collectively referred to as JICA Partnership Programs since FY2002, and this report, therefore, uses the term Partnership Program with reference to projects that were started prior to FY2001 for consistency.

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Foreword

The Japan International Cooperation Agency (JICA) has been working toward the enhancement of its country-specific and issue-specific approaches by formulating JICA Country Programs, implementing Project Request Surveys, and drafting Thematic Guidelines. At present there are significant differences between countries in terms of progress levels or categorizations of development issues and cooperation programs. To improve further JICA Country Programs and deal with important development issues requires appropriate formulation of programs and projects based on a fundamental understanding of development issue and effective approaches toward them, while recognizing that situations and issues differ from country to country. JICA must clarify the priority areas for cooperation, based on both the actual conditions of each target country and a systematic approach for each development issue.

Therefore in FY2001 and FY2002 as a part of an effort to promote country-specific approaches by enhancing issue-specific approaches JICA conducted the study on "Approaches for Systematic Planning of Development Projects" in eight issues: Basic Education, HIV/AIDS, Rural Development, Promotion of Small and Medium Enterprises (SMEs), Poverty Reduction, Trade and Investment Promotion, Higher Education, and Information and Communication Technology. The study systematized these issues and specified the indicators to be used as references in planning, monitoring and evaluating JICA's activities. Furthermore, the study reviewed JICA's previous projects and summarized their trends, matters of concern and representative cases for each issue, based on Development Objectives Charts.

Due to a growing demand for systematization of other issues as well, a further study was carried out in FY2003. Three new development issues were taken up: Water Resources, Reproductive Health, Agricultural and Rural Development.

The findings of this study will be incorporated into the JICA Thematic Guidelines and further developed by the Agency Thematic Network.

In conducting the study and preparing this report, a task force was set up, chaired by Mr. Hiroshi Kato, JICA Director of Planning Group, Planning and Coordination Department, and comprising JICA staff of related departments, JICA Senior Advisors, Associate Specialists, and external consultants. A considerable number of JICA staff members, as well as external experts, further contributed by offering valuable comments on the draft report. I would like to take this opportunity to acknowledge the efforts and contribution of all of these individuals.

Finally, it is my sincere hope that this report will prove a worthwhile step in the enhancement of issue-specific approaches.

August 2004

Toru TAGUCHI
Director General,
Institute for International Cooperation
Japan International Cooperation Agency

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Contents

Outline of Study

1. Background and Purpose of the Study

This study is part of Phase III of the study on Approaches for Systematic Planning of Development Projects conducted in FY 2003. The study is designed to enhance country-specific approaches by strengthening issue-specific approaches. The previous studies, phase I and II focused on eight major development issues: Basic Education, Anti-HIV/AIDS Measures, Promotion of Small and Medium Enterprises, Rural Development, Poverty Reduction, Trade and Investment Promotion, Higher Education, and Information and Communication Technology. Problems and other matters associated with each of these issues were systematized and effective approaches to it were identified. Furthermore, the program reviewed JICA's activities based on Development Objectives Charts and compiled the findings into a series of reports titled "Approaches for Systematic Planning of Development Projects."

Amid mounting calls for similar systematization for other development issues, IFIC consulted with other departments concerned within JICA. Based on this consultation, IFIC decided to work on three other issues – Water Resources, Reproductive Health, and Agricultural and Rural Development – during FY2003.

IFIC expects the findings of this study to be constructive in the following ways:

- Serve as basic information for formulating and revising Development Objectives Matrices for JICA Country Programs.
- Serve as basic information for project formation (including studies for this purpose) and program formulation.
- Serve as basic information for program evaluations and country-specific evaluations,
- Serve as literature when JICA staff, survey missions, or experts explain JICA's views on development issues to recipient countries and other donors in the consultation process.
- To be stored in the JICA Thematic Database and shared within JICA with respect to views and approaches to development issues.

2. Organization of this Report [1]

Chapter 1 Overview of the Issue (Current Situation, Definition, International Trends, Trends in Japanese Assistance)

Chapter 2 Effective Approaches to the Issue (Objectives, Effective Approaches)
*This chapter explains approaches to the development issue and reviews JICA's activities on the issue based on the Development Objectives Chart.

Chapter 3 JICA's Cooperation Policy (JICA's Priorities and Points of Concern, Items for Future Consideration)

[1] As the findings of the study are to be utilized in developing JICA's Thematic Guidelines, the organization of this report is designed to be consistent with the standard organization of such guidelines.

3. Structure of the Development Objectives Chart

This study program has come up with a Development Objectives Chart as shown below for each development issue.

An Excerpt of the Development Objectives Chart for the Issue of Information and Communication Technology Developed in FY2002

Development Objectives	Mid-term Objectives	Sub-goals of Mid-term Objectives	Examples of Activities
1. Improvement of Ability to Formulate IT Policies	1-1 Establishment of Telecommunications Policy	Introduction of Competitive Market Principle	× Support formulation of foreign capital investment policy × Support policy to promote private investment × Support deregulation of market entry ○ Support formation of competitive markets

＊Marks in the column of Examples of Activities indicate how often JICA has implemented relevant projects.
◎: JICA has considerable experience, ○: JICA has certain experience,
△: JICA has experience as a component of projects, and ×: JICA has little experience.

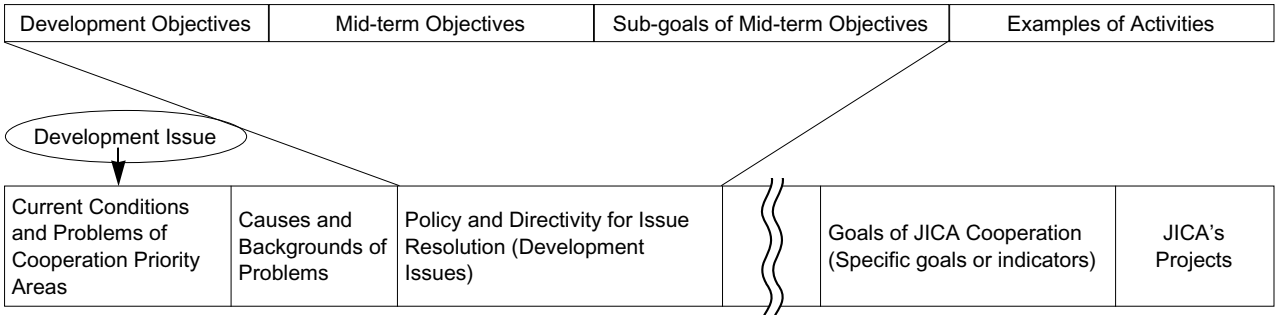
"Development Objectives," "Mid-term Objectives," and "Sub-goals of Mid-term Objectives" in the above chart represent a multi-level breakdown of the development issue.

In this report, the complete Development Objectives Chart, which covers all items ranging from "Development Objectives" to "Examples of Activities," appears later in this section, Outline of Study. In addition, the items for each Development Objective, ranging from "Mid-term Objectives" to "Examples of Activities" appear in the corresponding subsection in Chapter 2.

The relationship between the Development Objectives Chart and the corresponding JICA Country Program depends on the recipient country or sector in question. A rule of thumb, however, is that the Development Issue in the Chart corresponds to the Priority Sector in the Development Objectives Matrix of the JICA Country Program. Likewise, Development Objectives, Mid-term Objectives, and Sub-goals of Mid-term Objectives in the Chart correspond to Policy and Direction for Solving the Problems (Development Issues)" in the Matrix. These objectives/targets levels corresponding to Development Issues in the Matrix depend on the recipient country or sector in question.)

Relationship between the Development Objectives Chart and the Development Objectives Matrix of the JICA Country Program

<Development Objectives Chart>



<JICA Country Program, Development Objectives Matrix>

4. Task Force

The members of the task force for the study are listed below. Within the task force, the group on each of the three development issues drew up an interim draft report, which was examined at the plenary meetings of the task force. With input from JICA staff at overseas offices and headquarters as well as external experts, the task force added amendments to the three interim draft reports to produce the final reports.

Members of the task force

Chief	Director, Planning Group, Planning and Coordination Department	Hiroshi KATO
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Development Objectives Chart for Water Resources (1)

Development Objectives	Mid-term Objectives	Sub-goals of Mid-term Objectives	Examples of Activities
1. Promoting Integrated Water Resources Management Note 1	**1-1 Institutional Strengthening to Promote IWRM**	**Institutional Strengthening for Unified Management of Water Resources**	○Creating and developing organizational structures for unified management and those for coordination ○Defining the responsibilities and authorities of government agencies concerned ○Strengthening the capacity to improve coordination among government agencies concerned ○Developing the legal structure for water resources management ○Developing manuals and guidelines for implementing relevant laws ◎Training administrators and engineers
		Financial Improvement and Private Sector Participation	○Creating rules for sharing costs ×Taking advantage of private funds ○Expanding the user-based fees and revenue from fees ◎Optimizing budget execution ×Taking advantage of the private sector through privatization and PPP; strengthening supervising arrangements
		Information System Development and Information Disclosure	◎Collecting basic information at the river basin level ○Making institutional arrangements to share information among relevant organizations concerned ◎Developing and disclosing statistics ○Providing public access to information; promoting public relations for residents
	1-2 Promoting River Basin Management	**Water Resources Assessment and IWRM Planning**	◎Assessing the amounts of available water resources and water demands ○Sharing the basic concept and developing the basic policy of IWRM at the basin level ◎Developing water resources management plans ○Developing implementation plans
		Appropriate Water Allocation	○Allocating Available Water ○Developing policies for allocation among sectors and regions ○Participation mechanisms to involve a wide range of stakeholders
		Selecting the Tool for Integrated Water Resources Development	×Developing integrated facility construction plans ◎Developing dams (for multiple use) ○Developing forest conservation plans for water resources cultivation
	1-3 Effective Management of International Rivers	**Fostering Cooperation among Countries in International River Basins**	△Promoting dialogue △Supporting international interaction at the working and technical levels ○Considering other river basin countries when developing water projects ○Collecting, disclosure and sharing information ×Creating and strengthening coordinating bodies
2. Ensuring Efficient and Sustainable Supply of Safe Water	**2-1 Controlling Water Demands**	**Promoting Efficient Water Use**	×Improving coordination among stakeholders regarding water rights △Reducing water demands with water recycling technologies △Promoting water-saving farming methods and a shift to crops with higher water productivity
		Promoting Water Saving	○Water channel lining ○Purchasing water-saving irrigation equipment (drip irritation equipment, sprinklers, etc.) ◎Improving irrigation systems ◎Introducing small-sized participatory irrigation schemes △Introducing water-saving facilities and equipment (water-saving division boxes, etc.) ◎Promoting measures to prevent tap water leakages △Raising the awareness of residents about water saving ×Statutory regulation ○Water charging based on the user-pays principle ○Improving the water charging system (e.g. introducing incremental or pay-for-use rates) ○Organizing water management (water use) associations of residents and other water users ○Introducing and entrenching management based on a self-supporting accounting system ×Involving the private sector in water services
		Promoting Unified Management of Water Resources	△Reorganizing the administrative structure or establishing a coordinating agency
	2-2 Increasing Water Supplies with Water Resource Development	**Exploitation of groundwater**	◎Assessing groundwater availability ◎Water examination ◎Construction and installation (including drilling) of well-related facilities (wells, pumps, etc.) ○Monitoring water levels and qualities

Development Objectives Chart for Water Resources (2)

Development Objectives	Mid-term Objectives	Sub-goals of Mid-term Objectives	Examples of Activities
2 Ensuring Efficient and Sustainable Supply of Safe Water	**2-2 Increasing Water Supplies with Water Resource Development**	**Securing Surface Water**	◎Assessing the discharge and water quality (hydrological surveys) ×Appropriate water intake control (water intake restriction under the river law, etc.) ◎IWRM planning or integrated river basin development planning ◎Establishing the purification system ◎Developing facilities for water resources development (intake weirs, water storage facilities, purification facilities, etc.) △Appropriate water intake control for environmental conservation △Conserving water conservation forests
		Using Rainwater	×Taking a positive look at traditional techniques for using rainwater (water harvest, etc.) △Putting in place rainwater collecting facilities (reservoirs, etc.)
		Using Water Efficiently	△Proper selection of water resources according to water use and the quality
		Desalinating Brackish Water and Seawater	△Commercialization of desalination technologies
	2-3 Conserving Water Quality (both at Source and at the Tap)	**Securing the Quality of Water Sources (See also Development Objective 4: Conserving the Water Environment)**	◎Putting in place water purification facilities and equipment ◎Appropriate operation and management of water purification facilities ◎Putting in place pollution treatment facilities (e.g., sewage treatment systems and household wastewater treatment tanks) △Introducing the polluter-pays-principle for industrial wastewater ○Reducing waste emissions from industrial plants with cleaner production △Promoting farming methods that use less pesticides and chemical fertilizers △Applying stricter water examination and developing alternative water sources for arsenic, fluoride, nitrate, etc. ○Developing and diffusing technologies to appropriately treat groundwater containing arsenic, fluoride, etc.
		Strengthening arrangements for pollution control	◎Setting water quality standards and goals ◎Water quality monitoring △Effluent control of waste water ○Strengthening the examination and guidance framework
	2-4 Ensuring Equitable Water Allocation	**Establishing a principle of equitable water allocation among users**	○Formulating a water law, river law, and others △Establishing water rights and other frameworks △Establishing a system to allocate water equitably between different uses
		Unified Water Management	△Establishing an unified management organization; consolidating existing organizations ◎Developing IWRM plans (river basin management plans) [DS]
		Appropriate Water Allocation to End Users	△Involving a widest possible range of water users in making relevant legal arrangements, operating water management organizations, and developing IWRM plans △Considerations to the socially vulnerable
		Effective Water Supply <Agricultural Water>	○Developing irrigation-related laws and regulations ○Developing irrigated farm fields ◎Constructing and repairing irrigation facilities (designed to manage water sources and take in, convey and distribute water) ◎Introducing a small-scale irrigation system ○Salinity control ○Capacity building of framers (with focus on awareness and skills) ◎Organizing farmers and bolstering water use associations (e.g., promoting participation, collecting water use fees, and taking charge of operation and maintenance) ◎Improving water management capacity (in terms of skills and planning) △Ensuring equity in allocating water down to end users (in relation to water rights, etc.)
		Effective Water Supply <Municipal Water>	△Developing laws and regulations related to water supply ◎ Constructing and repairing water supply systems (facilities to store, take in, convey, purify and distribute water) ◎Rehabilitating existing facilities ◎Water leakage management (e.g., renewing timeworn pipes) ◎Training engineers who operate and maintain related facilities ○Institution building to operate and maintain related facilities △Establishing the framework for maintenance service provision ○Establishing a cost-recovery system (installing water meters and establishing an appropriate water pricing and tariff collection systems ◎Improving water purification technologies ○Establishing and strengthening water utilities △Improving management (e.g. introducing a self-supporting accounting system, contracting out to the private sector, and promoting privatization) ○Reducing non-revenue water (due to leakage or theft) △Water charging that considers the poor

Development Objectives Chart for Water Resources (3)

Development Objectives	Mid-term Objectives	Sub-goals of Mid-term Objectives	Examples of Activities
2. Ensuring Efficient and Sustainable Supply of Safe Water	**2-4 Ensuring Equitable Water Allocation**	**Effective Water Supply <Rural Water Supply>**	◎Putting in place rural water supply facilities and equipment ○ Awareness-raising with focus on hygiene education ○Building a framework for VLOM (with communities collecting tariffs and operating and maintaining water supply facilities) ○Support from governments and NGOs in monitoring and major repairs
3. Improving Flood Control to Protect Lives and Properties	**3-1 Institution Building for Disaster Preparedness**	**Legal and Institutional Arrangements**	△Legislative arrangements ◎Institutional arrangements for flood forecasting and warning activities and evacuation and relief operations ○Institutional arrangements for first-aid operations △Institutional arrangements for flood-fighting operations △Introducing the framework for flood damage compensation ○Institutional arrangements for disaster restoration ○Establishing technical standards for facility construction ○Establishing technical guidelines for facility operation and maintenance ○Establishing and improving rules for facility operation ○Developing disaster prevention manuals and guidelines ◎Land use planning and restriction △Guidance and restriction for large-scale development projects △Relocation and resettlement ○Guidance for afforestation and forest conservation △Clarifying who are accountable for the management of river structures △Providing incentives for water-resistant construction; establishing building standards, and putting urban planning in place
		Effective Flood Control Planning	◎Developing policies and strategies for flood control ◎Developing master plans at the river basin level ◎Developing project implementation plans ◎Setting the design discharge and river borders ○Developing appropriate management plans for water source areas △Support for efforts to mediate between competing interests of river basin countries and to build consensus between these countries ○Mediating between competing interests of river basin areas; building consensus between these areas ×Securing the budget for disaster prevention; building consensus on how to share costs
		Strengthening Administrative Arrangements for Disaster Prevention	◎Defining the role of each agency and community and clarifying the chain of command ◎Strengthening arrangements for cooperation between local authorities and communities
		Collecting Data	◎Collecting basic data on flood control (topographic and geological features, vegetation, river bed materials, flood flow conditions, flood damage assessment, etc.) ◎Putting in place observation equipment/stations designed to collect meteorological, hydrological and oceanographic data ◎Making observing and monitoring arrangements ◎Integrating data into a database ◎Preparing and distributing hazard maps
		Developing Human Resources for Disaster Prevention	◎HRD at government agencies ○Improving college education in river, coastal and civil engineering
		Strengthening the Capacity of Communities to Deal with Disasters	**<Fostering and strengthening community organizations>** ○Forming and strengthening community-based mutual-aid organizations ○HRD at community organizations ○Disseminating knowledge, and raising the awareness about, disaster prevention of river basin communities ○Public relations about the management of water source areas ○Improving the capacity of river basin communities to operate and maintain flood control structures △Teaching disaster prevention at primary and secondary education ○Fostering and strengthening flood fighting associations ○Flood fighting training ○Conducting evacuation drills **<Procuring equipment for community preparedness>** ◎Putting in place a system to monitor debris flows and others ◎putting in place a flood forecasting and warning system ◎Constructing shelters and other refuge facilities ◎Constructing refuge roads or at least raising their ground levels △Raising the ground levels and boosting water resistance of existing buildings and structures ○Procuring flood-fighting equipment **<Promoting community development and community preparedness>** ○Community development and livelihood improvement by taking advantage of secondary benefits of flood control structures △Changing to farming that can better cope with disasters **<Reconstructing disaster-affected communities>** ○Implementing a social development program to provide relief to disaster victims ○Land and infrastructure development for relocation and resettlement

Development Objectives Chart for Water Resources (4)

Development Objectives	Mid-term Objectives	Sub-goals of Mid-term Objectives	Examples of Activities
3. Improving Flood Control to Protect Lives and Properties	**3-2 Strengthening Erosion and Sediment Control for Debris Hazards Mitigation**	**Conserving Mountainous Areas and Hill slopes**	◎Afforestation of mountainous areas and hillslopes ◎Putting in place a flood forecasting and warning system; awareness-raising for communities
		Constructing Sabo Structures	◎Constructing sabo dams (weirs for erosion and sediment control), hillside works, training levees, channel works and others ○Constructing sand pockets ○Terracing on mountainous areas and hillslopes ○Landslide prevention with anchors
	3-3 Promoting Flood Mitigation	**Controlling the Flood Runoff Flowing Into Rivers**	◎Promoting afforestation in the river basin ◎Conserving green areas, forests, etc. under land use regulations ○Installing rainwater percolation facilities ○Installing rainwater storage facility for each household ○Constructing disaster prevention ponds ○Establishing forest or grass belts to retard water flows
		Leveling River Discharges	○Improving rules for operating flood control dams ○Constructing and expanding flood control dams ○Constructing and conserving retarding basins ○Restoring the capacity of existing dams by sediment dredging
		Reinforcing and Protecting Dikes for Flood Control	◎Reducing the failure risk with dike reinforcement ◎Bank erosion control with spur kikes, revetments, fascine mattresses, etc. ○Constructing levee roads (roads which also serve as levees with their embankments) △Constructing ring levees to protect settlements and other important entities △Constructing local levees to protect areas of special importance ×Change the river route to detour an area where population and wealth are concentrated
		Boosting the River Discharge Capacity	○Developing design guidelines for structures in or over river channels, such as weirs and bridges ○Securing appropriate uses of riverbeds ○River improvement works (including river channel widening) and dike construction ○Raising ground levels of existing dikes ○Constructing floodways designed to divert floodwaters directly to the sea ○Constructing short cuts to replace tortuous channels ◎Putting in place pumps and pumping stations ○Dredging and excavating riverbeds
		Boosting the Rainwater Drainage Capacity	○Improving solid waster collection systems to deter the dumping of such waste into drains ○Cleaning and dredging rainwater drains ○Involving communities in cleaning and dredging drains; mounting awareness-raising campaigns to discourage residents from dumping waste into drains ◎Constructing and expanding rainwater drainage systems ○Constructing rainwater storage facilities ◎Installing rainwater drainage pumps ×Installing rainwater percolation facilities
	3-4 Promoting Coastal Protection	**Coastal Erosion Control as Part of Disaster Prevention and National Land Conservation**	△Preventing over development of costal areas under land use regulations; regulating coastal reclamation △Regulating sand and gravel exploitation △Conserving natural beaches ○Conserving mangrove forests, including tree planting ○Conserving coral reefs ○Constructing dikes, seawalls, jetties, offshore breakwaters, etc. ×Beach nourishment
		Protecting lives and properties from storm surges	○Putting in place a flood forecasting and warning system ○Plans to evacuate residents △Conserving natural beaches; regulating land use in coastal areas ○Developing and implementing plans to construct dikes, seawalls, jetties, offshore breakwaters, wave dissipating works, etc. ×Beach nourishment
4. Conserving the Water Environment	**4-1 Improving the Capacity for Water Environmental Management**	**Improving the Implementation Capacity of Government Agencies Concerned**	△Defining the role of each agency and clarifying the chain of command △Establishing a council on environmental conservation in a particular water area ◎Making available equipment for environmental monitoring and analysis ◎Strengthening arrangements for water quality monitoring

Development Objectives Chart for Water Resources (5)

Development Objectives	Mid-term Objectives	Sub-goals of Mid-term Objectives	Examples of Activities
4. Conserving the Water Environment	**4-1 Improving the Capacity for Water Environmental Management**	**HRD for Water Environment Management**	×Enhancing higher education in environmental engineering ◎Improving the capacity to formulate water environment management plans ○Strengthening arrangements for operating and maintaining sewerage services (with focus on business management and maintenance skills, including those in tariff collection) ◎Skill training for human resources at environmental monitoring agencies ○Entrenching tools to feed back the findings of environmental monitoring to policy-making ◎Training in mounting information campaigns for communities
		Raising awareness of environmental issues for communities	◎Providing environmental education on a particular water area for pupils, students and adults △Providing hygiene education on appropriate sewage treatment △Promoting the use of low-cost sanitation facilities for better QOL
		Setting Environmental Standards	△Reviewing related laws and regulations ×Setting environmental standards △Setting limits and guidelines (regarding the optimal water treatment option, emission concentration control, total emission control, nitrogen and phosphorus control, etc.) △**Establishing penalties for non-compliance**
		Implementing Regulations Appropriately	△Developing and applying simulation models for water pollution load △Measuring water quality and quantity; conducting regular environmental monitoring (of water quality and ecosystems) △Developing and implementing systems to identify pollution sources and conduct on-site inspections
	4-2 Developing Wastewater Treatment Facilities	**Phasing in Centralized Wastewater Treatment Systems**	◎Constructing, repairing and expanding wastewater treatment facilities ◎Constructing, repairing and expanding sewer networks ○Installing and operating sludge treatment equipment ×R&D and selection of appropriate technologies
		Installing decentralized sewage treatment systems	△Promoting on-site treatment facilities (household wastewater treatment tanks, VIP latrines, etc.) △**R&D and selection of appropriate technologies**
		Appropriate Treatment of Industrial Wastewater Note: See also Thematic Guidelines on "Pollution Control."	○Promoting water saving (recycling) and cleaner production
	4-3 Promoting Water Environmental Conservation in Public Waters	**Hydrological Cycle Management** Note: See also Thematic Guidelines on "Natural Environmental Conservation."	×Studies on water and material circulation in the whole river basin from the water sources down to the mouth and surrounding coasts ○Developing and implementing plans to conserve forests in water source areas △Restricting development with environmental zoning △Raising public awareness of eco-friendly development and promoting regional development with ecotourism and urban water amenities △Studying and planning to promote the reuse of treated water
		Preventing the Deterioration of Water Quality	△Developing and implementing measures to control the eutrophication of lakes ◎Improving water quality and conserving the functions of public waters, including rivers, waterways and coastal areas ×Assessing — and studying ways to combat — groundwater pollution caused by chemicals and natural materials △Developing and implementing waste management measures as part of water pollution control △Reducing the environmental impact of dams on the water area (by, for example, developing wetland in the surrounding area) △Preventing river water storage structures from blocking the flow of nutrients into rivers

Note 1: "Effective Approaches for Water Resources" can be characterized as the most important development objective other than "Ensuring Efficient and Sustainable Supply of Safe Water," "Improving Flood Control to Protect Lives" and "Properties and Conserving the Water Environment." Thus, all of JICA's activities are expected to contribute to the objective.

◎=when there are more than five cases include the Examples of Activities as project objectives.
→when more than 10 experts and JOCV are dispatched.
○=when there is any project which includes the Examples of Activities as project objectives.
△=when the Examples of Activities are not included as project objectives, but the project includes it as one of elements.
×=when JICA has little experience, or when JICA dispatches only short-term experts or researchers.

Overview of Effective Approaches for Water Resources: Executive Summary

1. Overview of Water Resources

1-1 The State of Water Resources

Water resources are indispensable for human life, which is virtually built on human intervention in the hydrological cycle of the earth. Yet the amount of accessible water per person has been falling as population growth and economic development in recent years have resulted in growing demand for and deteriorating quality of finite water resources.

Although the shrinking supply of water is having the greatest impact on the poor and socially vulnerable in developing countries, it also poses a serious problem for Japan, which imports vast amounts of water resources. Amid the deepening water crisis, water-related problems are now recognized as an urgent issue that should be addressed at the international level. In fact, international efforts to address the issue are on the rise.

1-2 Definition

In general, water resources refer to water as resources for agricultural, industrial (including power generation) and domestic uses (*water utilization*). From the perspective of the hydrological cycle, however, they assume a wider sense to include resources for two other types of concepts: controlling floods caused by rainfall runoffs (*flood control*), and regenerating the water environment (*the environment*). This report adopts the wider sense of water resources and looks at water from four different perspectives: (i) integrated water resources management (IWRM), (ii) water utilization, (iii) flood control, and (iv) the water environment.

1-3 International Trends

International efforts to address the water crisis may date back to 1977, when the United Nations convened the first conference on water in Mar del Plata in Argentina. The conference designated 1981-1990 as the United Nations Decade of Water and Sanitation. During the decade, efforts were made in the world to ensure the supply of safe water and develop sanitation facilities.

Since the 1990s, many efforts have been made at the global level to address the water crisis. In 1992, the International Conference on Water and the Environment in Dublin, Ireland called for immediate action to reverse the trends of overconsumption, pollution, and rising threats from drought and floods. Later in the same year, the United Nations Conference on Environment and Development adopted the Agenda 21 – a global action plan for sustainable development – which took up water as one of the issues to be addressed at the international level. The First World Water Forum (WWF) in 1997 discussed how the international community should address the water crisis. The Second WWF in March 2000 endorsed the World Water Vision. The U.N. General Assembly (UNGA) in September 2000 adopted the Millennium Development Goals (MDGs), which regarded the water crisis as an important development issue. In December 2000, the UNGA proclaimed the year 2003 as the International Year of Freshwater. The Third World Water Forum held in Japan in March 2003 came up with the Portfolio of Water Actions.

Of note, the participation of the private sector in water and wastewater projects has been attracting attention in recent years. There are growing expectations for such participation because these projects require vast amounts of funds.

1-4 Trends in Japan's Assistance

Japan has launched a serious of initiatives to address the water crisis and other global issues. At the 19th United Nations General Assembly Special Session, Japan announced the Initiative for Sustainable Development toward the 21st Century (ISD), which set out Japan's commitment to technical cooperation in the water sector. The Environmental Conservation Initiative for Sustainable Development (EcoISD), a revised version of ISD, added its commitments to support the sustainable supply of safe drinking water and the development of sanitation facilities and further involve NGOs and women. Japan also announced the Initiative for Japan's ODA on Water at the Third Water Forum. This initiative focused on such issues of improving governance, promoting capacity building, meeting the needs for large-scale financing, and addressing many aspects of the water crisis.

The Tokyo Agenda for Action, adopted at the Second Tokyo International Conferences on African Development (TICAD II), has provided a framework for Japan's ODA policies at the regional level. As a result, Japan's aid resources, which tended to concentrate on Asia, have recently been diverted in increasing amounts to Africa and Latin America.

Japan's assistance is moving toward more integrated approaches to encompass non-physical as well as physical infrastructure.

2. Effective Approaches for Water Resources

2-1 Objectives of Assistance in the Water Sector

The deepening water crisis calls for effective development assistance that will mitigate flood and landslide disasters, ensure universal, equitable and sustainable access to the adequate quality and quantity of water, and even conserve and regenerate the water environment. With this in mind, Chapter 2 first considers three issues: (i) the diversity of water issues, (ii) regional peculiarities, and (iii) the presence of diverse stakeholders. Then the chapter sets out four development objectives: (i) Promoting Integrated Water Resources Management, (ii) Ensuring Efficient and Sustainable Supply of Safe Water, (iii) Improving Flood Control to Protect Lives and Properties, and (iv) Conserving the Water Environment.

2-2 Effective Approaches for Water Resources

Development Objective 1: Promoting Integrated Water Resources Management

This objective is cross-sectoral because integrated water resources management (IWRM) is a comprehensive concept that encompasses the focuses of the other three development objectives: water utilization, flood control and the water environment.

Because water projects transcend boundaries between different sectors and government offices, it is necessary to make institutional and legal arrangements toward integrated management. Establishing new laws and revising the existing laws provide an important foundation for institutional building, reviewing the water rate policy, and developing information systems.

Integrated water resources management requires assessing the balance between water supply and demand and then developing an integrated water resources management plan based on such assessment. Efforts should be made to ensure appropriate distribution of water and develop mechanisms designed to involve a wide rage of stakeholders. International rivers, which run through two or more countries, may not be managed effectively without water security and cooperation among these countries.

In other words, integrated water resources management means taking administrative and interdisciplinary approaches to integrate functional, hydrological and ecological aspects of water. JICA's wide range of activities in the water sector is based on this idea.

Development Objective 2: Ensuring Efficient and Sustainable Supply of Safe Water

This objective, which focuses on water utilization, is to ensure sustainable supply of safe water for all. To this end, efforts should be made to secure appropriate amounts of water, and ensure the quality of water (water sources and drinking water) and its equitable distribution.

Securing appropriate amounts of water has two aspects. One is controlling water demand through such means as efficient water use, including water saving, and awareness raising for water consumers. The other is increasing water supplies mainly by developing untapped water resources, including groundwater and surface water, and reviewing traditional water uses.

Ensuring water quality requires not only ensuring water quality at source but also purifying such water resources before using them. In this context, domestic and industrial waste water should be controlled with the establishment of treatment facilities and the introduction of the polluter pays principle. In addition to technology transfer and physical infrastructure assistance, developing water quality master plans and institutional building to that end are both indispensable for ensuring water quality.

To address the inequitable distribution of water and water shortages, it is necessary to develop the legal system in a systematic manner, establish integrated water management organizations and coordination agencies, and develop integrated water resources management plans. The socially vulnerable, whose voice tends to be disregarded by government authorities, should be further encouraged to participate in the decision-making process.

Development Objective 3: Improving Flood Control to Protect Lives and Properties

Flood control is recently shifting its focus from physical measures, including dike construction, toward integrated approaches that also cover non-physical measures. Behind this trend are two factors. One is a growing recognition that the problem-solving capacity of physical measures is limited. Other is increasing emphasis on environmental conservation.

Four mid-term objectives for this development objective involve: (i) institutional building for disaster preparedness, (ii) landslide disaster mitigation, (iii) flood mitigation, and (iv) coastal protection. For the first mid-term objective, clear distinction of roles among different organizations, along with clear liaison arrangements and chain of command in case of emergency, is important to promptly respond to floods and other disasters. For second and third objectives, emphasis is place on non-physical measures as well as structures such as sabo (erosion and sediment control) structures and dams. Non-physical measures includes flood forecasting and warning systems, as well as extensive runoff control as highlighted by river basin management and integrated flood control. For the fourth objective, measures against coastal erosion and high-tides are identified. Broad-based approaches that cover mountainous regions, rivers and costal regions are required for this objective.

For Development Objective 3 as a whole, physical measures involve flood control planning that pays adequate attention to its impact on the living environment for local communities and on the local natural environment. Non-physical measures involve community-based initiatives that emphasize disaster-prevention activities by residents in the basin and their capacity building in this regard.

Development Objective 4: Conserving the Water Environment

This development objective revolves around the conservation of the natural environment and the improvement of the sanitary environment. Development assistance is increasingly required to shift from one-off approaches to integrated approaches that accommodate the hydrological cycle, that is, approaches of integrated water resources management designed to make good use of finite water resources and promote sustainable development.

Building the capacity for managing the water environment involves a series of activities. Among such activities are developing relevant laws, setting environmental standards, environmental monitoring, taking appropriate measures against pollution, and awareness-raising. In particular, monitoring results should be fed back to authorities and put to good use for conserving the local living environment and eco systems. Efforts should be made to set attainable environmental standards.

Waste water treatment facilities should be designed to accommodate local conditions, including population density, technical levels, financing and land use. It is especially important to accurately assess the local capacity for operating and maintaining these facilities, with consideration given to different conditions between urban and rural areas.

In consideration of the hydrological cycle, water quality conservation of public waters constitutes another mid-term objective. In developing countries, point sources of pollution should be addressed first. At these points, pollutants, causes of pollution and pollution loads should be assessed to develop specific antipollution measures. Then the roles of local communities, industry and government should be defined. Middle- to long-term assistance is needed to cover these processes. In addition, cross-sectoral approaches are required to conserve not only the water environment but also the natural environment as a whole.

3. JICA's Cooperation Policy

3-1 JICA's Priorities and Points of Concern

At the Third World Water Forum held in Japan in 2003, participating countries have recognized the importance of integrated approaches that involve water governance, capacity building and financing. Japan, which has accumulated experience in the water sector through rapid modernization after World War II, has a prominent role to play in development assistance in this sector. In forming development programs and projects in water, Japan needs to take account of the Millennium Development Goals (MDGs), integrated water resources management (IWRM) and public-private partnership (PPP).

In the water sector, which is attracting attention at home and abroad, JICA has committed itself to give priority to four objectives: (i) promoting integrated water resources management, (ii) ensuring efficient and sustainable supply of safe water, (iii) improving flood control to protect lives and properties, and (iv) conserving the environment by improving water quality.

To achieve these objectives, JICA will promote six types of approaches as shown below:

1) Program approach

Shifting from the traditional, one-off approaches in the water sector to program approaches, which are holistic in nature.

2) Capacity building

Making institutional and legal arrangements, developing information systems, and promoting interagency approaches at the central government; participatory approaches that involve local communities, women and the poor at the rural level.

3) Coordination with financial assistance

In preliminary surveys, which play an important role in project implementation, close coordination with other stakeholders is needed at an early stage to ensure that projects are implemented promptly and effectively.

4) Accommodating local conditions

Making good use of local human resources and adequately respecting natural and socioeconomic conditions in the area.

5) Taking advantage of Japan's experience

Reviewing the expertise Japan has accumulated in the water sector and examining which part of its expertise can be applied to recipient countries.

6) Environmental and social considerations

Taking more systematic approaches under the JICA Guidelines for Environmental and Social Considerations to be established during 2004.

3-2 Future Issues to be Examined

Problems involving international rivers and other waters that transcend national borders are important issues, but they are traditionally low on the agenda as many obstacles must be removed before solving them. In the future, Japan should address these problems under its regional strategies.

Amid the growing participation of private capital in water projects, Japan should explore ways to take advantage of public-private partnership (PPP) while ensuring sustainable supply of safe water and equitable and appropriate distribution of water resources.

Chapter 1 Overview of Water Resources

This chapter summarizes the state of affairs and aid trends surrounding water issues before discussing effective approaches to address them.

1-1 The State of Water Resources

1-1-1 Water: Finite Resource

Water: finite resource

Of all the water resources on the earth, those available to humans are quite limited.

Of the world's water resources, those available for human use are quite limited. Scientists estimate the total volume of water on earth at some 1.4 billion cubic kilometers, of which sea water accounts for 97.5 percent and fresh water for the remaining 2.5 percent. Because most of the fresh water is held in the polar ice caps and glaciers, the remaining fresh water – including groundwater, river water and lake water – represents only 0.8 percent of the world's fresh water. Moreover, the volume of fresh water accessible for human use, that is, river water and lake water, is estimated at about 0.1 million cubic kilometers, making up a mere 0.01 percent of all water on earth. If all of the earth's water filled one bathtub, the fresh water accessible for human use would be equivalent to only one drop[1].

1-1-2 Deteriorating Water Problems

Deteriorating water problems

Problems associated with water resources are becoming worse and more diversified in the world due mainly to rapid population growth and economic.

Water shortages, floods, water pollution, and other problems associated with precious water resources are becoming worse and more diversified in the world due mainly to rapid population growth and economic development. Above all, developing countries, and especially the socially vulnerable in those countries, including the poor and children, are most affected. Demand for water resources associated with population growth has soared. For the past half a century, total water consumption in the world has grown at a rate more than twice as fast as growth in the world population[2]. At present, water shortages affect one in three people around the world, and more than a billion people have no access to safe drinking water[3]. Moreover, some 80 percent of the diseases in the developing world are caused by polluted water, and one child dies of a water-related disease every eight seconds[4]. Furthermore,

[1] Secretariat of the 3rd World Water Forum, ed. Sekai no Mizu to Nihon [World Water and Japan] (in Japanese). Tokyo: TRANS ART, 2002.
[2] *ibid.*
[3] JICA's Approach in Water Sectors announced at the 3rd World Water Forum.
[4] Secretariat of the 3rd World Water Forum, ed. op. cit.

many of the problems related to water resources, including floods and food shortages stemming from unequal distribution of water resources, are occurring in developing countries.

Japan relies heavily on world water resources

The world's water crisis is a major challenge for Japan, which imports vast amounts of water from around the world for its consumption.

1-1-3 Japan Relies Heavily on World Water Resources

The world's water crisis is a vital issue for Japan's national security. Japan imports vast amounts of water from around the world for its consumption – if water used to produce agricultural and industrial products (which is called "virtual water") as well as visible water (e.g., mineral water for drinking) is included. Should Japan produce these products domestically, it would need more than 40 billion cubic meters of water per year. This translates into the total domestic water consumption for 350 million people or three times as many as Japan's total population; domestic water consumption per person in Japan is 323 liters a day[5]. Japan will face a serious challenge if these imports are threatened by the deepening water crisis in the world.

Growing international efforts

The rapidly deteriorating water crisis has prompted international efforts to address it. As a key executing agency for Japan's ODA, JICA is increasingly required to deliver high-quality programs and projects.

1-1-4 Growing International Efforts

The rapidly deteriorating water crisis has prompted international efforts to address it (see 1-3 International Trends for detail). In March 2003, Japan hosted the Third World Water Forum, which was designed to "translate visions into concrete actions and commitments." At the forum, participating countries adopted a ministerial declaration and the Japan government announced **the Initiative for Japan's ODA on Water**. As this forum shows, water-related problems are increasingly recognized as an urgent issue that should be addressed internationally. As a major donor*, Japan is expected to play a more positive role in the water sector. JICA's international impact is not small. The key executing agency for Japan's ODA has responsibility to deliver more effective programs and projects.

Definition

Water resources refer to water that is regarded as resources. This report takes up as many issues as possible if they are related to any of the four different aspects: integrated water resources management, flood control, water utilization and the water environment.

1-2 Definition

Water resources are generally defined **as water that is considered resources** for agricultural, industrial (including power generation) and domestic uses. The concept is derived from the growing need to coordinate distribution among different uses – especially between industrial and municipal use and agricultural use – and tap new water resources[6]. In this report, water resources also encompass the concept of environmental resources, because it is increasingly recognized that water influences environmental conservation mainly through the hydrological cycle.

[5] Water Resources Department, Land and Water Bureau, Ministry of Land, Infrastructure and Transport (MLIT) ed. (2001)
[6] Iwanami Shoten, *Kojien* (a respected Japanese dictionary).

Based on this definition, **this report focuses on four aspects of water and identifies issues from these aspects for development assistance**. Issues not directly associated with water (e.g., how to combat diseases derived from water pollution) are excluded. These four aspects correspond to four development objectives to be discussed in Chapter 2.

(1) IWRM* (corresponding to the Development Objective of Promoting IWRM)
- Issues concerning integrated water resources management. Specific targets include institutional building, river basin management and international river management.

(2) Water utilization (corresponding to the Development Objective of Ensuring Efficient and Sustainable Supply of Safe Water)
- Issues concerning human use of water resources regardless their sources. Among specific targets are efficient water use, including water saving, water supply, and securing of water sources.

(3) Flood control (corresponding to the Development Objective of Improving Flood Control to Protect Lives and Properties)
- Issues concerning the mitigation of water-related disasters. Specific targets include landslide disaster mitigation, flood mitigation, and coastal protection.

(4) The water environment (corresponding to the Development Objective of Conserving the Water Environment)
- Issues concerning the environmental impact attributable to the nature of water (including the impact on the hydrological cycle) and human intervention in this environmental impact. Specific targets include water quality management and conservation, and waste water treatment.

1-3 International Trends

1-3-1 Early Stages of International Initiatives

Belated international efforts in water

In 1977, the United Nations convened the first conference exclusively on water in **Mar del Plata**, Argentina. The conference designated 1981-1990 as **the United Nations Decade of Water and Sanitation**. During the decade, the U.N. led the world in the supply of safe water and the development of sanitation facilities*.

During the 1980s, the water crisis deepened in the face of inadequate water supply and sanitary facilities development, as well as the rapid population growth.

This initiative, however, met with a major challenge. During the 1980s, developing countries saw their external debts snowball amid rising interest rates and plummeting prices in primary commodities, on which they depended for more than half of their trade income. For this reason, many of the public investment plans for water supply and sanitation facilities* were not implemented as scheduled. To make matters worse, population growth remained

unabated in many developing countries. As a result, the water crisis deepened as described below:

- Deforestation in river basins triggered soil runoffs, threatening water sources.
- Land and water were ill-managed.
- A rapid concentration of the population on cities aggravated water shortages there.
- Water pollution exacerbated the living environment.

1-3-2 Growing Awareness of the Importance of Water

In 1987, the World Commission on Environment and Development, chaired by Norwegian Prime Minister Gro Harlem Brundtland, put forward the concept of sustainable development. The Brundtland Commission referred to the importance of water as a global issue in its report titled "Our Common Future," which caused a sensation in the world.

Four Dublin Principles

It is important that stakeholders at all levels should be involved in the discussion and decision-making processes.

In January 1992, the International Conference on Water and the Environment in Dublin, Ireland called for immediate action to reverse the trends of overconsumption, pollution, and rising threats from drought and floods. The Dublin Conference set out four guiding principles as shown below. These principles have served as a basis for international discussion on water since then.

(1) Fresh water is a finite and vulnerable resource, essential to sustain life, development and the environment.
(2) Water development and management should be based on a participatory approach, involving users, planners and policy-makers at all levels.
(3) Women play a central part in the provision, management and safeguarding of water.
(4) Water has an economic value in all its competing uses and should be recognized as an economic good.

These principles are closely related to the economic, social and environmental aspects of water. The Dublin Conference made clear that stakeholders at all levels should be involved in the discussion and decision-making processes and that dialogue among stakeholders is important as the first step.

Rio Environmental Summit

The need for integrated approaches was widely recognized.

Later in 1992, **the United Nations Conference on Environment and Development** was held in Rio de Janeiro, Brazil. In line with the Dublin Conference, the Rio Environmental Summit discussed water as an issue that should be addressed at the international level. The conference adopted a global action plan, **Agenda 21, which included Chapter 18: Protection of the Quality and Supply of Freshwater Resources: Application of Integrated Approaches to the Development, Management and Use of Water Resource**.

1-3-3 The Establishment of International Networks

Following the Rio Environmental Summit, there was a growing momentum for concentrating international wisdom and experience in a wide range of specialized fields in the water sector in order to put Chapter 18 of Agenda 21 into practice. The World Bank*, the United Nations Development Programme (UNDP), the Swedish International Development Agency (Sida*) and other institutions worked together to set up **the Global Water Partnership (GWP)** in 1996 in Stockholm, Sweden, as a stronger network to address the water crisis. In the same year, multinational institutions, experts, academic societies and others established **the World Water Council (WWC)***, a think tank on water, in Marseilles, France. As advocated by WWC, **the First World Water Forum (WWF)** was held in Marrakesh, Morocco. The First WWF sent a wakeup call to the world about the water crisis in the 21st century.

Three years later in 2000, the Second WWF was held in The Hague, the Netherlands. At this forum, the World Water Vision was endorsed as a vision for world water, life and the environment based on the discussions through international networks in the preparation process. The forum's ministerial conference discussed international cooperation and coordination in the water sector. Then the conference adopted the Hague Declaration, which laid out common understanding about water and participating countries' commitment to address the water crisis.

Target in MDGs:
Halve the proportion of people without access to safe drinking water

1-3-4 Millennium Development Goals (MDGs)* and Water

At the U.N. General Assembly (UNGA), which was convened in September 2000 out of concern that the world was making little headway in poverty reduction, adopted **the Millennium Development Goals (MDGs)**. One of the MDGs involved a target: **"reduce by half the proportion of people without sustainable access to safe drinking water" by 2015**. The UNGA in December 2000 proclaimed the year 2003 as the International Year of Freshwater.

Target in WSSD:
Halve the proportion of people without access to sanitation facilities*

In December 2001, **the International Conference on Freshwater** was held in Bonn, Germany. In preparation for **the World Summit on Sustainable Development (WSSD)*** the next year, the conference discussed water issues with focus on sustainable development.

In August 2002, the World Summit on Sustainable Development (WSSD) was held in August 2002 in Johannesburg, South Africa. In light of the discussions up to then, **the Plan of Implementation announced at the WSSD incorporated the target of halving the proportion of people without access to basic sanitation by the year 2015. This target was designed to work in pairs with the MDG target on safe drinking water mentioned above.**

1-3-5 Third WWF – a Participatory International Conference – and Beyond

Building on the outcomes of the water initiatives up to then, the World Water Council organized **the Third World Water Forum**, which was held in March 2003 in the Lake Biwa and Yodo River Basin, Japan. More than 24,000 people from Japan and other countries participated in this action-oriented conference. Products of the international conference included: the Ministerial Declaration, a document agreed on by participating countries and multinational organizations; and the Portfolio of Water Actions, a list of voluntary actions by participating countries and multinational organizations.

Water - A G8 Action Plan
1. Promoting good governance
2. Utilizing all financial resources
3. Building infrastructure by empowering local authorities and communities
4. Strengthening monitoring, assessment and research
5. Reinforcing engagement of international organizations

In light of the importance of the water sector and action-oriented approaches reconfirmed at the Third WWF, the heads of eight major industrialized countries announced a statement titled "Water - A G8 Action Plan" at the June 2003 Summit in Evian, France. Building on the outcomes of the Third WWF and other forums, G8 committed themselves to play a more active role in achieving development objectives in the water sector.

To address the water crisis, it is hoped that governments and multinational institutions will continue their efforts to put in practice the past declarations and the Portfolio of Water Actions. It is also hoped that networks to promote such efforts will be developed.

PPP in water and wastewater projects

1-3-6 The Private Sector's Participation in Water Projects and its Concern

It should be noted that public-private partnership (PPP)* – which covers a range of concepts, including contracting out work to private companies, privatization, transformation into independent administrative institutions, and private finance initiative (PFI)* – in water and waste water projects has been promoted internationally since the 1990s both in developing or developed countries. At present, major actors in the privatization of the water sector are water companies of the U.K., France, Germany, the U.S. and other countries in which have acquired a lot of expertise their own. These companies are proactively operating in both developing and developed countries in the form of consortiums with financial institutions and local water-related companies.

Points of concern about private participation
1. Water rates may soar.
2. The poor may be disregarded.
3. Water supply may become unstable.

Although PPP has advantages in terms of more efficient operation and better service, it – especially privatization – has caused problems in some developing countries. It is often the case that soaring water rates restrict people's access to water and that poverty areas are disregarded altogether.

Still, experts agree that the participation of the private sector is inevitable, given the fact that international development goals in the water and waste water sector cannot be achieved without vast amounts of funds. It is expected that more and more information will be obtained in the future regarding such aspects as: the pluses and minuses of PPP, how to minimize the minuses, criteria to

Table 1-1 Selected International Conferences, Initiatives, etc. Regarding Water

Year	International Conferences, etc.	Japan's initiatives
1977	U.N. Water Conference (Mar del Plata)	
1981～90	U.N. Decade of Water and Sanitation	
1992	International Conference on Water and the Environment (Dublin) U.N. Conference on Environment and Development (Rio de Janeiro)	
1997	First WWF (Marrakesh)	19th UNGA Special Session ISD
1998		TICAD II "Tokyo Agenda for Action"
1999		"Japan's Medium-Term Policy on ODA"
2000	Second WWF (The Hague) U.N. Millennium Summit* (New York) Reduce by half the proportion of people without sustainable access to safe drinking water.	
2002	WSSD (Johannesburg) Reduce by half the proportion of people without access to appropriate basic sanitation by the year 2015.	WSSD ISD was transformed into EcoISD Japan-U.S. Initiative "Clean Water for People"
2003	Third WWF (Kyoto, Osaka and Shiga) G8 Summit (Evian)	Third WWF "Initiative for Japan's ODA on Water" "Japan-France Water Sector Cooperation"

judge whether PPP is effective in a particular country or local authority, and factors that determine the best mix of public and private participation. In fact, such a trend is already emerging and closely watched today. (See Chapter 2, 2-2 Mid-term Objectives, 1-1 (2))

1-4 Trends in Japan's Assistance

1-4-1 Major Trends in Japan's ODA Policies

Japan's ODA policies announced at international conference

(1) ODA policies of the Japanese government and JICA announced at international conferences

Japan announced its ODA policies at the 19th UNGA Special Session, TICAD, WSSD, Third WWF and other occasions.

At the 19th United Nations General Assembly Special Session, Japan announced **the Initiative for Sustainable Development toward the 21st Century (ISD)**. Regarding water issues, ISD set out Japan's commitment to extending assistance to developing countries in the area of water supply and sewage systems, water quality conservation, and technical cooperation through community participation based on Japan's experience in promoting water users' committees.

Japan's Medium-Term Policy on Official Development Assistance, announced in 1999, referred to water resources in two priority issues of "Support for Poverty Alleviation Programs and Social Development" and "Support for Economic and Social Infrastructure.*" In relation to social development, the

medium-term policy said: “As access to safe water constitutes a vital element in supporting human health, the scarcity of water resources could conceivably result in increased tensions in the future. For this reason, assistance for water resource development and the management and use of existing water resources has become increasingly important.” In the context of economic and social infrastructure*, the policy said that Japan will continue to extend assistance in electric power generation, and river and irrigation facilities.

At **the World Summit on Sustainable Development (WSSD)*** in 2002, Japan announced the Environmental Conservation Initiative for Sustainable Development (EcoISD), a revised version of ISD of 1997. Aside from “support the sustainable supply of safe drinking water and the development of sanitary sewerage systems,” Eco ISD emphasized “collaboration with NGOs” and “taking into account the important role of women.” At the WSSD, Japan also announced the Japan-U.S. Clean Water for People Initiative, which was designed to strengthen coordination between the two countries in the water and sanitation sectors.

At **the Third Water Forum** in March 2003, Japan announced **the Initiative for Japan’s ODA on Water**. This initiative said that addressing the water problems demands improving governance, building capacity*, recognizing the importance of financing, and promoting integrated approaches. Based on this recognition, the initiative expressed Japan’s resolve to focus on: (i) providing drinking water and sanitation to poor countries and regions; (ii) addressing the needs to provide large-scale financing to urban areas; and (iii) assisting capacity building*.

In preparation for the Third World Water Forum, JICA established in February 2002 the Study Group on Development Assistance in Water Sectors. Based on the recommendations by the group, JICA identified four guiding principles of **JICA’s basic policy on water:** (i) ensuring sustainable supply of safe water, (ii) promoting integrated water resources management, (iii) conserving the environment by improving water quality, and (iv) securing food through appropriate water use. JICA announced this policy at the Third WWF.

In order to promote collaboration with international community, Japan also set out the initiative **“Japan-France Water Sector Cooperation”** at the Third WWF, following the Japan-U.S. Clean Water for People Initiative the previous year.

As a regional approach, Japan hosted a total of three **Tokyo International Conferences on African Development (TICAD I, II and III)** in 1993, 1998 and 2003. **The Tokyo Agenda for Action**, adopted at TICAD II, set out – in the section on health and population – the goal of providing access to safe water supply and sanitation for at least 80 percent of the population by 2005. At the TICAD III in 2003, a key item of human-centered development, one of the priority areas for Africa, was defined as cooperation for water resource

management* by emphasizing community-level ownership* and responsibility, and at major river basins, etc.

ODA policies and initiatives by government agencies concerned

Government agencies that play a proactive role in development aid include MOFA, JICA, JBIC, MHLW, MLIT, MAFF, METI and MOE.

(2) Initiatives by government agencies concerned

In line with these trends in Japan's ODA policies, the Ministry of Foreign Affairs (MOFA), JICA and the Japan Bank for International Cooperation (JBIC)* have been in charge of a significant portion of Japan's ODA in the water sector. Yet other government agencies also have their own aid policies and initiatives, as this sector involves a range of government agencies.

The Ministry of Health, Labour and Welfare (MHLW), which is responsible for the water supply sector, has its own ODA guidelines on water supply. The gist of the guidelines is: (i) promoting international cooperation based on shared understanding in the world (putting quality before quantity); (ii) promoting area-specific approaches (with focus on neighboring countries in Asia); (iii) concentrating resources on priority issues (arsenic and other pollution problems, water leakage*); (iv) ensuring consistency; (v) adopting multiple approaches (policy support, community participation, coordination with other sectors, cooperation with local authorities and NGOs); (vi) shifting from physical to non-physical infrastructure (ensuring sustainability with focus on the operational, maintenance and management aspects); (vii) conducting project evaluation with a view to promoting self-sustaining development; (viii) improving institutional arrangements in Japan; and (ix) building the knowledge-disseminating capacity.

The Ministry of Land, Infrastructure and Transport (MLIT) supports the **International Flood Network (IFNet)**, which was launched at the Third World Water Forum in 2003. IFNet is designed to facilitate international cooperation in mitigating flood hazards. Specifically, MLIT is involved in the Global Flood Alert System (GFAS) project. At the Third WWF, the River Bureau of MLIT has committed itself to support inland waterway transport (IWT) activities that may help invigorate communities and cities. In addition, the Ministry of Agriculture, Forestry and Fisheries (MAFF) extends assistance in irrigation, the Ministry of Economy, Trade and Industry (METI) in hydroelectric power generation, and industrial water and waste water, and the Ministry of the Environment (MOE) in environmental aspects of water.

Trends in ODA policies

(3) Overview of trends in Japan's assistance

An overview of these trends in Japan's ODA policies shows that supply of safe drinking water has remained a centerpiece of these policies over the years. A noticeable change is that integrated water resources management (IWRM) has recently been playing a central role in Japan's ODA policies on water as an effective assistance approach. Calls for broad-based and effective IWRM have been mounting as the water crisis is deepening and increasing in complexity due

- From narrow-based infrastructural development to integrated approaches.
- From physical to non-physical infrastructure development.

to rapid socioeconomic changes, which were caused by population growth, urbanization, industrialization and excessive agricultural development on a global scale. For example, support for drinking water supply is increasingly required to encompass a range of aspects – including policy support and cross-sectoral coordination – rather than focusing on the development of physical infrastructure such as water supply facilities.

Another major trend is that aid projects have recently been shifting in focus from physical to non-physical infrastructure. Traditional aid policies that focused on physical infrastructure have been increasingly replaced over the years by those that incorporate, in consideration of sustainability, a range of approaches – including coordination with NGOs, gender mainstreaming*, governance enhancement, capacity building*, and community-level ownership*.

1-4-2 The Present Situation in Japan's Assistance

(1) Overview

Japan's ODA has traditionally given priority to water sectors. For the period of three years (FY1999-2001), Japan provided a total of over 650 billion yen (about 5.7 billion dollars) in ODA for these sectors. Japan's ODA for drinking water and sanitation, a sector for which development targets have been set in MDGs and WSSD, amounted to around one billion dollars for the same period, accounting for one third of the total ODA in the world (some three billion dollars). This made Japan the biggest donor* in this sector among donor countries and multinational organizations.

(2) Trends by region

Asia accounts for more than 70 percent of the countries that receive yen loans. In terms of grant aid, Asia represents about 40 percent, followed by Africa with 33 percent. Asia also takes up a great portion of Japan's technical cooperation, but the proportions of Africa and Latin America are on the rise.

(3) Trends by sector

As far as yen loans are concerned, the proportions of hydroelectric power generation and irrigation/drainage have both decreased while that of water supply and sewerage systems has increased over the past ten years. Water supply and sewerage systems account for 70 percent of the total grant aid. Within technical cooperation, trainees from developing countries in environment-related sectors are increasing in number. In project-type technical cooperation, multi-purpose projects and integrated projects involving rural development and other sectors are both on the rise.

(4) Trends by scheme

Of JICA's cooperation schemes in water sectors, development studies have always accounted for around 60 percent, followed by grant aid. In recent years, however, the proportion of project-type technical cooperation has been increasing. By region, development studies represent a great portion for Asia, Latin America and Middle East, and so does grant aid for Africa.

Chapter 2 Effective Approaches for Water Resources

This chapter identifies the development objectives in the water sector and approaches to achieve them. (These objectives and approaches are identified for aid agencies in general, rather than for JICA only.)

2-1 Objectives of Cooperation in Water Resources

The Need for Cooperation in Water Resources

2-1-1 The Need for Cooperation in Water Resources

Water is vital for human life. It is necessary to ensure sustainable and equitable supply of adequate quantity and quality of water for all. In reality, however, many people are suffering from insufficient supplies of water. The water crisis is rapidly deepening in other aspects as well, including floods, food shortages derived from inequitable water allocation, and occurrences and high death rates of communicable diseases caused by polluted drinking water. This has promoted the international community to take action. Expectations are high for active involvement of Japan as a big importer of water and a key donor*. As a key deliverer of Japan's international cooperation, JICA is required to take more effective approaches to the water crisis.

The deepening water crisis requires more effective approaches.

Considerations for Effective Approaches

2-1-2 Considerations for Effective Approaches

Effective approaches for water resources makes it necessary to consider the following points in light of the characteristics of water resources and lessons JICA has learned in this sector.

The necessary considerations for effective approaches include:
(1) Diversity of water issues
(2) Regional characteristics
(3) Presence of diverse stakeholders

(1) Diversity of Water Issues

Water is essential for sustaining life. It is closely associated with the natural environment (the climate, ecosystems, vegetation, etc.). The availability of water greatly affects industry. For these reasons, issues stemming from water resources are quite diverse. In addition, growing globalization in the socioeconomic aspect has given rise to new (or hitherto not serious) problems (e.g., concern about the adverse effects of commercialization of water resources on the poor). Under these circumstances, it may be impossible to take effective action without multidimensional perspectives and integrated approaches.

(2) Regional Characteristics

Availability of water resources greatly depends on the climate and geographical conditions such as topographical and geological features in a

particular region. Water sources used (or polluted) in the region include surface water* in the form of as rivers, lakes, ponds and others, groundwater including springwater, and rainwater. These water sources are used differently depending on the culture, history and lifestyles in the region. It is necessary to use more than one water sources according to local conditions.

(3) Presence of Diverse Stakeholders

Water is equally indispensable for all. In reality, however, water brings benefits to some people and hazards to others. In other words, water is often used inequitably (unequally) in the same water area due to such factors as gender disparity, caste, ethnicity, class, and poverty. In addition, it is often the case that a wide range of different stakeholders are involved in one water area, including a number of government agencies, local authorities, local communities, and NGOs. In such a case, effective outcomes may not be expected without systematic arrangements for cooperation and coordination among these stakeholders.

Framework of the Approach Based on Considerations

2-1-3 Framework of the Approach Based on Considerations

Taking the considerations discussed above into account, the objectives and targets have been established and thus developed the Development Objectives Chart based on the following two policies:

(1) Characterize the objective of Promoting Integrated Water Resources Management as the most important and comprehensive development objective in order to better address the water crisis, which is becoming more serious and complex.
(2) Include even objectives and targets that are considered important but not covered by JICA in the Chart in order to provide a more complete view of the various issues associated with water resources (see 1-2 Definition for the extent of coverage in this paper).

Four Development Objectives
1. Promoting Integrated Water Resources Management
2. Ensuring Efficient and Sustainable Supply of Safe Water
3. Improving Flood Control to Protect Lives and Properties
4. Conserving the Water Environment

Based on these two policies, four development objectives have been identified: (i) Promoting Integrated Water Resources Management*, (ii) Ensuring Efficient and Sustainable Supply of Safe Water, (iii) Improving Flood Control to Protect Lives and Properties, and (iv) Conserving the Water Environment (details of these objectives are discussed later). To illustrate the relationship between the first objective with the three others, the former is positioned above the latter three and partitioning between them is with a dotted line in the Chart on P.v note that, each Development Objective (higher-order objective) is broken down to Mid-term Objectives (middle-order objectives), which are further divided into Targets in Mid-term Objectives (lower-order

objectives).

2-2 Effective Approaches for Water Resources

Development Objective 1:
Promoting Integrated Water Resources Management

Development Objective 1: Promoting Integrated Water Resources Management

Integrated water resources management (IWRM)* is the overall, cross-sectoral objective that is most important of all. In other words, IWRM integrates the other development objectives: (ii) Ensuring Efficient and Sustainable Supply of Safe Water, (iii) Improving Flood Control to Protect Lives and Properties, and (iv) Conserving the Water Environment. IWRM* is made possible by taking administrative and interdisciplinary approaches to integrate functional, hydrological and ecological aspects of water resources management in a defined geological area[7]. In this report, the term IWRM is used in a broad sense and encompasses water utilization, flood control and the water environment as well.

Mid-term Objective 1-1:
Institutional Strengthening to Promote IWRM

Mid-term Objective 1-1: Institutional Strengthening to Promote IWRM

(1) Institutional Strengthening for Unified Management of Water Resources

Institutional strengthening for unified management of water resources should be approached from two aspects: the development of organizational function and the development of the underlying legal system.

Unified management of water resources requires the development of organizational and legal structures.

On the organizational aspect, it is important to improve the capacity to coordinate different organizations involved in water resources management. A viable option may be to define the role of each organization and put in place a mechanism to systematically exchange information among different organizations; cross-sectoral coordination at the river basin level often hold a key. Such a mechanism should be designed to accommodate local conditions. Experience in developing countries suggests that a particular water project often involves a number of government agencies and that a particular river basin often covers a number of local authorities. Some developing countries have an organization aimed at unified management of water resources at the national level. However, only a few of such organizations are working properly despite the efforts being made to improve them. Likewise, only a small number of rivers have a river basin management organization.

The water pricing policy should be designed to ensure cost-recovery and at the same time accommodate the ability of users to pay and the levels of services.

As to the legal aspect, an appropriate legal system should be developed to ensure that river basin plans, relevant organization and necessary information

[7] Institute for International Cooperation, JICA (2002)

systems will be developed properly. Development intervention as to the choice of an appropriate legal system, which involves legal techniques, takes the form of discussion or consultation with legal experts and policymakers in a particular recipient country. It is important that a donor should suggest a legal system that is acceptable for the local society in light of the existing legal system. The following two points should be considered in extending support in legal system development:

1) How to characterize the legal structure (in relation to: respect for customary law, the sharing of the idea of communal ownership of water rights*, the recognition of groundwater as a shared resource, and the user-pays principle)
2) How to facilitate the operation the legal structure (e.g., developing human resources, and keeping operational records with the help of database etc.)

(2) Financial Improvement and Private Sector Participation

Water pricing policy should be based on the user-pays principle. Yet determining how much users should pay, especially accurately assessing poor people's ability and willingness to pay, constitutes a key factor. An appropriate pricing policy, if implemented, makes it possible to cover the cost of operating, maintaining and even investing water facilities through cost recovery, so that sustainable operation of such facilities is ensured. An appropriate pricing policy also encourages users to save water. Service levels and additional costs of preventing water theft and other problems should also be considered in setting water prices.

Recent years have seen marked private sector participation in water sector. Advocates say private participation is necessary to fill a financial void with private funds and improve operational efficiency with management expertise of the private sector. Opponents say that private participation has resulted in higher water prices and that the private sector is reluctant to extend services to poor areas. The governments of developing countries often lack the capacity to closely monitor and supervise private participation, which takes many forms. In promoting such participation, donors need to help recipient countries to develop the legal system, institutional framework and human resources with special emphasis on expertise in contracts and monitoring arrangements. They also need to provide support so that recipient countries can accurately assess costs and revenues in relation to water programs and projects.

(3) Information System Development and Information Disclosure

Appropriate management of relevant information and its effective use are key to integrated water resources management. Specifically, it is important to develop a system to collect and provide (disclose) a wide range of information on rivers and their basins. Such a system, if operated properly, also helps

agencies and local communities concerned to work together toward proper river basin management. Disclosing and sharing collected data and other information is significant in that it provides opportunities for discussion bases on common understanding, encourages wider participation, and promotes confidence building among different stakeholders.

JICA's Activities:
JICA offers support in organizational and legal structures and technical advisors for recipient countries. It also implements projects focusing on capacity development.

JICA's Activities

JICA offers recommendations on organizational and legal system through development studies and sends experts to recipient countries as policy advisors. It also implements projects focusing on capacity development.

JICA has suggested reform of water authorities and the establishment of river basin water resources management committees in some of its development studies. In its "Improvement of the Water Rights" in China, JICA plans to offer support in developing systems regarding water rights and water markets.

At the Water Resources Information Center in Syria, JICA provides support in developing a system to mange water resources information. Also, JICA is engaged in the development of human resources in observational and data processing skills as well as in observation planning.

Mid-term Objective 1-2:
Promoting River Basin Management

Mid-term Objective 1-2: Promoting River Basin Management

(1) Water Resources Assessment and IWRM Planning

IWRM planning is needed at the river basin level. Important considerations for such planning include equitable allocation of water and mechanisms to encourage wide participation of stakeholders.

IWRM at the river basin level requires IWRM planning. Yet many developing countries are facing many challenges in terms of experience, human resources and finances; they have difficulty making progress in this sector without external assistance. Assistance in this sector primarily focuses on IWRM planning, and through such planning, basin development and management policies are identified and coordinating mechanisms are developed. The first step to IWRM planning is to collect data to assess the balance between water supply and demand more accurately.

It is significant for Japan to promote its assistance in this sector for two main reasons. One is that it will help mitigate the water crisis in the developing world. The other is that it will help to prioritize a number of projects in a particular river basin, which will result in more effective assistance from Japan.

Through planning, organizing policy for River basin development and management and developing coordination mechanism will be done at the same time. The implementation of IWRM plans need capacity building in recipient countries.

Attention should be paid to ensure that the scale of a water project will not become too large in the name of integrated management. For each project, aid resources should be allocated to the area, sectors and coordinating mechanism that have been given priority in light of local conditions.

(2) Appropriate Water Allocation

As to water allocation, the first priority should be given to equitability. To this end, it is important to ensure that the coordinating mechanism works properly. Important considerations for such a mechanism are as follows:

•Securing and Allocating Available Water

In general, the less water is available, the more difficult it is to allocate the water appropriately. The first step is to access the amount of available water. Then water resources development and effective water use should be explored in terms of appropriate allocation of water.

•Ensuring equitability

In allocating limited water resources equitably, respect should be paid to the community-rooted concept of equity, which is based, in large part, on social climate, culture and tradition. Adequate consideration should be given to local customary water use and traditional organizations of water users. In addition, organizational and legal system should be developed.

The shares of funds for development and operation will be determined based on water allocation.

•Providing a Mechanism for Participation

Participation should be encouraged at all levels. Support should also be given for the formation of partnership among the government, the private sector, NGOs and communities and for the empowerment* of communities. These efforts play an important role in strengthening ownership*.

Other requirements include fuller stakeholder analysis, participation at the planning stage, more shared responsibility among stakeholders, and more clearly defined division of labor among them.

(3) Selecting the Tool for Integrated Water Resources Development

Tools for integrated water resources development which are designed to draw on above-mentioned planning and allocation can be largely divided into two types: tools that span subsectors directly associated with water and those that straddle between the water sector and other related sector. Among example of the latter type are: interaction and collaboration between water source areas and downstream beneficiary areas, coordination between flood control projects and urban or housing development projects, forest conservation aimed at conserving water sources, and soil saving and erosion control projects.

In water resources development projects, consideration should be given to such factors as the environment, involuntary resettlement, ethnic minorities, gender, poverty, and community participation. JICA and JBIC have guidelines on environmental and social considerations. Other donors also have similar

procedures in place.

It is important to take environmental and social considerations in to account and conduct cost-benefit analysis as preconditions especially for constructing a large-scale facility for water resources development that have major environmental and social impacts. In this regard, the Report of the World Commission on Dams (2000) provides suggestions worth noting. Reviewing the past dam development, the report says: "Dams have made an important and significant contribution to human development, and the benefits derived from them have been considerable. In too many cases an unacceptable and often unnecessary price has been paid to secure those benefits, especially in social and environmental terms, by people displaced, by communities downstream, by taxpayers and by the natural environment." Then the report puts forward: (i) criteria and guidelines for the planning, design, construction, operation and decommissioning of large dams, and (ii) frameworks for options assessment and decision-making regarding water and energy resources development.

(For more efficient use of water, see Mid-term Objective 2-1: Controlling Water Demands)

(4) Conserving Water Sources

Forest conservation is important from the aspect of river basin management as well as other aspects. In developing countries, forest departments sometimes have river basin management plans in place.

Because excessive pumping of groundwater may result in land subsidence, it may be necessary to restrict such pumping as part of groundwater basin management and to change the water source.

For water quality conservation, refer to Development Objective 4.

JICA's Activities:
JICA offers support in planning water resources development and management mainly in its development studies.

JICA's Activities

Through development studies, JICA supports the assessment of local conditions in a recipient country, and then, based on that assessment, basic policy planning, supply and demand prediction, and development and management planning.

Some of JICA's development studies have suggested conducting opinion surveys on the residents or form a group in charge of community participation within a water authority.

An example of such studies is the Study on the Comprehensive Management Plan for the Water Resources of the Brantas River Basin in the Republic of Indonesia. In its final report in 1998, JICA formulated an IWRM master plan, which included monitoring arrangements, a water use plan and institutional building.

Mid-term Objective 1-3:
Effective Management of International Rivers

It is vital to establish the concept of water security and foster cooperation among stakeholders involved in the management of international river basins.

Mid-term Objective 1-3: Effective Management of International Rivers

(1) Concept of Water Security

The Hague Declaration, which was announced at the ministerial conference with the Second WWF, endorsed the concept of water security and set out goals and challenges in achieving it. This concept has two aspects. First, there is a need to secure water resources in order to prevent conflicts arising from competition to gain scarce water resources. Second, the issue of national security between countries affects water resources. From these two and other aspects, great importance is placed on the management of international rivers.

(2) Fostering Cooperation among Countries in International River Basins

It is believed that local water conflicts and national security top the agenda for the management of international rivers and basins.

As a code of conduct for river basin countries, the U.N. General Assembly adopted the Convention on the Law of the Non-navigational Uses of International Watercourses in 1997. The U.N. Convention set out equitable and reasonable utilization and participation in respect to an international watercourse as general principles. It stipulates that watercourse states should, in utilizing an international watercourse in their territories, prevent the cause of significant harm to other watercourse states.

Priority should be given to the following kinds of assistance.

•Support at the Low Politics Level

For negotiations and interactions among river basin countries over an international basin, a forum at the working or technical level ("low politics") is often provided in addition to opportunities for consultation at the formal diplomatic level ("high politics"). Japan's aid agencies have to date provided technical and other support in water resources development and management at the low politics. Building on such experience, the aid agencies should continue to offer support at this level.

•Promoting Dialogue

Bilateral donor* agencies should, while maintaining their neutrality, provide opportunities for dialog among stakeholders in river basin countries and thus encourage these countries to deepen their understanding and mutual confidence regarding international river basins for further cooperation.

•Considering Other River Basin Countries in Water Projects

Bilateral aid* agencies, when they engage in a project in an international

basin, should take account of possible harm it may cause to other river basin countries in light of the U.N. Convention on the Law of the Non-navigational Uses of International Watercourses (1997).

•Collecting, disclosure and sharing information

Data collection is one of the sectors for which development assistance has proved to be effective. Disclosure of collected data and other information is important in three main aspects: promoting civil society participation, encouraging donors' assistance to the basin in question, and building mutual confidence among river basin countries. This point is the need to promote disclosure of information in the basin.

JICA's Activities:
JICA has conducted hydrological data analysis and human resources development regarding the international river of Mekong.

JICA's Activities

JICA has supported the Mekong River Commission by sending experts and conducting a study on hydro-meteorological monitoring for water quality rules in the Mekong River Basin. Through these studies, JICA conducted hydrological and meteorological observation and data analysis, as well as human resources development.

Development Objective 1: Promoting Integrated Water Resources Management

Mid-term Objective 1-1 Institutional Strengthening to Promote IWRM			
Sub-goals of Mid-term Objectives	**Examples of Activities**	**Case No.**	**JICA's Main Activities**
Institutional Strengthening for Unified Management of Water Resources	○Creating and developing organizational structures for unified management and those for coordination ○Defining the responsibilities and authorities of government agencies concerned ○Strengthening the capacity to improve coordination among government agencies concerned ○Developing the legal structure for water resources management ○Developing manuals and guidelines for implementing relevant laws ◎Training administrators and engineers	1, 3, 4, 6, 7, 16, 23	• Supporting the development of water rights systems [DS, TCP] • Developing IWRM plans [DS] • Sending policy advisors on water resources management [DE] • Offering recommendations on institution building [DS] • Strengthening water use associations [TCP, DE] • Strengthening the capacity to manage water resources [TCP, AT]
Financial Improvement and Private Sector Participation	○Creating rules for sharing costs ×Taking advantage of private funds ○Expanding the user-based fees and revenue from fees ◎Optimizing budget execution ×Taking advantage of the private sector through privatization and PPP; strengthening supervising arrangements	24	• Supporting the development of water markets [DS]
Information System Development and Information Disclosure	◎Collecting basic information at the river basin level ○Making institutional arrangements to share information among relevant organizations concerned ◎Developing and disclosing statistics ○Providing public access to information; promoting public relations for residents	1, 6	• Promoting water rights system development [TCP]

Mid-term Objective 1-2 Promoting River Basin Management			
Sub-goals of Mid-term Objectives	**Examples of Activities**	**Case No.**	**JICA's Main Activities**
Water Resources Assessment and IWRM Planning	◎Assessing the amounts of available water resources and water demands ○Sharing the basic concept and developing the basic policy of IWRM at the basin level ◎Developing water resources management plans ○Developing implementation plans	1, 4, 16, 18, 23, 68	• Developing IWRM plans [DS] • Supporting water management plans [TCP] • Building the capacity to manage river basins [DE] • Strengthening the river basin management [DE]
Appropriate Water Allocation	○Allocating Available Water ○Developing policies for allocation among sectors and regions ○Participation mechanisms to involve a wide range of stakeholders		
Selecting the Tool for Integrated Water Resources Development	×Developing integrated facility construction plans ◎Developing dams (for multiple use) ○Developing forest conservation plans for water resources cultivation	4	

Mid-term Objective 1-3 Effective Management of International Rivers			
Sub-goals of Mid-term Objectives	**Examples of Activities**	**Case No.**	**JICA's Main Activities**
Fostering Cooperation among Countries in International River Basin	△Promoting dialogue △Supporting international interaction at the working and technical levels ○Considering other river basin countries when developing water projects ○Collecting, disclosure and sharing information ×Creating and strengthening coordinating bodies	6, 7	• Hydrological monitoring plans [DE]

※Case numbers correspond to the numbers in the Annex Table (Project List), Appendix 1.
※TCP: Technical Cooperation Project GA: Grant Aid DS: Development Study LA: Loan Aid DE: Dispatch of Experts
JPP: JICA Partnership Program D/D: Detailed Design Study GT: Group Training JOCV: Japan Overseas Cooperation Volunteers Program

◎=when there are more than five cases include the Examples of Activities as project objectives.
→when more than 10 experts and JOCV are dispatched.
○=when there is any project which includes the Examples of Activities as project objectives.
△=when the Examples of Activities are not included as project objectives, but the project includes it as one of elements.
×=when JICA has little experience, or when JICA dispatches only short-term experts or researchers.

Development Objective 2:
Ensuring Efficient and Sustainable Supply of Safe Water

Necessary Approach:
To ensure sustainable supply of safe water amid deteriorating water shortages, with focus on securing enough water (controlling water demands and increasing water supplies), conserving water quality (both at source and at the tap) and ensuring equitable water allocation.

Development Objective 2: Ensuring Efficient and Sustainable Supply of Safe Water

Humans use water resources in varies ways for sustaining their lives and other purposes. In addition to agricultural, industrial (including power generation), domestic uses (for drinking water and others), water resources are used for environmental conservation, fisheries, leisure, and navigation. **In recent years, however, rapid population growth and economic development have resulted in growing water demand, water pollution and inequitable allocation. This has in turn led to water shortages in many parts of the world**. The effects of climate changes will also become evident, and experts warn that the worsening water situation will further deteriorate and fall into a critical state later in the 21st century.

To ensure sustainable supply of safe water for all **under these circumstance, focus should be placed on three aspects**: securing enough water (controlling water demands and increasing water supplies), conserving water quality (both at source and at the tap) and ensuring equitable water allocation.

The situation in water resources greatly varies from region to region. To accommodate such regional characteristics and thus optimize development assistance, it is important to take many considerations into account and thus select the most effective option in the context of integrated water resources management (IWRM)*.

Mid-term Objective 2-1
Controlling Water Demands

Mid-term Objective 2-1: Controlling Water Demands

Necessary Approach:
Water demands can be controlled by making water uses more efficient, promoting water saving, and raising the awareness of water users.

Water demands can be controlled by **making water uses more efficient, introducing water saving technologies, and raising the awareness of water users.**

A viable option for **making water uses more efficient** is to improve coordination among stakeholders regarding water rights, thus reducing the total water consumption. (For example, the agriculture ministry or a farming association consults with hydroelectric power generators so that discharges from dams occur when demand for irrigation water is high.) To that end, it is desirable to **establish an organization or coordinating system that is designed to ensure unified management of water resources** as part of administrative reorganization. This would facilitate cross-sectoral control of water demands.

In addition, more efficient use of water for the agriculture sector can be achieved by promoting water-saving farming methods and a shift to crops with higher water productivity. Enhancement of the efficiency of irrigation systems and the introduction of small, participatory irrigation schemes are also among the options. Industrial water consumption can be reduced by introducing water recycling technologies.

Among viable options for **water saving** are engineering development improvements,, the wider use of water-saving equipment and the promotion of measures to prevent tap water leakages*. Water-saving equipment includes automatic shut-off faucets, water-saving packing, which limits the water flow, and many other devices. Measures against water leakages can be largely divided into remedial and preemptive ones. The former include detecting leakages (by locating the source of irregular sound in the case of underground leakages, which are often found in developing countries) and repair of the pipes. The latter includes developing leakage prevention plans and replacing distribution and service pipes (with better ones). Locating leakages requires a certain level of experience and expertise. Moreover, fundamental measures against leakages entail a sustainable institutional framework for leak detection and surveying. These requirements point to the essential need for institution building for executing agencies.

The means to **raise the awareness of water users (about water saving)** are not limited to water-saving education of water users and statutory regulations. It is also important to provide economic incentives, such as water

and sewage service charges based on the Use-Pays Principle. As to the water charging system, incremental or pay-for-use rates may encourage users to save water while allowing them to secure the minimum amount of water. Unaccounted-for water due to leakage or theft can be reduced by **increasing the ownership* of local communities and introducing a self-supporting accounting system or an efficient management system characteristic of the private sector**. The ownership of a local community is increased when residents and other water users organize a water management association or water user association and thus operate and maintain related facilities on their own. In setting water tariffs based on the user-pays principle, however, there is a need to consider poor people in the context of BHNs.

JICA's Activities:
JICA has to date conducted planning and technology transfer for each sector.
In the future, JICA should consider allocating water supplies among sectors in the context of IWRM.

JICA's Activities

JICA has provided various kinds of assistance to promote efficient water use in developing countries. For example, it has supported unified management of water resources by conducting development studies and dispatching experts. In water supply planning, JICA has addressed the issue of water leakage and made recommendations to improve water charging systems. In agriculture, the Japanese aid agency has considered water-saving measures – including water-saving or small-scale irrigation schemes – when supporting the development of farm programs and transferring technologies.

These types of assistance have approached water resources utilization in the context of meeting development needs in each sector. For example, they have so far addressed the issue of water saving as part of larger, sectoral goals. In the future, JICA should integrate its experience in technical and other aspects of water saving in different sectors in the context of IWRM*. Building on such integration, JICA should help developing countries to allocate water supplies among different sectors in such a way to mitigate water shortages.

Mid-term Objective 2-2:
Increasing Water Supplies through Water Resources Development

Mid-term Objective 2-2: Increasing Water Supplies through Water Resources Development

Freshwater resources, which are part of the hydrological cycle, are scarce and unevenly distributed. Means to develop water resources differ from region to region, depending on such factors as geographical and natural conditions, water demands, and social systems.

Water resources development in developing countries generally translates into the exploitation of groundwater by digging wells, the use of surface water* in the form of rivers and lakes, and the use of rainwater.

Groundwater (including springwater) often provides relatively safe water for drinking in a sustainable manner and the costs of associated operations and maintenance are low. It can therefore be the main water source for small-

Necessary Approach:
Among the means to achieve water resources development are the exploitation of surface water* and groundwater. Sustainable water supply requires environmental and social considerations. Traditional techniques rooted in communities are now being looked at in a more positive light.

scale water supply projects in the provinces. It should be noted, however, that excessive pumping may not only result in the salinization and drawdown of groundwater and land subsidence, but also disturb the overall water balance – including surface water* – in the region. In recent years, the problem of water pollution involving arsenic and fluorine has arisen with regard to groundwater. For these reasons, the use of groundwater requires appropriate management by conducting resource potential and environmental impact assessments, water examination in the planning phase and regular monitoring of water levels and qualities in the operation phase.

Tapping surface water* in the form of rivers, lakes and others for drinking entails both water resources development including intake facilities and purification systems. As far as large dams are concerned, environmental and social considerations should be appropriately taken into account because of their impact on ecosystems and human society. Such considerations include close scrutiny of the need of a large dam in the first place and alternative options. Among other requirements for sustainable use of river water sources is integrated water basin management, including appropriate water intake control in the context of environmental conservation, and protection of water conservation forests.

Utilization of rainwater is a common practice for some regions, including small island nations suffering from chronic water shortages. These regions may need facilities designed to collect and store rainwater (reservoirs, rainwater tanks, and even drains). On the other hand, traditional techniques for using rainwater in regions with certain levels of precipitation have recently been given more credit as an effective way to secure safe water. Even in water-scarce regions, traditional techniques, including water harvest[8], is now being looked at in a more positive light. Some arid regions, however, have no choice but to exploit non-conventional water sources as an alternative to scarce freshwater resources through such means as the desalination of brackish water or seawater and the recycling of treated water.

Whatever the case may be, freshwater is a scarce resource. This points to the need for effective use of this scarce resource – through the best mix of above-mentioned water resources, proper selection of these resources depending on their qualities and uses, and other means. Effective water use, in turn, calls for planning of integrated water resources management as an essential requirement. In addition, there are some cases in which depletion of the existing water sources has occurred due to abnormal weather, so efforts should preferably be made to investigate the causes of this.

[8] For the definition of water harvest (harvesting), refer to the glossary.

JICA's Activities:
To date, Japan has engaged in the formulation of IWRM plans, groundwater development and irrigation development (basin water management) in each sector through many projects under such schemes as development studies, grant aid and technical cooperation. In the future, JICA should adopt an approach that promotes the effective use of various water sources.

JICA's Activities

JICA has provided assistance in formulating mater plans* and water conveyance plans at the national and basin levels as well as in developing water conservation forests.

As to groundwater development, JICA has supported planning and facility construction through development studies and grant aid, with special emphasis on regional water supply projects.

In the agricultural sector also, JICA has implemented many projects for irrigation development and river basin management through such schemes as development studies, grant aid, dispatch of experts, and technical cooperation projects.

In the future, Japan should preferably shift its focus to the effective use of a wide range of water resources in the context of IWRM,* mindful that it is increasingly difficult to construct dams, which have so far been a key option for water resources development, in consideration of their environmental and social impacts.

Mid-term Objective 2-3:
Conserving Water Quality (both at Source and at the Tap)

Mid-term Objective 2-3: Conserving Water Quality (both at Source and at the Tap)

"Safe water" is water that meets the minimal quality requirements for each use. To provide safe water, it is necessary to conserve the quality of water sources and purify them before use.

Necessary Approach:
Safe water provision entails conserving the quality of water sources and purifying them before use as necessary.

(1) Conserving the Quality of Water Sources

Conserving and maintaining the quality of water sources has two aspects: treating domestic, industrial and agricultural wastewater – a key factor for water pollution, and addressing natural causes of water pollution (e.g., arsenic pollution of groundwater).

Measures to address the former, man-made pollution may include: **installing wastewater treatment facilities such as sewage treatment systems and household wastewater treatment tanks (for domestic wastewater); reducing waste emissions from industrial plants with the introduction of the polluter-pays-principle facilities or cleaner production* (for industrial wastewater), and promoting farming methods that use less pesticides and chemical fertilizers** (for agricultural wastewater).

Of the water-polluting agents, fluoride and heavy metals derived from natural soil including iron, manganese and arsenic, as well as nitrate, which may be attributable to livestock farming, are all widely distributed and difficult to trace back to. This in turn makes it difficult to take effective measures. In fact, measures against arsenic, fluoride and nitrate, which are particularly causing serious groundwater pollution in some regions, are currently limited to stricter

water examination systems and the development of alternative water sources. Measures to prevent the spread of this kind of pollution are vital, although the development and widespread use of small treatment equipment remain high on the agenda.

For details about water quality conservation, see also Development Objective 4: Conserving the Water Environment later.

(2) Purification Before Use

A general requirement for water purification before use as domestic and industrial water in cities is the construction and improvement of purification facilities. Major processes of purification include coagulation and sedimentation, sand filtration and disinfection (by chlorine). It should be noted that although large purification plants have high treatment potential, their construction alone needs vast amounts of funds and their operation and maintenance require certain levels of financial management and skills.

For rural water supply, purifying methods that heavily rely on chemicals and machinery are not practical because of its scale and users' ability to pay water charges. It is therefore necessary to raise the awareness of users about the need for water treatment (and pollution control) as part of hygiene education*. Specifically, users should be encouraged to boil the water before drinking it and keep the water container clean when conveying it. Note that small-scale equipment designed to remove iron in water is in wide use in developing countries.

(3) Strengthening Organizational Structures to Cover Water Quality Management as a Whole

In addition to separate physical infrastructure development projects and water purification technologies discussed above, **it is also essential to formulate master plans for water quality management and strengthen organizational structures to implement them**. Such master plans that cover the whole basin or region should be formulated with the aid executing agency maintaining close coordination with other agencies responsible for water quality, which often include a wide range of government offices such as the environmental ministry, health ministry and water resources ministry. Based on these master plans, support should be given to drawing up action plans, making legal arrangements, and creating the relevant standards and guidelines (standards for water quality and measurement, and manuals). In addition, specific action should also be supported, such as the implementation of effluent control; monitoring and data analysis regarding water quality; raising awareness among residents; disclosure of the results of such actions, and the development of a framework for putting these results to good use in strengthening organizational structures in the future.

JICA's Activities:
To date, JICA has supported sewerage development and sanitary improvement in urban and rural areas as part of its sanitary initiative, and environmental conservation at the basin level and water quality improvement as part of its environmental initiative.
In the future, it will be important for JICA to consider water quality conservation and pollution control as part of IWRM.

JICA's Activities

JICA's engagement to date in this field include the development of sewerage in cities and sanitation facilities* in rural areas under the schemes of grant aid and development studies. JICA has also supported environmental conservation planning at the basin level, water quality improvement, and urban environmental improvement as part of its development studies and technical cooperation. JICA's grant aid programs designed to address issues specific to regions or sectors (e.g., Guinea worms and arsenic pollution of groundwater) have not been limited to development studies. They have also included technical cooperation projects* and community empowerment programs*.

In the future, JICA should increase its focus on integrated water resources management, which is aimed at, among other things, enlarging the scope of availability of water as a resource. In addition, JICA is required to implement programs based on the recognition that conservation of the water environment will bring benefit to the aspect of water use in the context of the hydrological cycle. For example, JICA should support the simultaneous development of water supply systems and sewerage; sewerage tends to be disregarded compared with water supply systems.

Mid-term Objective 2-4:
Ensuring Equitable Water Allocation and Water Supply

Mid-term Objective 2-4: Ensuring Equitable Water Allocation and Water Supply

Securing water sources and conserving water quality alone are not the end of the story. These water resources should be allocated appropriately on the basis of equitability. Insufficient coordination among different stakeholders over the development and use of water resources may result in inappropriate allocations to end users such as residents and farmers or in water shortages for a certain social class or region. This in turn leads to conflicts of interest among different types of users.

Necessary Approach:
To solve water shortages resulting from inequitable water allocation, it is necessary to develop a systematic legal framework, establish an integrated water management organization or coordinating agency, and develop a IWRM plan. Special consideration should be given to the socially vulnerable.

It is therefore important to settle oft-fierce conflicts of diverse interests and ensure equitable water supply according to the use and quality of water. This makes it necessary to **constitute water laws, river laws and other relevant laws and organize water rights* systems more systematically and to establish principles that ensure the equitable allocation of water resources** in the eyes of different kinds of water users.

At issue is **how to allocate water equitably between different uses**, especially agricultural, industrial and municipal uses. There are two major requirements to achieve that end. One is **establishing an integrated water management organization or coordinating agency** to abandoning the practice of different government agencies dealing with different water uses separately. The other is **developing IWRM* plans** aimed at systematic water allocation to different uses.

Furthermore, appropriate allocation to end users may not be achieved unless a wide range (preferably the widest possible range) of water users are involved in making relevant legal arrangements, operating water management organizations, and developing IWRM plans. **Special attention should be paid to the poor, women, and the socially vulnerable**, whose voices tend to be disregarded by government agencies.

The following are specific requirements for each use. (Water use is roughly broken down into **agricultural, industrial and domestic uses**. Domestic use [for **drinking** and other purposes] is further divided into municipal and rural uses.)

Necessary Approach:
Based on an improved legal framework and an physical infrastructure development plan, facilities to supply irrigation, municipal and rural water should be constructed. Operational efficiency should be increased by such means as establishing a water user association, introducing a self-supporting accounting system, and contracting out part of water services to the private sector. Residents and other water users should be involved in planning and decision-making processes.

<Agricultural Water Supply>

Construction of Facilities: Agricultural water is provided chiefly by irrigation and drainage facilities. In recent year, the construction of new, large-scale irrigation facilities has been in a downward trend for environmental, financial and operational reasons. Now the mainstream approach is to increase the actual area under irrigation by improving the existing irrigation systems or adopt a small-scale irrigation scheme.

Operation and Maintenance of Facilities: Because irrigation is impossible without collaborative work of many users, it is important that users themselves operate and maintain irrigation and drainage facilities appropriately. This calls for **the adoption and promotion of participatory water resources management, where farmers themselves play a part** in allocating irrigation water, including equipment operation), and the operation and maintenance of the facilities. Among the preconditions for this participatory approach are capacity building of farmers and water use associations and equitable water allocation down to end users.

<Municipal Water Supply (including tap water for industrial use)>

Construction of Facilities: Municipal water supply is made possible by **the construction, expansion and repair of water supply systems**, which consist of facilities to take in water from surface and ground water sources, convey, treat and distribute it. The capacity of each facility should be designed so that it not only reflect local water use, but also promotes water saving. It is also imperative to adopt systems that reflect the technical and economic levels of each recipient country. Domestic water, after use, is mostly discharged into the living environment as wastewater, causing environmental pollution. This situation points to the need to treat domestic wastewater as well, including sewerage system development.

Operation and Maintenance of Facilities: Requirements for **appropriate management, operation and maintenance of water supply systems** include reviewing the relevant institutional framework, securing necessary human

resources, and even **improving management of water service providers**. It is important that the costs of providing water services, including those of developing, operating and maintaining relevant facilities, should be covered by charging appropriate water prices. This can be made possible by measuring water consumption with water meters and improving water charging systems and tariff collection systems. One of the options available to achieve this end may be to introduce and establish self-supporting accounting systems for better management. In an increasing number of cases, **operation and maintenance of facilities are contracted out to the private sector** on a long-term basis for more efficient management. At the international level, there are growing calls for **the participation of the private sector in water services** through such means as privatization, PFI* and PPP. For successful private participation, a number of challenges should be addressed, including how to deal with poor people who do not afford water tariffs and how to achieve managerial stability. This is where appropriate regulation of the private sector by governments is necessary. **Non-revenue water due to leakage, theft and other reasons**, which is often a major problem in managing municipal water services, can be reduced from two different approaches – physical and non-physical. The physical approach includes pipeline rehabilitation to reduce water leakages. The non-physical approach includes providing water to poor people for reduced prices, and enhancing a sense of morality on the part of residents and even staff of the government and water authorities.

<Rural Water Supply>

Construction of Facilities: **Groundwater is a major water source for small-scale services in rural areas**. Although there are many other sources, including springwater, rainwater, and surface water that has undergone primary treatment, the sources that better accommodate the local conditions should be selected. Likewise, the level of service should reflect such factors as the population, operational and maintenance capacity, and housing density of the targeted village. There are generally three service levels. Level 1 is a service provided through only one tap (e.g., a well equipped with a hand pump) without piping. Level 2 is a service provided through two or more public taps connected with each other by piping. Level 3 is a service provided through a tap for each household. Groundwater development must be accompanied by **hygiene education* and other awareness-raising activities** amid at providing incentives for communities to support such development and sanitation facilities* designed to conserve water quality.

Operation and Maintenance of Facilities: Because water supply facilities are often small and simple in rural areas, water utilities cannot ensure efficient management. In fact, **village level operation and maintenance (VLOM)** is an increasingly common approach to ensuring sustainable rural water supply. It is

hoped that the sustainability of water facilities will be enhanced with increased ownership of a community; such ownership is increased when residents organize a **water resources management association** and thus collect water tariffs and operate and maintain facilities on their own. This approach can also be applied when providing water to slums in cities and using public taps in regional cities, as it may not only result in community-based tariff collection but also reduce water leakages and thefts. Yet community-based operation has its limitations in terms of water quality monitoring and major repairs of facilities. These are areas where NGOs should provide appropriate levels of regular support in cooperation with government agencies and private businesses as necessary.

The installment and operation of these water supply facilities should preferably be conducted systematically in line with **the development of laws concerning irrigation and water supply and of plans concerning irrigation, water supply and water utilities**. Communities should be encouraged to **participate in the planning and decision-making processes**, since such participation will result in a water supply system that better meet local needs. In particular, women – the key users of water services – should be more involved in these processes.

JICA's Activities:
As far as water use is concerned, JICA supports planning, facility construction, human resources development, operation and maintenance, and water examination in such subsectors as irrigation and drainage, waterworks, and rural water supply. In recent years, more emphasis is placed on non-physical infrastructure development, such as improving the management of organizations responsible for facility operation and maintenance, and promoting community-based water management associations. In the future, JICA should further promote legal system development and unified management of water resources in the context of ensuring equitable water allocation. JICA should also achieve closer coordination between its aid schemes for more effective assistance.

JICA's Activities

JICA's engagement in this field has centered on IWRM* planning in its development studies. JICA has less experience in legal system development involving water laws, water rights and others or in the establishment of integrated water management agencies. These are areas where Japan's experience cannot be directly applied, because recipient countries have different backgrounds and conditions. In the future, the conditions and needs of recipient countries should be further examined in relation to Japan's experience. In addition, JICA should increase its support in institution building for integrated water resources management. Many developing countries are working toward IWRM by government agencies and other coordinating agencies such as water resources management committees.

In agriculture and irrigation, JICA has provided assistance in formulating irrigation development plans and basin management plans, constructing irrigation and drainage facilities, and developing human resources under its schematic frameworks of technical cooperation projects*, grand aid, development studies and dispatch of experts.

For municipal water supply, JICA has provided support in developing transmission and distribution networks and purification plants and in improving, expanding and maintaining water supply systems for reducing water leakages* and other purposes, all under its schematic frameworks of development studies and grant aid. Under the framework of technical cooperation and development studies, JICA has provided: training for water supply engineers; capacity

building for relevant organizations; recommendations on management of water utilities, water pricing policies, and measures to reduce non-revenue water*. JICA has also supported in strengthening organizational structures for water quality management and examination. In a few cases, JICA has engaged in the simultaneous development of waterworks and sewerage in order to control water pollution caused by an increase in domestic wastewater as a result of waterworks development.

As to rural water supply, JICA has provided much support in two major fields as part of its grant aid scheme. One such field is the procurement of equipment and supplies, including excavators and pumps for groundwater development, power generators, pipes. The other is the construction and repair of wells and small water systems. In recent years, JICA's grant aid projects tend to combine physical infrastructure development with non-physical infrastructure development, including organizing residents (end users) and providing them with hygiene education*. Non-physical infrastructure development, which is often supported by technology transfer, is aimed at building systems that facilitate operation/maintenance and cost recovery. This integrated approach is designed to ensure the sustainability and proper operation and maintenance of water supply programs. JICA's development studies also support the planning of groundwater development planning and the monitoring of groundwater levels and quality. It is vital, however, for JICA to ensure closer coordination between it grand aid scheme and development studies scheme.

In the future, in addition to closer coordination with relevant agencies in developing countries and with other donors*, more importance should preferably placed on the community approach, because local communities are end users of water. Although it has been and will be important to improve management of water utilities by such means as the introduction of self-supporting accounting systems, private participation in water, which is gaining popularity abroad, should be placed in close scrutiny in term of feasibility and cost-benefit performance.

Development Objective 2: Ensuring Efficient and Sustainable Supply of Safe Water

Mid-term Objective 2-1 Controlling Water Demands

Sub-goals of Mid-term Objectives	Examples of Activities	Case No.	JICA's Main Activities
Promoting Efficient Water Use	×Improving coordination among stakeholders regarding water rights △Reducing water demands with water recycling technologies △Promoting water-saving farming methods and a shift to crops with higher water productivity	4, 11, 13, 14, 15	• Technology transfer regarding the development of small irrigation (water-saving irrigation) schemes [TCP, DS]
Promoting Water Saving	○Water channel lining ○Purchasing water-saving irrigation equipment (drip irritation equipment, sprinklers, etc.) ◎Improving irrigation systems ◎Introducing small-sized participatory irrigation schemes △Introducing water-saving facilities and equipment (water-saving division boxes, etc.) ◎Promoting measures to prevent tap water leakages △Raising the awareness of residents about water saving ×Statutory regulation ○Water charging based on the user-pays principle ○Improving the water charging system (e.g. introducing incremental or pay-for-use rates) ○Organizing water management (water use) associations of residents and other water users ○Introducing and entrenching management based on a self-supporting accounting system ×Involving the private sector in water services	8, 10, 12, 13, 20, 29, 30, 40	• Studies on plans to improve water service management and water pricing policies [DS] • Water leakage management by replacing distribution pipes [GA] • Transferring water leakage management technologies [TCP]
Promoting Unified management of Water Resources	△Reorganizing the administrative structure or establishing a coordinating agency	16	

Mid-term Objective 2-2 Increasing Water Supplies with Water Resource Development

Sub-goals of Mid-term Objectives	Examples of Activities	Case No.	JICA's Main Activities
Exploitation of groundwater	◎Assessing groundwater availability ◎Water examination ◎Construction and installation (including drilling) of well-related facilities (wells, pumps, etc.) ○Monitoring water levels and qualities	17, 19, 20, 23, 24, 29, 34, 35, 36, 38, 42	• Groundwater supply services [TCP] • Surveys to assess groundwater availability [DS]
Securing Surface Water	◎Assessing the discharge and water quality (hydrological surveys) ×Appropriate water intake control (water intake restriction under the river law, etc.) ◎IWRM planning or integrated river basin development planning ◎Establishing the purification system ◎Developing facilities for water resources development (intake weirs, water storage facilities, purification facilities, etc.) △Appropriate water intake control for environmental conservation △Conserving water conservation forests	16, 18, 26, 31, 32, 33, 37, 39, 40	• Water resources development planning [DS]
Using Rainwater	×Taking a positive look at traditional techniques for using rainwater (water harvest, etc.) △Putting in place rainwater collecting facilities (reservoirs, etc.)		
Using Water Efficiently	△Proper selection of water resources according to water use and the quality	30	
Desalinating Brackish Water and Seawater	△Commercialization of desalination technologies	22	

Mid-term Objective 2-3 Conserving Water Quality (both at Source and at the Tap)			
Sub-goals of Mid-term Objectives	**Examples of Activities**	**Case No.**	**JICA's Main Activities**
Securing the Quality of Water Sources (See also Development Objective 4: Conserving the Water Environment)	◎Putting in place water purification facilities and equipment ◎Appropriate operation and management of water purification facilities ◎Putting in place pollution treatment facilities (e.g., sewage treatment systems and household wastewater treatment tanks) △Introducing the polluter-pays-principle for industrial wastewater ○Reducing waste emissions from industrial plants with cleaner production △Promoting farming methods that use less pesticides and chemical fertilizers △Applying stricter water examination and developing alternative water sources for arsenic, fluoride, nitrate, etc. ○Developing and diffusing technologies to appropriately treat groundwater containing arsenic, fluoride, etc.	13, 19, 23, 28, 31, 32, 33, 34, 39, 40, 42, 65, 66, 68, 71	• Studies on water quality improvement plans [DS] • Putting in place water purification plants [GA]
Strengthening arrangements for pollution control	◎Setting water quality standards and goals ◎Water quality monitoring △Effluent control of waste water ○Strengthening the examination and guidance framework	20, 22, 24, 25, 41, 64	• Water pollution monitoring planning [GA]

Mid-term Objective 2-4 Ensuring Equitable Water Allocation			
Sub-goals of Mid-term Objectives	**Examples of Activities**	**Case No.**	**JICA's Main Activities**
Establishing a principle of equitable water allocation among users	△Formulating a water law, river law, and others ○Establishing water rights and other frameworks △Establishing a system to allocate water equitably between different uses	16, 38, 39	• Developing IWRM plans [DS]
Unified Water Management	△Establishing an unified management organization; consolidating existing organizations ◎Developing IWRM plans (river basin management plans) [DS]	9, 16, 18, 28	• Waterworks projects [DS, GA]
Appropriate Water Allocation to End Users	△Involving a widest possible range of water users in making relevant legal arrangements, operating water management organizations, and developing IWRM plans △Considerations to the socially vulnerable		
Effective Water Supply <Agricultural Water>	○Developing irrigation-related laws and regulations ○Developing irrigated farm fields ◎Constructing and repairing irrigation facilities (designed to manage water sources and take in, convey and distribute water) ◎Introducing a small-scale irrigation system ○Salinity control ○Capacity building of framers (with focus on awareness and skills) ◎Organizing farmers and bolstering water use associations (e.g., promoting participation, collecting water use fees, and taking charge of operation and maintenance) ◎Improving water management capacity (in terms of skills and planning) △Ensuring equity in allocating water down to end users (in relation to water rights, etc.)	13, 14, 15, 22, 35, 42	

Sub-goals of Mid-term Objectives	Examples of Activities	Case No.	JICA's Main Activities
Effective Water Supply <Municipal Water>	△Developing laws and regulations related to water supply ◎Constructing and repairing water supply systems (facilities to store, take in, convey, purify and distribute water) ◎Rehabilitating existing facilities ◎Water leakage management (e.g., renewing timeworn pipes) ◎Training engineers who operate and maintain related facilities ○Institution building to operate and maintain related facilities △Establishing the framework for maintenance service provision ○Establishing a cost-recovery system (installing water meters and establishing an appropriate water pricing and tariff collection systems ◎ Improving water purification technologies ○Establishing and strengthening water utilities △Improving management (e.g. introducing a self-supporting accounting system, contracting out to the private sector, and promoting privatization) ○Reducing non-revenue water (due to leakage or theft) △Water charging that considers the poor	8, 9, 10, 11, 12, 22, 27, 30, 31, 32, 33, 40, 42	• Plans to improve water supply facilities [GA] •Training water supply engineering [TCP]
Effective Water Supply <Rural Water Supply>	◎Putting in place rural water supply facilities and equipment ○Awareness-raising with focus on hygiene education ○Building a framework for VLOM (with communities collecting tariffs and operating and maintaining water supply facilities) ○ Support from governments and NGOs in monitoring and major repairs	17, 19, 20, 23, 24, 28, 29, 34, 36, 37, 38	• Plans for rural water supply and hygiene improvement [DS, GA] • Plans to strengthen community organizations in charge of rural water supply [TCP]

※Case numbers correspond to the numbers in the Annex Table (Project List), Appendix 1.
※TCP: Technical Cooperation Project GA: Grant Aid DS: Development Study LA: Loan Aid DE: Dispatch of Experts
JPP: JICA Partnership Program D/D: Detailed Design Study GT: Group Training JOCV: Japan Overseas Cooperation Volunteers Program

◎＝when there are more than five cases include the Examples of Activities as project objectives.
→when more than 10 experts and JOCV are dispatched.
○＝when there is any project which includes the Examples of Activities as project objectives.
△＝when the Examples of Activities are not included as project objectives, but the project includes it as one of elements.
×＝when JICA has little experience, or when JICA dispatches only short-term experts or researchers.

Development Objective 3:
Improving Flood Control to Protect Lives and Properties

Development Objective 3: Improving Flood Control to Protect Lives and Properties

(1) Shift in Approach: From Physical to Non-Physical Infrastructure Development

To date, flood control has been focused on physical infrastructure, such as dikes along rivers and coastal lines and other structures. However, **the recent years are seeing a shift toward multiple or integrated flood control that also addresses the non-physical aspect**.

Specifically, more focus is placed on two major objectives: (i) **reducing the amount of rainwater that runs into rivers**, and (ii) **building more disaster resistant cities**. Measures to achieve the first objectives include: conserving forests and farmland in the basins, maintaining and boosting the water-retaining

and retarding capacity with regarding basins and others, and increasing the capacity to percolate and store rainwater underground in urban areas. Measures to achieve the second objectives include: **providing regulations and guidance for land use and urban development, and developing organizational and legal structures**.

Three major factors are behind the shift in approach toward integrated flood control. First, although river improvement works are still relevant today, such physical infrastructure development alone is increasingly insufficient for flood control. This is because land development and urbanization in river basins have reduced subsurface percolation of rainwater, which in turn has resulted in more rainwater running into rivers. This change has turned attention to the more fundamental cause of floods, which is runoff from basins into the rivers. Second, a growing concern about the environmental impact of dams and river improvement works calls for more prudence in proceeding with these kinds of projects. Third, the approach to create a more disaster resistant society with institutional as well as physical infrastructure development is getting more and more attention in recent years.

In the flood control sector, there has recently been a shift from the conventional approach based on dikes and other physical structures to a more integrated approach that also emphasizes non-physical aspects such as land use in river basins, government regulations and guidance for urban development, and organizational and legal structures.

These developments should be factored into the decisions about flood control.

(2) Flood Control for the Whole Basin

Reinforcing the dikes in some parts of the river basin may raise the possibility of dike failures elsewhere. Deforestation upstream may increase the cases of flood and landslide disasters downstream. These concerns point to **the need for a well-balanced approach to flood control that considers the whole basin, from upstream to downstream, and promotes consensus among different stakeholders**.

The need for a flood control approach that consider the whole basin, from upstream to downstream.

(3) Flood Control Activity Broken Down into Time-Series Phases and Different Types of Support Providers

Disaster prevention activity can be broken down into four time-series phases as shown below:

- (i) Disaster mitigation (ii) Preparedness (ex-ante response)
- (iii) Emergency response (response immediately after a disaster)
- (iv) Rehabilitation and reconstruction (ex-post response)

Support providers in disaster prevention activity include:

- Public help: Public authorities
- Mutual help: Community organizations,
- Self help: Families and individuals

Flood control activity can be broken down into time-series phases (mitigation, preparedness, emergency response, and rehabilitation/reconstruction) and different types of support providers (public help, mutual help and self help)[9].

[9] Institute for International Cooperation, JICA (2003)

Efficient disaster prevention activity is particularly needed in developing countries, where human and other resources are limited. An effective approach for **drawing up a flood control plan** for a particular river basin should be made up of the following steps: **(i) creating a matrix that list time-series phases in its column and support providers in its row; (ii) identifying past and on-going activities as well as resources for future activities in the basin based on the matrix;** and (iii) then devising physical and non-physical measures.

The need for community preparedness, which is aimed at promoting disaster prevention activities by residents in the basin and at strengthening their capacity to deal with disasters.

(4) Efforts toward Community Preparedness

In the past, development assistance in flood control focused on "public help," or public authorities. In recent years, however, such aid has been expanding its scope to include the aspects of "mutual help" and "self help." In other words, development aid now supports the approach of community preparedness[10] that is aimed at promoting disaster prevention activities by residents in the basin and at strengthening their capacity to deal with disasters.

Japan has a long history of community preparedness for disasters. Since old times, local residents have organized flood fighting associations to monitor rivers and prevent dike failures. It is hoped that Japan's experience in this field will be put to better use for promoting community preparedness in developing countries.

(5) Four Mid-Term Objectives in the Development Objectives Chart

Of the four mid-term objectives of Development Objective 3 in the Chart, **Institution Building for Disaster Preparedness** is a common theme for all kinds of flood control activities. The other three mid-term objectives deal with specific kinds of disasters or locations: **Landslide Disaster Mitigation** (primarily in upstream, mountainous regions; **Flood Mitigation** (primarily in the midstream to downstream regions); and **Coastal Protection** (primarily in the river mouth and coastal regions).

Mid-term Objective 3-1:
Institution Building for Disaster Preparedness

It is important to strengthen the preparedness on the part of public authorities by defining the role of each agency, along with clear liaison arrangements and chain of command in case of emergency.

Mid-term Objective 3-1: Institution Building for Disaster Preparedness

Flood control involves a wide range of stakeholders, including central government agencies, local authorities and communities, and private businesses that use rivers and coasts. When a flood occurs, prompt action is critical. **It is therefore important to strengthen the preparedness on the part of public authorities by clearly defining the role of each agency, along with clear liaison arrangements and chain of command in case of emergency**.

Among the areas that can be addressed by development assistance for

[10] Community-based disaster management is also used to express the similar concept.

public authorities are legal system development, flood control planning, meteorological and hydrological data development, and human resources development. **Of particular importance is assistance in non-physical infrastructure development, including forest conservation at water sources, government regulation of land use in the river basin based on a hazard map*, the development of flood forecasting and warning systems, and support for flood victims**.

Poor people are most vulnerable to flood hazards. Aid for disaster prevention that will also contribute to social development of communities and livelihood improvement is an effective approach.

Development aid for local communities should aim to raise the disaster awareness of residents. Community-based disaster education should play a central role in achieving this objective. Among specific activities that constitute an effective approach are: developing and distributing hazard maps*, mounting information campaigns for residents, promoting flood fighting associations, diffusing flood fighting techniques, developing shelters and other refuge facilities, and holding evacuation drills.

An effective approach to ensure that disaster preparedness is entrenched in communities is by making disaster prevention facilities work for social development and livelihood improvement (e.g., using shelters as schools and breeding freshwater fish in retarding basins). **Incorporating livelihood improvement for the poor into community-based disaster prevention is an advisable approach. This is because the economic status of individuals and their vulnerability to disasters are closely related each other. In other words, the overwhelming majority of such vulnerable people are poor. This makes fight against poverty essential**. Communication with illiterate people (especially women), who are more likely to be poor, requires special attention. Furthermore, in societies where social norms restrict women's roles, gender considerations are essential in developing shelters and other evacuation facilities and holding evacuation drills.

Note that development aid will be more effective when it encourages public authorities to work with communities or promote both sides to work together, than when it target each side separately.

JICA's Activities

JICA's Activities:
JICA has a wealth of resources and expertise and a good track record in flood control. Under its schematic frameworks of technical cooperation projects*, dispatch of experts and development studies, JICA's assistance place importance on non-physical infrastructure development.

As Japan has a wealth of resources in flood control and one of the most advanced countries in terms of related technologies, JICA has provided much aid in this sector to Asia and other regions of the world.

JICA's engagement in human resources development, technical development, technical standard improvement is under its schematic framework of **technical cooperation projects*** and that of **dispatch of experts.** To date, JICA has implemented separate projects to establish a number of facilities including: the Volcano Sabo Technical Center in Indonesia, the Flood Control and Sabo Engineering Center in the Philippines, and the Water Induced Disaster Prevention Technical Center in Nepal.

While the projects for Indonesia and Nepal emphasized community preparedness, the project for the Philippines focused on institution building and technical standard improvement for public authorities. JICA's Caribbean Disaster Management Project is a regional project designed both to improve the capacity to formulate community-based disaster management plans and to develop information networks. Special emphasis in placed on developing hazard maps*.

As to flood control planning, **JICA has conducted many development studies** on flood-prone river basins and key basins where socioeconomic activities are concentrated. **Recommendations in recent study reports tend to place importance on non-physical measures.**

For example, the Master Plan Study on Flood Forecasting System for Atlas Region in the Kingdom of Morocco involved the development of a flood forecasting and warning system and evacuation drills on a pilot project basis. These outcomes were fed back to the planning process. In the Study on Flood Control and Landslide Prevention in the Metropolitan Area of the Republic of Honduras, JICA held a series of workshop as early as in the preliminary survey phase to promote consensus among different stakeholders and better coordination among the organizations concerned. The Study Rural Development Focusing on Flood Proofing in the People's Republic of Bangladesh resulted in a flood control plan that is also aimed at improving the livelihoods of flood victims.

Under the **grant aid** scheme, JICA support the development of flood forecasting and warning systems aimed at disaster preparedness. In Bangladesh, JICA constructed multi-purpose cyclone shelters that also serve as schools in an effort to promote both disaster preparedness and rural community development.

Mid-term Objective 3-2:
Strengthening Erosion and Sediment Control for Debris Hazard Mitigation

Aid is more effective when encompassing non-physical measures (forest conservation, flood forecasting and warning systems, awareness-raising for residents, etc.) as well as physical measures (the construction of sabo structures).

Mid-term Objective 3-2: Strengthening Erosion and Sediment Control for Debris Hazard Mitigation

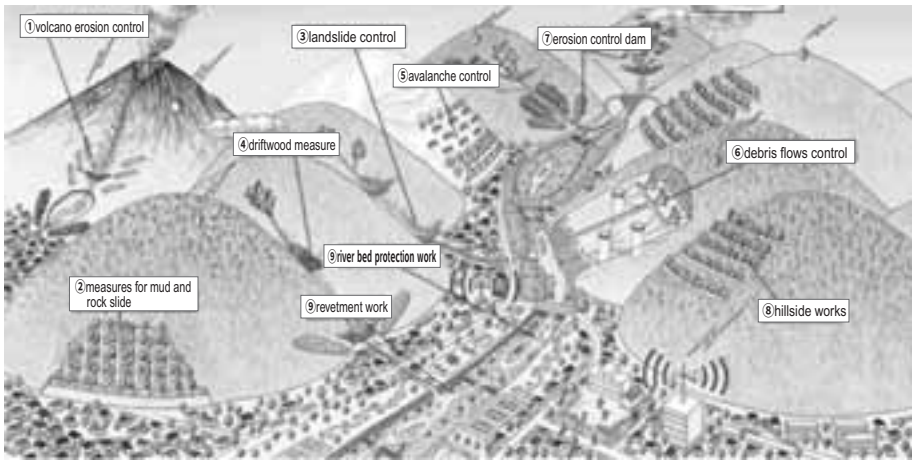
Measures against landslide disasters, including debris flows, landslides and slope failure, can be largely divided into physical and non-physical ones. Combining these two types of measures is a preferable approach.

Physical measures centered on the construction of sabo (erosion and sediment control) structures, which can be largely divided into:

- Those designed to control hillslope erosion and sediment outflow
- Those designed to prevent sediment runoffs from reaching villages and infrastructure facilities downstream

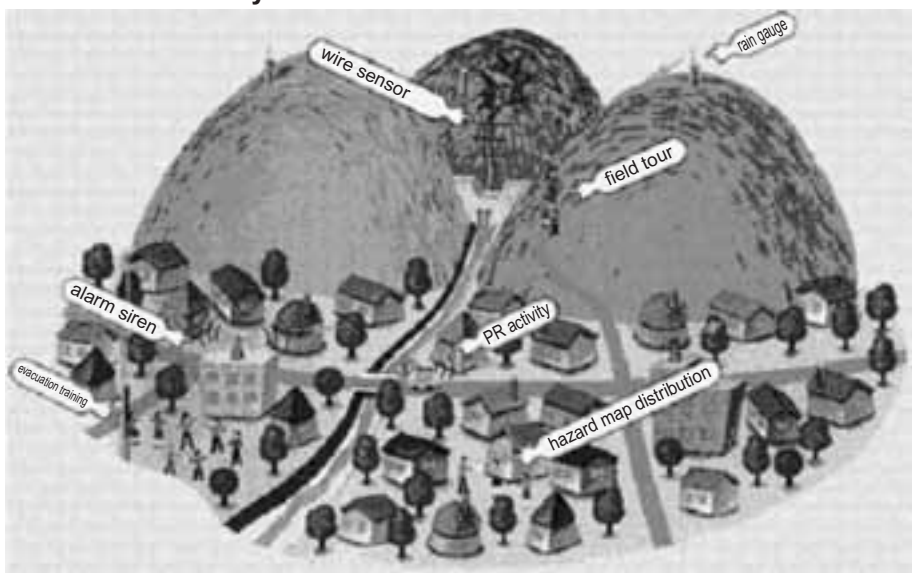
The former includes: terracing, which turns the river course into a stepped structure; and hillside works, which are designed to regenerate vegetation by such means as planting works, earth retaining and drainage works.

Chart 2-1 Physical Measures for Erosion and Sediment Control



Source: MLIT (Ministry of Land, Infrastructure and Transport) website
(http://www.mlit.go.jp/river/sabo/link03013.htm)

Chart 2-2 Non-Physical Measures for Erosion and Sediment Control



Source: MLIT website
(http://www.mlit.go.jp/river/sabo/link03013.htm)

The latter includes, among others, *sabo* dams* and dikes.

Among non-physical measures are: putting in place flood forecasting and warning systems; amounting awareness campaigns for residents; protecting forests and vegetation, including tree planting, to conserve mountainous areas and hill slopes that are prone to landslide disasters.

JICA's Activities:
JICA have implemented many projects that supported planning and afforestation.

JICA's Activities

As to *sabo* structures, JICA has formulated many plans concerned under the development study scheme. The construction of such structures, which requires a vast amount of money, has tended to be taken over by yen-loan

projects following development studies (e.g., the Study on Sabo and Flood Control for Western River Basin of Mount Pinatubo in the Republic of the Philippines).

JICA has little experience in constructing sabo structures under its grant aid scheme, except for sabo dams in the Project for Flood Control and Sabo in the Choloma River in Honduras.

Afforestation in mountainous areas **has been promoted by many technical cooperation projects***. These projects have been supported with planting stock production facilities and construction machinery procured under the grant aid scheme.

Mid-term Objective 3-3:
Promoting Flood Mitigation

Mid-term Objective 3-3: Promoting Flood Mitigation

Measures against urban drainage floods include reducing the discharge into sewers and drains, boosting the rainwater drainage capacity, and protecting key installations. Awareness-raising among residents is an important element to maintain the function of rainwater drainage facilities.

Floods can be divided into river floods and urban drainage floods. **A river flood refers to inundation caused when a river floods** after the amount of rainwater runoff flowing the river exceeds its discharge capacity (inundation by floodwater from rivers). **An urban drainage flood refers to inundation caused when the amount of stormwater exceeds the drainage capacity of a city**, typically a city on a plain (inundation by stormwater).

In considering flood control options, precedence should be given to land use restriction, afforestation, retarding basins* and other tools for river basin management.

Measures against river floods include:

- Controlling the amount of runoff flowing into rivers,
- Reducing peak river discharges (discharge leveling)
- Boosting the discharge capacity of rivers with dikes and other river improvement works, and
- Reinforcing existing dikes and keeping them in good order.

In Japan, a great number of dikes and dams, including those designed for flood control as well as other purposes, have been constructed to date. At the international level, however, it is increasingly **difficult to construct new dams amid growing concern about their environmental and social impacts**. Therefore, in considering flood control options, **precedence should be given to river basin management** over dam construction; tools for river basin management include land use restrictions, afforestation, rainwater infiltration and storage facilities, and retarding basins*. **While taking social and environmental considerations fully into account, alternative options should be examined through consensus decision-making among different stakeholders and then incorporated into flood control plans.**

In river improvement works and dike construction, there is a growing

trend toward approaches that respect landscapes, ecosystems, and amenities, including neo-natural river reconstruction and amenity-oriented dikes.

Measures against **urban drainage floods** include:

- Reducing the discharge into sewers and drains with rainwater infiltration and storage facilities in cities,
- Boosting the rainwater drainage capacity, and
- Protecting key installations by raising ground levels, constructing dikes and other means.

Of these measures, the objective to **boost the rainwater drainage capacity** have attracted many development projects, which have generally supported physical infrastructure development, including sewers, rainwater drains and pumping stations. Such physical measures will achieve better performance if they are supplemented by **non-physical measures, such as launching awareness raising campaigns aimed at deterring the dumping of waste into drains, and organizing community activities to clean up and dredge* drains**.

JICA's Activities:
JICA's projects are centered on technology transfer and planning. Development studies on physical infrastructure development often lead to actual infrastructure development under yen loan programs.

JICA's Activities

JICA has much experience in controlling river floods. Its assistance has centered on technology transfer and planning under its schematic frameworks of technical cooperation projects*, dispatch of experts, acceptance of trainees, and development studies. The grant aid scheme has mostly addressed the procurement of construction machinery and materials to support dike construction by developing countries themselves. Only exception is the Project for Flood Mitigation in Ormoc City in the Philippines, which supported physical infrastructure development involving bridge replacement and river improvement works. Because of its financial requirement, physical infrastructure development is often addressed by yen loan programs, in which the findings of development studies are reflected in many cases.

JICA's Activities:
JICA's engagement in urban drainage floods is mainly through development studies.

As for urban drainage floods, JICA has **conducted many development studies for** large cities on floodplains in Asia, including Jakarta, Manila, Hanoi, Ho Chi Minh City, Phnom Penh and Dacca. Development studies for Phnom Penh and Dacca led to grant aid projects, by which drains were upgraded and pumping stations and water gates were constructed. For the central part of the Metro Manila, a drainage network improvement plan was developed in the framework of oversea basic study. Under the plan, drains were upgraded with funds coming from the Philippine government.

Mid-term Objective 3-4:
Promoting Coastal Protection

Mid-term Objective 3-4: Promoting Coastal Protection

Flood control along coasts can be divided into **coastal erosion control** and **measures against storm surge**.

Coast erosion control requires broad-based study to find out its causes.

Coastal erosion control can be attained by two different methods. One is a remedial response to deep erosions, constructing seawalls and dikes (hard beach method). The other is beach nourishment, by which sand is brought in from other places to restore or expand the beach (soft beach method). At any rate, **broad-based study should be made** to find out the causes of coastal erosion because the main cause is often found elsewhere other than the eroded beach. The construction of a dam upstream may have reduced the amount of earth and sand that reach the beach. Port improvement work or dike construction at some distance may have changed the longshore current. Or global warming may have resulted in a rise in sea levels.

Storm surge can be controlled more effectively by a mixed approach that involves both physical and non-physical infrastructure development.

Storm surge can be controlled more effectively by a mixed approach that involves both physical and non-physical infrastructure development. The former includes dike construction and the latter includes land use restriction in coastal areas, warning systems and evacuation drills for local residents.

JICA's Activities:
JICA's assistance in coastal conservation has centered on seawall construction under the grant aid scheme and the dispatch of experts to educational and research institutions. Only a few projects and development studies have been conducted in this subsector.

JICA's Activities

As far as coastal conservation is concerned, JICA has to date implemented only a few projects and development studies. Yet JICA has supported the construction of seawalls as part of its post-disaster rehabilitation programs for island nations, including Tonga, Samoa and Maldives. JICA has also dispatched experts to educational and research institutions in Indonesia, Turkey, Brazil and other countries.

Development Objective 3: Improving Flood Control to Protect Lives and Properties

Mid-term Objective 3-1 Institution Building for Disaster Preparedness

Sub-goals of Mid-term Objectives	Examples of Activities	Case No.	JICA's Main Activities
Legal and Institutional Arrangement	△Legislative arrangements ◎Institutional arrangements for flood forecasting and warning activities and evacuation and relief operations ○Institutional arrangements for first-aid operations △Institutional arrangements for flood-fighting operations △Introducing the framework for flood damage compensation ○Institutional arrangements for disaster restoration ○Establishing technical standards for facility construction ○Establishing technical guidelines for facility operation and maintenance ○Establishing and improving rules for facility operation ○Developing disaster prevention manuals and guidelines ◎Land use planning and restriction △Guidance and restriction for large-scale development projects △Relocation and resettlement ○Guidance for afforestation and forest conservation △Clarifying who are accountable for the management of river structures △Providing incentives for water-resistant construction; establishing building standards, and putting urban planning in place	45, 47, 56	• Planning the construction and repair of flood control and sabo structures [DS] • Establishing flood forecasting and warning [TCP] • Establishing models and systems for disaster prevention [TCP]
Effective Flood Control Planning	◎Developing policies and strategies for flood control ◎Developing master plans at the river basin level ◎Developing project implementation plans ◎Setting the design discharge and river borders ○Developing appropriate management plans for water source areas △Support for efforts to mediate between competing interests of river basin countries and to build consensus between these countries ○Mediating between competing interests of river basin areas; building consensus between these areas ×Securing the budget for disaster prevention; building consensus on how to share costs	3, 45, 48, 55, 56, 57	• Developing the disaster prevention strategy [DS]
Strengthening Administrative Arrangements for Disaster Prevention	◎Defining the role of each agency and community and clarifying the chain of command ◎Strengthening arrangements for cooperation between local authorities and communities	47, 54	• Establishing an integrated disaster prevention model and the local framework for disaster prevention [DS]
Collecting Data	◎Collecting basic data on flood control (topographic and geological features, vegetation, river bed materials, flood flow conditions, flood damage assessment, etc.) ◎Putting in place observation equipment/stations designed to collect meteorological, hydrological and oceanographic data ◎Making observing and monitoring arrangements ◎Integrating data into a database ◎Preparing and distributing hazard maps	46	• Developing hazard maps [TCP]
Developing Human Resources for Disaster Prevention	◎HRD at government agencies ○Improving college education in river, coastal and civil engineering	3, 49	• Institution building and HRD for disaster prevention [TCP]

Sub-goals of Mid-term Objectives	Examples of Activities	Case No.	JICA's Main Activities
Strengthening the Capacity of Communities to Deal with Disasters	**<Fostering and strengthening community organizations>** ○Forming and strengthening community-based mutual-aid organizations ○HRD at community organizations ○Disseminating knowledge, and raising the awareness about, disaster prevention of river basin communities ○Public relations about the management of water source areas ○Improving the capacity of river basin communities to operate and maintain flood control structures △Teaching disaster prevention at primary and secondary education ○Fostering and strengthening flood fighting associations ○Flood fighting training ○Conducting evacuation drills **<Procuring equipment for community preparedness>** ◎Putting in place a system to monitor debris flows and others ◎Putting in place a flood forecasting and warning system ◎Constructing shelters and other refuge facilities ◎Constructing refuge roads or at least raising their ground levels △Raising the ground levels and boosting water resistance of existing buildings and structures ○Procuring flood-fighting equipment **<Promoting community development and community preparedness>** ○Community development and livelihood improvement by taking advantage of secondary benefits of flood control structures △Changing to farming that can better cope with disasters **<Reconstructing disaster-affected communities>** ○Implementing a social development program to provide relief to disaster victims ○Land and infrastructure development for	43, 44, 46, 49, 53	• Raising the community awareness about disaster prevention [TCP] • Putting in place equipment for community preparedness [GA] • Institution building and HRD for disaster prevention [TCP]

Mid-term Objective 3-2 Strengthening erosion and Sediment Control for Debris Hazard Mitigation

Sub-goals of Mid-term Objectives	Examples of Activities	Case No.	JICA's Main Activities
Conserving Mountainous Areas and Hill Slopes	◎Afforestation of mountainous areas and hillslopes ◎Putting in place a flood forecasting and warning system; awareness-raising for communities	4, 46, 48, 49, 54	• Afforestation, institutional improvement, etc. [DS] • Improving land use regulations [DS]
Constructing Sabo Structures	◎Constructing sabo dams (weirs for erosion and sediment control), hillside works, training levees, channel works and others ○Constructing sand pockets ○Terracing on mountainous areas and hillslopes ○Landslide prevention with anchors	3, 43, 45, 47, 48, 50, 51, 52, 53	• Planning the construction and repair of flood control and sabo structures [DS] • Disaster prevention planning [TCP]

Mid-term Objective 3-3 Promoting Flood Mitigation

Sub-goals of Mid-term Objectives	Examples of Activities	Case No.	JICA's Main Activities
Controlling the Flood Runoff Flowing Into Rivers	◎Promoting afforestation in the river basin ◎Conserving green areas, forests, etc. under land use regulations ○Installing rainwater percolation facilities ○Installing rainwater storage facility for each household ○**Constructing disaster prevention ponds** ○**Establishing forest or grass belts to retard water flows**	4, 54	• Supporting measures to mitigate river floods [DS, GA]
Leveling River Discharges	○Improving rules for operating flood control dams ○Constructing and expanding flood control dams ○Constructing and conserving retarding basins ○Restoring the capacity of existing dams by sediment dredging	4, 45, 47, 48, 50, 51	

Mid-term Objective 3-3 Promoting Flood Mitigation			
Sub-goals of Mid-term Objectives	**Examples of Activities**	**Case No.**	**JICA's Main Activities**
Reinforcing and Protecting Dikes for Flood Control	◎Reducing the failure risk with dike reinforcement ◎Bank erosion control with spur kikes, revetments, fascine mattresses, etc. ○Constructing levee roads (roads which also serve as levees with their embankments) △Constructing ring levees to protect settlements and other important entities △Constructing local levees to protect areas of special importance ×Change the river route to detour an area where population and wealth are concentrated	45, 47, 48, 51, 55, 57	• Planning flood control projects [DS, GA]
Boosting the River Discharge Capacity	○Developing design guidelines for structures in or over river channels, such as weirs and bridges ○Securing appropriate uses of riverbeds ○River improvement works (including river channel widening) and dike construction ○Raising ground levels of existing dikes ○Constructing floodways designed to divert floodwaters directly to the sea ○Constructing short cuts to replace tortuous channels ◎Putting in place pumps and pumping stations ○Dredging and excavating riverbeds	48, 50, 51, 52, 55	
Boosting the Rainwater Drainage Capacity	○Improving solid waster collection systems to deter the dumping of such waste into drains ○Cleaning and dredging rainwater drains ○Involving communities in cleaning and dredging drains; mounting awareness-raising campaigns to discourage residents from dumping waste into drains ◎Constructing and expanding rainwater drainage systems ○Constructing rainwater storage facilities ◎Installing rainwater drainage pumps ×Installing rainwater percolation facilities	56, 57	• Developing plans to install rainwater drainage facilities [DS, GA]

Mid-term Objective 3-4 Promoting Coastal Conservation			
Sub-goals of Mid-term Objectives	**Examples of Activities**	**Case No.**	**JICA's Main Activities**
Coastal Erosion Control as Part of Disaster Prevention and National Land Conservation	△Preventing over development of costal areas under land use regulations; regulating coastal reclamation △Regulating sand and gravel exploitation △Conserving natural beaches ○Conserving mangrove forests, including tree planting ○Conserving coral reefs ○Constructing dikes, seawalls, jetties, offshore breakwaters, etc. ×Beach nourishment	59	
Protecting lives and properties from storm surges	○Putting in place a flood forecasting and warning system ○Plans to evacuate residents △Conserving natural beaches; regulating land use in coastal areas ○Developing and implementing plans to construct dikes, seawalls, jetties, offshore breakwaters, wave dissipating works, etc. ×Beach nourishment	58	• Implementing coastal disaster prevention plans [DS, GA]

※Case numbers correspond to the numbers in the Annex Table (Project List), Appendix 1.
※TCP: Technical Cooperation Project GA: Grant Aid DS: Development Study LA: Loan Aid DE: Dispatch of Experts
JPP: JICA Partnership Program D/D: Detailed Design Study GT: Group Training JOCV: Japan Overseas Cooperation Volunteers Program

◎=when there are more than five cases include the Examples of Activities as project objectives.
→when more than 10 experts and JOCV are dispatched.
○=when there is any project which includes the Examples of Activities as project objectives.
△=when the Examples of Activities are not included as project objectives, but the project includes it as one of elements.
×=when JICA has little experience, or when JICA dispatches only short-term experts or researchers.

Development Objective 4: Conserving the Water Environment

Development Objective 4: Conserving the Water Environment

Efforts to conserve the water environment are meaningful in two aspects: ① conserving the quality of water sources to ensure safe water supply; and ② conserving the natural environment.

To date, Japan's official development assistance in relation to the water environment has focused on two major objectives: wastewater treatment and the conservation of the natural environment. For the first objective, Japan has supported, for example, the establishment of sewage management plans and the construction and upgrading of sewage treatment plants. As for the second objective, Japan has assisted the efforts of recipient countries such as for the assessment of water pollution, through the construction of water quality monitoring facilities and the transfer of analytical technologies. In general, such assistance has been provided by stand-alone projects.

Cooperation on the water environment shall be promoted in the context of the hydrological cycle, taking into account the aims of IWRM*, the effective use of finite water resources and sustainable development.

However, this project-based approach is now under scrutiny in light of the recent trend towards a program approach, which requires more results-oriented implementation. In the future, Japan is required to pursue cooperation in the context of **the hydrological cycle, taking into account the viewpoint of integrated water resources management*,** which is aimed at the effective use of finite water resources and sustainable development. For example, in the case of cooperation for the improvement of water supply, it is necessary to study wastewater management at the same time, since any increase in water supply causes an increase in wastewater. In regions where water resources are particularly scarce, the option of reusing treated water is worth considering. In developing plans to improve public waters such as rivers, strategic environmental assessment is needed to reflect consideration for the water environment in decision-making in the planning and policy-making phases.

Greater emphasis on the hydrological cycle means that conserving the water environment should involve a wider concept, dealing not only with water systems, but also encompassing other ecosystems as well. However, merely appealing for the conservation of the water environment, which entails regulations and restrictions, will not accommodate the needs of local communities whose livelihoods depend on the water environment. Nor would it always gain their support for water sources conservation or even motivate them to take action to achieve it. This is why development programmes in this sub-sector should preferably be designed to provide incentives for local communities. In other words, such programmes should ensure that the conservation of the water environment will also stimulate the local economy through such means as conserving local fishery resources, promoting ecotourism and providing urban water amenities.

Based on the above recognition, three mid-term objectives are identified in the Development Objectives Chart. These are: (i) institutional arrangements

and human resources development for conserving the water environment (Improving the Capacity for Water Environmental Management); (ii) wastewater management (Promoting Proper Wastewater Management through Developing Wastewater Treatment Facilities); and (iii) environmental conservation in context of the hydrological cycle (Promoting Water Environmental Conservation in Public Waters).

Mid-term Objective 4-1:
Improving the Capacity for Water Environmental Management

Mid-term Objective 4-1: Improving the Capacity for Water Environmental Management

Five requirements are: the legal framework, appropriate environmental standards, regular monitoring of water quality and quantity, regulation implantation, and awareness campaigns for communities and business operators.

To promote water environmental conservation, it is necessary to take a series of actions: ① **developing the related legal framework;** ② setting appropriate environmental standards to sustain human activities and natural ecosystems; ③ **making arrangements to conduct water quality and quantity monitoring regularly** in order to assess the situation in the water environment; ④ **the proper implementation of regulations and guidance, advice and countermeasures for rectification** in order to ensure adherence to the regulations when the water environment is damaged (water pollution, a reduction in water discharges, etc.); and ⑤ mounting awareness-raising campaigns to sustain the water environment through partnerships among public authorities, business operators and local communities while ensuring that damage to the water environment is minimal. To take all these actions, it is vital to improve the capacity of **the government agencies concerned with institutional arrangements, establish facilities and equipment, and ensure human resources development.**

Government agencies shall be the primary target for the cooperation. Then, through the support to these agencies for developing their implementation abilities, sufficient information-sharing with stakeholders such as local communities and business operators should be conducted.

For approaches applied to water environmental conservation, legal enforcement according to relevant laws and regulations and awareness and participation of the communities are indispensable. In addition, effective coordination by administrative organizations is required, since community-based activities tend to cover limited areas, and are not suitable for wide-ranging areas. Furthermore, most activities are not profitable, therefore water environmental conservation requires public investment. Thus, **government agencies shall be the primary target for cooperation. Then, through support to these agencies, such as for the establishment and implementation of the legislative framework and the planning of public advocacy activities, sufficient information-sharing with stakeholders such as local communities and business operators should be conducted. This information-sharing is a part of efforts to avoid conflicts of interest among different types of water users, including business operators, and to take into account the diversity and inherent characteristics of traditional water use in local communities.**

To ensure a high standard of performance in development cooperation, the following aspects should be considered in the project formation and

implementation phases:

It is necessary to present the means by which the outcomes of environmental monitoring can be reflected in real administrative actions for water environmental conservation.

When strengthening arrangements (in terms of institutional framework, technology and equipment) for monitoring the water environment, it is important to **present the means by which the outcomes of the monitoring will contribute to real administrative action and further the conservation of the living environment and natural ecosystems**. Otherwise, the outcomes may not have wider impacts. For example, the enhanced analytical ability of engineers may not result in environmental improvement.

Support for setting environmental standards and regulations should ensure their feasibility. To this end, it may be necessary to allow appropriate leeway depending on the situation in water resources and the technical capacity of the recipient country.

In setting environmental standards, it is necessary to consider internationally recognized norms, such as those in the WHO guidelines. However, **the situation with regard to water resources and the technical and other capacities of the recipient country in question should also be factored into environmental standards. Otherwise, impractical standards may result**.

Many developing countries already have environmental standards on par with those in developed countries, although these standards are not complied with in many cases. It is therefore necessary to **incorporate strengthening of the capacity to implement legislation into cooperation programmes from the programme formation stage**. For example, with regard to water environmental management for rivers, capacity may be strengthened by establishing a framework to ensure adequate coordination between the river management department and the environment department.

Government agencies shall be the primary targets of cooperation. By supporting the capacity development of these agencies, cooperation also focuses on encouraging them to share appropriate information with local communities and business operators.

JICA's Activities:
- Grant aid for the construction and upgrading of environmental research and monitoring centers, including the training of personnel
- Transfer of technologies for environmental analysis through group training
- Capacity development of executing agencies though the formulation of water environment improvement and management plans and integrated river management plans under the development study scheme

JICA's Activities

To date, JICA has provided technical cooperation and group training for the establishment and upgrading of environmental research and monitoring centers. As part of such cooperation, JICA addresses the issue of water quality conservation largely by transferring technologies for monitoring and analyzing water quality. JICA's projects in this subsector include: those designed to support environmental research and monitoring centers in China, Indonesia, Chile and Egypt with environmental technologies; and those designed to support centers specializing in water environmental conservation in Thailand, China and South Korea. Many of these centers have been constructed under Japan's grant aid scheme. JICA has also conducted many development studies aimed at water environment improvement and management or integrated river management in all the regions in the world except Africa. Through these studies, JICA has carried out capacity development of executing agencies in recipient countries.

Mid-term Objective 4-2:
Promoting Proper Wastewater Management through Developing Wastewater Treatment Facilities

Wastewater treatment facilities should be tailored to the population density, technical and financial capacities, and land use characteristics of a particular area.

Mid-term Objective 4-2: Promoting Proper Wastewater Management through Developing Wastewater Treatment Facilities

Appropriate treatment of excreta, domestic and industrial/agricultural wastewater discharged from people's social and productive activities reduces water pollution and thus contributes to water environmental conservation. Furthermore, it improves the living environment and thus contributes to the prevention of oral infectious diseases and other diseases. Wastewater treatment, which has these critical roles, is significantly lagging behind compared to water supply in many developing countries. **Promotion of wastewater treatment facilities that are tailored to the population density, technical and financial capacities, and land use characteristics of a particular area** constitute a priority objective for development assistance. In fact, if Japan fails to give adequate attention to **the value of the integrated development of water supply facilities and wastewater treatment facilities** in the context of IWRM and the hydrological cycle, Japan's aid in this subsector could result in environmental degradation. This would in turn lose the confidence of recipient countries in Japan's aid policy.

(1) Wastewater Treatment in the Capital and Provincial Cities

For sewerage management in large cities, it is important to explore the possibility of applying a system that is easy to operate and low-cost in terms of both initial investment and operation and maintenance. With a view to phasing in a larger system, the sewerage authority (or the operator) must be sized up to see whether it will be able to properly operate and maintain the larger system.

For sewerage management in large cities in developing countries, it is often inappropriate to apply the advanced sewerage systems commonly found in developed countries – such as land-saving systems applying advanced technology that is designed to treat vast amounts of sewage – since their operation and maintenance requires high levels of expenditure and advanced skills. It is therefore **important to explore the possibility of applying systems that are easy to operate and low-cost in terms of both initial investment and their operation and maintenance**. Regarding the treatment method, it is essential to weigh a number of options depending on the scale and land use characteristics of the particular city, including the lagoon process* and oxidation ditch process*, as well as the activated sludge process,* which is common in developed countries. For sewer networks, a number of methods that can reduce construction costs have been developed, including a system that partly uses open conduits, the small-bore sewer system and the shallow sewer system.

In the future, however, sewerage authorities will be required to phase in high-efficiency and high-cost systems according to the development stage of a particular city. Typically they will start from a open conduit system (which drains both rainwater and sewage) to a closed conduit system, then to small sewerage, and further to an integrated treatment system designed to treat sewage from a wide area (a complex of a sewage treatment plant sewer network and sludge treatment plant). Partly because of high initial investment costs for a

For sewage management in rural areas, cooperation should support the promotion of on-site sanitation facilities* such as household wastewater treatment tanks* and VIP latrines*. Hygiene education is vital for the sustainable use of these facilities. To motivate residents to use sanitation facilities, these facilities should be constructed in line with water supply facilities.

large-scale system, a preferable approach is be to first divide the treatment district into smaller areas and address each area in order of priority, and then combine these separate systems into an integrated treatment system. This approach makes it possible to divide up investment costs.

There are some requirements for this approach, however. First, attention should always be paid to the master treatment plan. Second, this approach should be weighed against the approach to develop an integrated treatment system from the start in terms of cost-effectiveness. Third, **the sewerage authority (or the operator) should be accurately assessed** to see whether it will be able to properly operate and maintain the integrated treatment system, which tends to be large in scale. If there is a concern about the capacity of the authority, the donor should devise a plan – during the project formation phase – to provide multi-year training and opt not to increase the scale of the sewage treatment system until such training produce results.

(2) Sewage Management in Rural Areas

In rural areas, it is often the case that households do not have their own toilet. **A viable option is to promote on-site treatment facilities such as household wastewater treatment tanks* and VIP latrines*.** Communities' demand for sanitation facilities (toilets) are not always high compared to that for water supply facilities. In fact, sanitation facilities may go against local culture or tradition. They may even be considered a taboo. These circumstances point to the need to consult fully with communities **to raise their awareness about public hygiene** and decided on the design, installation locations and other conditions. Because water supply facilities are usually located in close proximity to villages, sanitation facilities designed to treat excreta and sewage with underground infiltration would be installed far enough from water supply facilities so as to avoid underground water pollution.

To ensure the sustainable and appropriate use of sanitation facilities*, it is **essential that they are properly maintained by communities themselves** with such means as cleaning (for toilets) and regular sludge removal (for household wastewater treatment tanks*). To achieve that end, a development project should have carefully crafted polities to **promote community participation – including cost sharing –** as early as in the construction planning phase, use materials that are inexpensive and locally available, and ensure financing and institution building for operation and maintenance. In some areas, appropriate use of sanitation facilities* is not part of local customs. In that case, substantial awareness-raising is needed to change the mindset of local people. As part of such efforts, **the installation of such facilities should be a condition for the construction of water supply facilities**.

Hygiene education* is important to prevent infectious diseases. Inadequate education is more likely to increase the chance of infection than no

education at all. This is why there is a need for **integrated hygiene education***, including basic knowledge about water-related infectious diseases and preventive measures ranging from sanitary management of drinking water to a hand washing practice after using a toilet. It is preferable that information campaigns on a daily basis with the use of radio and other media accessible for residence will supplement on-site campaigns.

(3) Appropriate Management of Industrial Wastewater

Unlike domestic water, identifying the source of industrial wastewater is easy. An effective approach to industrial wastewater management is to introduce the polluter-pays principle (PPP)* and **provide technical guidance tailored to a particular pollution source**.

For industrial wastewater management, an effective approach is to provide technical guidance tailored to a particular pollution source. Support for the introduction of technologies in water-saving, recycling and cleaner production* has a cost-reducing impact on industry.

In this subsector, Japan enjoys a comparative advantage. The country boasts advanced technologies to treat industrial wastewater, which were developed after the country paid a high price for rapid industrialization during the period of rapid economic growth after WWII, that is, serious pollution caused by effluents from industrial plants and mines, among other sources. Such pollution is highlighted by the mercury-caused Minamata disease and the cadmium-caused Itai-Itai disease. With this experience, Japan is in a position to provide appropriate solutions to countries undergoing rapid industrialization, so that the mistake Japan made will not be repeated.

In addition, **specific projects to support the introduction of technologies in water-saving, recycling or cleaner production* can greatly benefit the industrial sector as well, because they help industry to reduce industrial waste water, make better use of finite water recourse, and then reduce costs.**

JICA's Activities:
- Many development studies aimed at sewerage management planning (in urban areas)
- A few pilot projects* aimed at installing sanitation facilities in rural areas under the development study scheme.
- Human resources development for industrial wastewater management under the technical cooperation project scheme.

JICA's Activities

JICA's engagement in the development of sewage treatment facilities focuses on sewerage management planning in urban areas under the development study scheme. Among such development studies in the world, several studies in such countries as the Philippines, Bangladesh and Kenya gave rise to the actual construction of facilities under the grand aid scheme. Many others did not as sewerage development requires a lot of money. In Thailand, Japan supports human resources development at the Training Center of Sewerage Works. The issue of putting in place sanitation facilities* in rural areas was addressed by pilot projects as part of development studies on rural water supply. However, the issue has not been at the center of Japan's development assistance. As to industrial wastewater management, JICA has conducted development studies in such countries as Columbia, Viet Nam and Egypt. JICA has also conducted technical cooperation projects* in, and sent individual experts to, a number of countries including the Philippines, Thailand

and Argentina in this category.

Mid-term Objective 4-3:
Promoting Water Environmental Conservation in Public Waters

Mid-term Objective 4-3: Promoting Water Environmental Conservation in Public Waters

The value of water environmental conservation in public waters such as rivers and lakes is not limited to its role in conserving water resources, the living environment and ecosystems. **A water area that maintains favorable environmental conditions can contribute to the conservation of fishery resources. They can also play a part in reinvigorating local economy as tourism and recreation resources**. As public waters usually cover a wide range, government agencies take charge of the coordination, collaboration and implementation of policies (on regulation and financing). Hence, these government agencies are supposed to play a central role in promoting water environmental conservation in public waters, in coordination with conservation activities by people who reside around the water area or depend on them for water supply and fisheries downstream. Government agencies may launch awareness campaigns for these people as necessary.

In water quality management, controlling point-source pollution should be given priority in developing countries. Based on this idea, development aid should incorporate the following processes: identifying pollutants and their causes, assessing pollutant loads, devising specific measures to control pollutants, and defining each role of local communities, business operators and public authorities. Mid- to long-term support is needed.

Possible focuses of cooperation approaches include: **water pollution** assessment; guidance on technical solutions; guidance on planning of preventive measures; the formulation of integrated management and conservation plans covering the whole river basin from water sources down to the mouth and surrounding coasts **in the context of hydrological cycle management**; the introduction of strategic environmental assessment* in cooperation for formulating development plans; and regional development that strikes a balance between development and environmental conservation with the help of environmental zoning. To produce tangible results, **these focuses, along with target areas in recipient countries, should be given priority depending on the situation in the use and pollution of pubic waters.** (Attention should be paid to the fact that **closed water areas* such as lakes and enclosed bays are easily polluted.**)

(1) Water Pollution in Public Waters

The biggest causes of water quality degradation in developing counties are domestic wastewater (from area sources) and industrial waste water (from point sources such as industrial plants, pig farms and chicken farms). To prevent further quality degradation in public waters that have been more or less polluted already, priority should be given to more urgent issue – pollution by toxic chemicals or organic matter, the eutrophication of lakes, groundwater pollution by inorganic matter, the flow of nutrients into rivers, or other issues depending on the local conditions of the particular public waters. As for the prioritized issue(s), **studies should be conducted to identify pollutants, their causes, and**

to assess the pollutant loads*, and the behavior of pollutants should be predicted (behavior simulation). Based on the findings of such studies, **specific measures to control each pollutant** should be devised, including: sewerage development, the installment of facilities to treat industrial effluents, the transfer of industrial plants, sediment dredging, prevention of the inflow of solid waste, the appropriate use of pesticides and chemical fertilizers, and environmental education for local communities. **In devising these measures, the role of each of the local communities, business operators, and public authorities involved should be defined** to ensure tangible results. Relatively long-term, down-to-earth efforts are needed to achieve this end. **Donors are advised to provide medium- to long-term assistance in consultation with government officials, engineers, residents, business operators and other stakeholders in a particular area**. To prevent the pollution of public waters where water quality degradation remains at low levels, it is necessary to develop and implement integrated water environmental management plans, as discussed later.

(2) Preservation of the Hydrological Cycle

Preservation of the hydrological cycle will make it possible to secure water available for use, thus contributing to efficient water use. Programmes in this sub-sector should be cross-sectoral in nature, with the aim of conserving the natural environment as a whole rather than the water environment alone. To secure enough water supplies, donors are advised to consider reusing treated water as a viable option.

Appropriate preservation of the hydrological cycle is accompanied by a certain level of restriction on the use of public waters (including intake and discharges). This seems to place restrictions on economic development around a particular water area in the short term. In the long term, however, preservation of the hydrological cycle will reduce the cost of treating polluted water since the quality of the water can be kept at a desirable level under proper management of the hydrological cycle. This will also make it possible to secure sufficient supplies of water, while destruction of the water environment may lead to reduced water availability or a reduction in the utility value of the water area itself (in terms of fisheries, recreation and other uses). In this manner, the preservation of the hydrological cycle will contribute to efficient water use.

As for the preservation of the hydrological cycle, **cooperation programmes should be cross-sectoral in nature, with the aim of conserving the natural environment as a whole rather than the water environment alone**. It is desirable to take into account environmental considerations for a particular water area as a whole as early as in the project formation phase, with the introduction of strategic environmental assessment*. **Assistance is also needed in the establishment of management plans for the water environment, defining the role of each agency to ensure the feasibility of these plans, and developing policies aimed at securing the financial sources**. As an example, an environmental management plan may have the following approach: dividing the water area into small units for convenience according to their characteristics and management arrangements; setting appropriate goals regarding water quality and quantity for each unit; devising projects to achieve

these goals; and thus eventually managing the whole water area.

In regions where water resources are scarce, reuse of treated water must be considered as a viable option to ensure quantitative preservation of the hydrological cycle. In this field, **donors should consider supporting both research efforts to make safety assessment associated with the reuse of treated water and administrative efforts to devise and implant reuse plans.**

JICA's Activities:
- Many development studies on such themes as lake water quality improvement and bay pollution control
- Dispatch of JOCVs in the field of environmental education to support community awareness activities

JICA's Activities

As for water quality conservation in public waters, JICA has conducted many development studies, with their themes ranging from lake water quality improvement to ecotourism and urban water amenities as part of environmental conservation, further to bay pollution control in Latin America. Development study for IWRM plan in Jordan addressed the issue of reusing treated water in the context of hydrological cycle management.

Environmental awareness for local communities is often addressed by Japan Overseas Cooperation Volunteers (JOCVs) in charge of environmental education, water examination and other assignments.

Development Objective 4: Conserving the Water Environment

Mid-term Objective 4-1 Improving the Capacity for Water Environmental Management			
Sub-goals of Mid-term Objectives	**Examples of Activities**	**Case No.**	**JICA's Main Activities**
Improving the Implementation Capacity of Government Agencies Concerned	△Defining the role of each agency and clarifying the chain of command △Establishing a council on environmental conservation in a particular water area ◎Making available equipment for environmental monitoring and analysis ◎Strengthening arrangements for water quality monitoring	4, 18, 25, 62, 65, 66	• Establishing and upgrading environmental conservation centers [TCP plus GA] • Dispatching policy advisors
HRD for Water Environment Management	×Enhancing higher education in environmental engineering ◎Improving the capacity to formulate water environment management plans ○Strengthening arrangements for operating and maintaining sewerage services (with focus on business management and maintenance skills, including those in tariff collection) ◎Skill training for human resources at environmental monitoring agencies ○Entrenching tools to feed back the findings of environmental monitoring to policy-making ◎Training in mounting information campaigns for communities	60, 61, 63, 65	• Establishing and upgrading environmental conservation centers [TCP] • Group training in technologies for environmental analysis
Raising awareness of environmental issues for communities	◎Providing environmental education on a particular water area for pupils, students and adults △Providing hygiene education on appropriate sewage treatment △Promoting the use of low-cost sanitation facilities for better QOL		• Environmental education by JOCVs
Setting Environmental Standards	△Reviewing related laws and regulations ×Setting environmental standards △Setting limits and guidelines (regarding the optimal water treatment option, emission concentration control, total emission control, nitrogen and phosphorus control, etc.) △Establishing penalties for non-compliance	61	• Dispatching experts to environmental related agencies

Sub-goals of Mid-term Objectives	Examples of Activities	Case No.	JICA's Main Activities
Implementing Regulations Appropriately	△Developing and applying simulation models for water pollution load △Measuring water quality and quantity; conducting regular environmental monitoring (of water quality and ecosystems) △Developing and implementing systems to identify pollution sources and conduct on-site inspections	4	• Dispatching experts to environmental related agencies • Establishing and upgrading environmental conservation centers [TCP]

Mid-term Objective 4-2 Promoting Proper Wastewater Management through Developing Wastewater Treatment Facilities			
Sub-goals of Mid-term Objectives	**Examples of Activities**	**Case No.**	**JICA's Main Activities**
Phasing in Centralized Wastewater Treatment Systems	◎Constructing, repairing and expanding wastewater treatment facilities ◎Constructing, repairing and expanding sewer networks ○Installing and operating sludge treatment equipment ×R&D and selection of appropriate technologies	65, 68, 69	• Sewerage development planning [DS] • Repairing sewerage [GA]
Installing decentralized sewage treatment systems	△Promoting on-site treatment facilities (household wastewater treatment tanks, VIP latrines, etc.) △R&D and selection of appropriate technologies	61	• Pilot projects under rural water supply programs [DS]
Appropriate Treatment of Industrial Wastewater Note: See also Thematic Guidelines on "Pollution Control."	○Promoting water saving (recycling) and cleaner production	65, 66	• Planning industrial wastewater management [DS] • Dispatching experts

Mid-term Objective 4-3 Promoting Water Environmental Conservation in Public Waters			
Sub-goals of Mid-term Objectives	**Examples of Activities**	**Case No.**	**JICA's Main Activities**
Hydrological Cycle Management Note: See also Thematic Guidelines on "Natural Environmental Conservation."	×Studies on water and material circulation in the whole river basin from the water sources down to the mouth and surrounding coasts ○Developing and implementing plans to conserve forests in water source areas △Restricting development with environmental zoning △Raising public awareness of eco-friendly development and promoting regional development with ecotourism and urban water amenities △Studying and planning to promote the reuse of treated water		• Developing environmental conservation plans for public waters [DS]
Preventing the Deterioration of Water Quality	△Developing and implementing measures to control the eutrophication of lakes ◎Improving water quality and conserving the functions of public waters, including rivers, waterways and coastal areas ×Assessing－and studying ways to combat－groundwater pollution caused by chemicals and natural materials △Developing and implementing waste management measures as part of water pollution control △Reducing the environmental impact of dams on the water area (by, for example, developing wetland in the surrounding area) △Preventing river water storage structures from blocking the flow of nutrients into rivers	41, 67	• Developing environmental conservation plans for public waters [DS] • Developing IWRM plans [DS]

※Case numbers correspond to the numbers in the Annex Table (Project List), Appendix 1.
※TCP: Technical Cooperation Project GA: Grant Aid DS: Development Study LA: Loan Aid DE: Dispatch of Experts
JPP: JICA Partnership Program D/D: Detailed Design Study GT: Group Training JOCV: Japan Overseas Cooperation Volunteers Program

◎＝when there are more than five cases include the Examples of Activities as project objectives.
→when more than 10 experts and JOCV are dispatched.
○＝when there is any project which includes the Examples of Activities as project objectives.
△＝when the Examples of Activities are not included as project objectives, but the project includes it as one of elements.
×＝when JICA has little experience, or when JICA dispatches only short-term experts or researchers.

Chapter 3 JICA's Cooperation Policy

This chapter presents JICA's cooperation policy in water resources, based on the discussion in the preceding chapters.

3-1 JICA's Priorities and Points of Concern

Guiding Principles of JICA's Cooperation in Water

JICA should address a wide range of aspects including water governance, capacity development, financing and participation.

(1) Guiding Principles of JICA's Cooperation in Water

In March 2003, Japan hosted the Third World Water Forum. Participants identified water governance, capacity building, financing and participation as some of the major issues for the water crisis. In other words, they recognized the need for an integrated approach. After the forum, growing concerns about the water crisis culminated in the Evian Summit in June 2003. At the summit, the world leaders announced a statement titled "Water - A G8 Action Plan" aimed at achieving the Millennium Development Goals and WSSD targets.

At the Third Water Forum in March 2003, Japan announced the Initiative for Japan's ODA on Water. In this initiative, the strategic focuses were identified as: ① providing drinking water and sanitation to poor countries and regions; ② addressing the needs to provide large-scale financing to urban areas; and ③ assisting capacity building*. The country's specific targets were identified as: ① safe drinking water supply and sanitation; ② improvement of water productivity; ③ improvement of water pollution and ecosystem conservation; ④ disaster reduction and flood mitigation; ⑤ water resources management*, and ⑥ strengthening of partnerships with NGOs.

① Providing drinking water and sanitation to poor countries and regions
② Addressing the needs to provide large-scale financing to urban areas
③ Assisting capacity building*

Support for drinking water supply and sanitation was given priority at other international conferences in which Japan played an proactive role, including TICAD II (2001) and WSSD (2002).

As discussed above, the water crisis is recognized as a global challenge and Japan has committed itself to address the crisis. JICA should devise aid projects with special attention given to the following new approaches, which constitute part of the international aid trends:

- Millennium Development Goals (MDGs)
- Integrated water resources management (IWRM)
- PPP in water supply

① Millennium Development Goals (MDGs): Of the eight goals, "eradicate extreme poverty and hunger" and "ensure environmental sustainability" concern the water sector.

② Promotion of integrated water resources management (IWRM)[11]: This approach emphasizes transparent and participatory processes to meet

[11] For the differences between IWRM and comprehensive water management, refer to the glossary.

the needs of both ecosystems and humans. It addresses interagency issues.

③ PPP in water supply: The World Bank* and other aid agencies are promoting Private Public Partnership (PPP). PPP has been at issue particularly at government agencies in charge of trade and industry promotion. Recently, government agencies in charge of water are showing interest in it.

Drawing on expertise from abroad, Japan has made significant progress in IWRM, waterworks and sewerage and the water environment during the rapid modernization process since the Meiji Period (1868-1912), especially in the aftermath of WWII. JICA should capitalize on Japan's experience in the water sector and provide support in addressing the water crisis as a key aid agency of a major donor country in the world. Priority should be given to the following issues.

JICA's Priorities

(2) JICA's Priorities

JICA's priorities are shown below. For the relationships between these priorities and actual projects, refer to Appendix 1: Selected Aid Activities by Japan.

① Promoting Integrated Water Resources Management
② Ensuring Efficient and Sustainable Supply of Safe Water
③ EImproving Flood Control to Protect Lives and Properties
④ EConserving the Environment through Improving Water Quality

1) Promoting Integrated Water Resources Management

JICA should first look at many aspects of the diversifying needs of developing countries and then promote IWRM based on that observation. Note that there are many aspects of water and that they should be integrated[12]. Then focus should be placed on the following issues:

- Collecting basic data (and compiling it into a database) to assess the balance between water supply and demand in a particular water region; supporting unified management and use of such a database
- Defining the role of each agency (stakeholder) regarding water resources management; developing action plans based on the defined role
- Promoting capacity building of relevant agencies (institutional strengthening, financial and managerial strengthening, and human resources development)
- Supporting the development and improvement of feasible laws and systems
- Regenerating and conserving forests to conserve water sources and soil in the river basin and mitigate floods

[12] Institute for International Cooperation, JICA (2002) p.166

2) Ensuring Efficient and Sustainable Supply of Safe Water

JICA should be proactively involved in securing "safe water" and supplying it in a sustainable and efficient manner as this directly affect the life of local residents. While taking note of the MDG of reducing by half the proportion of people without sustainable access to safe drinking water by 2015, JICA should focus on:

- Supporting water supply planning that respects IWRM
- Developing water supply facilities (and water resources) and improving the their operation and maintenance
- Promoting participatory water management organizations (especially in provincial rural areas)
- Strengthening the management capacity and measures against non-revenue water for sustainable water supply services

3) Improving Flood Control to Protect Lives and Properties

As far as flood control is concerned, Japan enjoys a comparative advantage with a wealth of resources and expertise. JICA should provide assistance that encompasses integrated water management for a particular river basin as a whole to, among other regions, monsoon Asia where the need for flood control is significant. Focus should be placed on:

- Developing feasible plans that integrate physical and non-physical measures
- Improving the disaster mitigation capacity of local communities (especially the poor)
- Strengthening the preparedness of public authorities (by clearly defining the role of each agency, improving liaison arrangements, and developing the legal system, etc.)

4) Conserving the Environment through Improving Water Quality

In many developing countries, rapid economic development and population concentration on urban areas have increased domestic and industrial wastewater and aggravated water pollution. JICA should provide assistance aimed at improving water quality and promoting environmental conservation in the context of the hydrological cycle in a particular river basin as a whole. Focus should be placed on:

- Supporting the construction and operation/maintenance of wastewater treatment facilities tailored to local conditions
- Strengthening environmental monitoring arrangements with focus on water quality monitoring
- Supporting the development of effective and unified operation standards and manuals
- Transferring technologies for wastewater treatment

• Promoting environmental education

Approaches to JICA's Priorities

(3) Approaches to JICA's Priorities and Points of Concern

1) Promoting the Program Approach

If too much emphasis is placed on stand-alone projects, there may be difficulty in assessing performance as a whole. It is necessary for JICA to be more result-oriented and more focused on its priorities. This calls for the program approach, which is integrated in nature, with special emphasis on the following items 2) - 6).

1) Promoting the Program Approach
2) Capacity Development
3) Coordination with Financial Assistance
4) Accommodating Local Conditions
5) Taking advantage of Japan's Experience
6) Environmental and Social Considerations

JICA's overseas offices have an important role to play in taking an integrated approach based on the accurate assessment of local needs. JICA's headquarters, on the other hand, have an important role to play in making good use of Japan's expertise and other resources.

It is therefore necessary to make arrangements so that JICA can serve as a mediator between Japan and recipient countries with clear division of labor and close sharing of information between its overseas offices and headquarters.

2) Capacity Development

In recent years, integrated water resources management (IWRM) is attracting international attention. Japan has a long history of a similar approach—water basin management, especially in monsoon Asia, whose natural conditions are close to those of Japan. In this region and others, Japan is in a position to provide practical assistance based on its experience. Interagency efforts are needed to address a wide range of issues, including the formulation of integrated river basin plans, the development of organizational and legal structures, and the development of information systems. An participatory approach is also needed that accommodates such aspects as local communities, gender and poor people.

Assistance for the capacity development of executing agencies should be designed to take into account institution building as well, in relation to progress in decentralization and in privatization of part of the government sector. JICA should proactively engage in policy-making, legal system development, institution building, and management capacity building.

Service providers, in particular, should consider adopting the business administration approach with the introduction of the use-pays principle for appropriate operation and maintenance, although consideration for the poor is necessary.

The existing approach to human resources development with the transfer of specialized technologies through human resources development centers should be closely examined for possible improvement. For example, JICA should be flexible enough to explore the possibility of taking advantage of the existing structures and human resources of a particular municipal water

authority to train engineers in rural areas through on-the-job training.

Projects in rural areas, in particular, requires not only technology transfer to the executing agencies but also capacity development of other stakeholders involved in rural development, public health or education, including government agencies, local authorities and NGOs.

3) Coordination with Financial Assistance

The MDGs have specific numerical targets for developing countries, and the Japanese government should provide concrete assistance in achieving these targets. Many developing countries depend on donors* for most of their development funds. It is often the case that a particular technology is transferred to the counterpart agency but it is short of funds to apply that technology to the construction of facilities for local communities or the delivery of service to them. Hence, coordination with financial assistance is critical if JICA wants to achieve quantitative results in terms of service for communities in the short term.

Development studies and basic design studies* play an important role in realizing development projects under the loan aid or grant aid scheme. To ensure the flawless implementation of project formation, studies, and financial assistance, JICA should proactively involve itself in local ODA taskforces, thus contributing to consensus building for development programs or projects by the Japanese government as a whole. To this end, stakeholders envolved in these activities should maintain close coordination from early stages. Even when consensus has not been reached on project implementation under Japan's loan aid or grant aid scheme, JICA should increase the opportunity to ask other donors* to work on the findings of development studies it has conducted.

Building a new facility entails institution building and human resources development to operate and maintain that facility. Hence, good aid performance will be achieved when JICA maintains close coordination between its technical cooperation with financial assistance as early as in the preliminary study phase. During this phase, JICA should study how to improve the capacity of the counterpart* agency and what technical cooperation will be needed to implement the project.

4) Accommodating Local Conditions

In providing development assistance in the water sector, it is necessary to pay adequate respect for local characteristics of natural and socioeconomic conditions. Attempts to introduce laws or systems (water laws, water rights*, waster resources management, etc.) alien to a particular area may fail in the long term. As local water use systems have historical backgrounds, an effective approach will be to draw on the existing systems. Local NGOs and consultants should be put to good use in this context.

In each of the regions of the world, including Africa, Asia and Latin America, similarities in climate and culture are often found in different areas. For this reason, diffusing good practices regarding appropriate technologies or institutions may constitute an effective approach (to the treatment of turbid river water, water theft prevention, the maintenance of rural water supply facilities, and others). Hence, it is hoped that JICA's issue-based departments and regional departments will play a proactive role in systematizing appropriate technologies and experience and developing human resources networks including third-country experts, thus serving as a hub for providing technical information to JICA's overseas offices. Information provision can also be possible through such means as third-country training programs*, regional seminars and JICA-NET.

5) Taking Advantage of Japan's Experience

To ensure the applicability of Japan's own experience and expertise to developing counties, it is necessary to accumulate and systemize them. While taking into account the socioeconomic and natural conditions in developing countries, JICA should explore such applicability with demonstration experiments.

Domestic resources that have such experience or expertise are not necessarily interested in international cooperation. This highlights the need for JICA to encourage these resources to play a role in JICA's activities. In other words, JICA should forge partnership with organizations and groups with experience or expertise in the water sector and even develop human resources networks that connect Japan with developing countries.

Japan's traditional technologies (and institutions) are increasingly looked at in a more positive light at ministries and agencies in Japan. It is hoped that they such technologies will be applied in many developing counties, as they are often accommodative to local materials and human resources.

6) Environmental and Social Considerations

Despite their significant impact on the environment and society, large-scale projects, such as flood control or dam construction, will contribute to social well-being over the long term. These projects should be evaluated objectively and scientifically. JICA Guidelines for Environmental and Social Considerations, which will come into force during fiscal year 2004, will help in this regard.

If a particular project is feasible, Japan needs to demand a great deal of commitment – in terms of environmental and social considerations – from the government of the recipient country as early as in the study phase. Japan should therefore approach the government in a responsible manager in terms of financing as well.

Items for Future Consideration

1) Approaches to Problems That Transcend National Borders
2) Approaches to PPP

3-2 Future Issues to be Examined

(1) Approaches to Problems That Transcend National Borders

Problems involving regarding international rivers or those whose importance is recognized at international conferences on regional sectoral issues may not be given priority by recipient countries in country-specific project request surveys. Japan should proactively address problems that transcend national borders, including these seemingly latent problems, with a regional scheme under its diplomatic strategy.

In the future, JICA should make more efforts to identify common issues in a particular region and devise projects to address them that will entail more coordination with international agencies, while securing closer coordination both among its regional offices in that region and between them and its headquarters.

(2) Approaches to PPP

There is a growing trend toward public-private partnership (PPP) in the water sector – especially municipal water supply – in developing countries. Water supply is an indispensable to people's lives. It is essential to ensure sustainable supply of safe water, coupled with appropriate water charging systems (with special consideration for the poor).

Regarding PPP, the government has a vital role to play in ensuring that services are provided appropriately by monitoring and other means. If the regulatory bodies are weak, institution building becomes an important element of development assistance.

PFI was introduced in this subsector only recently in Japan, and it is limited to certain facilities. Despite all these facts, Japan should study how PFI should be applied to water supply in its development assistance.

Appendix 1 JICA's Major Activities

Japan's international cooperation in water resources, which started in the early 1970, has been implemented under various schemes, including Technical Cooperation Project, Development Study, Grant Aid, Dispatch of Experts, and Acceptance of Trainees. Of special note is that many of JICA's aid activities have produced positive results for particular river basins or areas as a whole, in close coordination among – or even sequencing of – these schemes. For future reference, it is worthwhile to list these aid activities according to the Development Objectives Chart, with focus on their features and coordination between different schemes.

Promoting Integrated Water Resources Management

1-1 Promoting Integrated Water Resources Management

Japan's assistance in integrated water resources management (IWRM) covers a wide range of issues, including research and planning, river basin management, flood control management, water use management, water quality management, and river environment management. It also encompasses institution building. Rather than focusing on a particular river from a myopic point of view, more emphasis is placed on IWRM, which targets the entire river basin and combines physical and non-physical approaches. JICA is also providing support for issues involving international rivers, although its experience in this subsector is limited as a bilateral aid agency.

Institutional Strengthening to Promote IWRM

1-1-1 Institutional Strengthening to Promote IWRM (Case No. 1-3)

In this subsector, JICA is engaged in data collection and system development for water resources information systems, including human resources development (HRD) for this purpose, mainly through technical cooperation projects. Under the development study scheme, JICA provides experts for policy advice on organizational and legal structures. River basin management organizations, water pricing policy that considers cost-recovery, and the introduction of the users-pay principle are also covered by JICA's development studies, as exemplified by a project for the Brantas River in Indonesia.

Promoting River Basin Management

1-1-2 Promoting River Basin Management (Case No. 4-5)

The integrated river basin development for the Brantas River in Indonesia is a typical example of Japan's continued engagement in a particular river basin with an integrated approach – an engagement that took a series of forms over the long-term. This engagement continued for nearly forty years from the first master plan launched in 1961 (study on the comprehensive development plan for the Brantas River basin) through the fourth master plan completed in 1998 (Study on the Comprehensive Management Plan for the Water Resources of the Brantas River Basin). The first and second master plans focused on physical measures, including the construction of multi-purpose dams and river improvement works designed for flood control and irrigation. The third master plan, however, included recommendations on the non-physical aspect, that is, institutional development. Among such recommendations were: the development of the river law; the establishment of a committee to coordinate different works for river management, and the installation of flood forecasting and warning systems. The fourth master plan went even further. It covered a wide range of issues, including: the user-pays principle regarding river management costs; awareness-raising about the effective and efficient operation of flood control facilities; community involvement in river management, the establishment of water authorities, financial self-sufficiency in operation, and the possibility of privatization.

JICA has recently implemented grant aid projects in a new area, that is, emergency response to dam sedimentation as part of its assistance to multi-purpose dam construction.

Effective Management of International Rivers

1-1-3 Effective Management of International Rivers (Case No. 6-7)

As its engagement in international river management, JICA has been assigning exerts to the Mekong River Commission since 1993. JICA also conducted the Study on the Hydro-meteorological Monitoring for Water Use Rules in Mekong River Basin as part of the water use planning initiative led by the World Bank. This study entailed the disclosure and exchange of hydrological data and other information among the river basin countries, contributing confidence building among them.

Ensuring Efficient and Sustainable Supply of Safe Water

1-2 Ensuring Efficient and Sustainable Supply of Safe Water (Water Use)

JICA's assistance in the supply of safe and adequate water covers a wide range of issues, and aid components somewhat differ depending on such factors as the water source (groundwater or surface water) and the type of the target area (urban or rural). For example, as the water source of urban water supply tends to

be surface water, aid components often include surveys and recommendations on water charging, measures to reduce non-revenue water, and institution building for water utilities. In the case of rural water supply, whose source tends to be groundwater or springwater, aid components are increasinlgy centered around participatory operation. Some of the recent projects address water supply, wastewater treatment, and even sanitary improvement in an integrated fashion.

Controlling Water Demands

1-2-1 Controlling Water Demands (Case No. 8-15)

Securing water resources does not necessarily mean water resources development. Preventing water leakage and promoting water-saving can have the same effect as the development of a new water resource. JICA's assistance in water leakage control gained major achievements with support in putting distribution pipes in place and dispatch of experts, as exemplified by its project in Damascus, Syria. JICA's development study for Vientiane, Laos included the promotion of water saving, as well as water leakage control, as an important component. It suggested mounting water-saving campaigns for citizens. Stressing the importance of the water authority's commitment to improving its services in rallying public support, the study stated that confidence building between water suppliers and users is the key to effective water saving.

Some of JICA's projects in irrigation are designed to improve the efficiency of water use with small or water-saving irrigation schemes. These projects focus on the transfer of technologies to build small, water-saving irrigation facilities rather than their construction of these facilities.

Increasing Water Supplies with Water Resource Development

1-2-2 Increasing Water Supplies with Water Resource Development (Case No. 16-22)

JICA has carried out development studies on national water resources development in many developing countries. In these studies, JICA assessed the water resources in particular countries or river basins and then developed water resources development plans based on water demand forecasts. JICA has tended to conduct groundwater development projects in tandem with water supply projects, as groundwater is often a major water source in rural areas.

In addition, JICA conducted feasibility studies on the desalination of brackish water in Jordan and seawater in Saudi Arabia, Oman, Algeria, Columbia, the United Arab Emirates and other water-scarse countries.

Conserving Water Quality (Both at Source and at the Tap)

1-2-3 Conserving Water Quality (Both at Source and at the Tap) (Case No. 23-27)

In some developing countries, arsenic and fluorine are major contaminants of water sources, causing health hazards. JICA has been addressing this problem. The Agency has support Bangladesh in arsenic pollution control with a JICA partnership program (JPP) and a development

study. In the JPP, the executing agencies secured alternative water sources, introduced small-scale water treatment equipment, and mounted awareness-raising campaigns for local communities. In the development study, JICA assessed arsenic pollution in Bangladesh and put forward a master plan to control this pollution. As for fluorine pollution, JICA researched small-scale fluorine removal units and conducted demonstration testing of such units at households.

In Mali and Mauritania, JICA supported guinea worm control with water supply facilities that use deep groundwater not contaminated with the worms. With improvements in the water and sanitary environments, this assistance significantly contributed to the eradication of the guinea worm disease.

JICA has also conducted grant aid projects and development studies aimed at water quality monitoring or water quality improvement in specific rivers or river basins.

Ensuring Equitable Water Allocation

1-2-4 Ensuring Equitable Water Allocation (Case No. 28-42)

In the context of securing water resources and equitable water supply, countries in Middle East and Sub-Saharan Africa face many challenges. JICA's Study on Water Resources Management in Jordan is a typical example of Japan's reaction to these challenges. JICA has experience in assessing finite water resources and then formulating IWRS plans designed to allocate the resources equitably among different uses. Yet the Agency has little experience in supporting legal framework development (including the water law and water rights systems) and the establishment of a unified water management organization.

JICA's program for water supply development in Phnom Penh deserved attention as a project with successful aid coordination with other donors. This program was launched in 1993 when JICA developed a master plan. Based on this plan, Japan supported the construction and expansion of water purification plants and a water distribution network through its grant aid scheme, and dispatched experts and Japan Overseas Cooperation Volunteers to the project. Other donors provided assistance largely in line with the JICA master plan. For example, UNDP and the World Bank supported utility management (in such aspects as tariff collection and accounting), as well as physical measures including water distribution networks and water purification plants. In addition, ADB and France also supported both physical and non-physical aspects.

Coordination with NGOs was pursued in JICA's grant aid program in Lusaka, Zambia. The program improved the operation and maintenance of water supply facilities with community involvement. As this program shows, recent grant aid programs tend to emphasize institution building and facility management, as well as physical infrastructure development. Increasingly, grant aid programs and projects in water supply include "soft" components, including:

transferring technologies to the counterparts involved in operation and management of facilities; and organizing water users associations.

JICA has conducted development studies aimed at both waterworks development and sanitary improvement in cases where waterworks development would result in increases in wastewater and pollutant loads, which may in turn lead to environmental degradation. Development studies for Metro Manila (the Philippines) and Kisumu (Kenya) are some of the examples. Such a development study for Astana, Kazakhstan led to D/D in coordination with JBIC.

The water supply program for Senegal is an example of JICA programs that continued over the years. This program consists of a series of 17 grant aid projects between 1979 and 2001. This program is noteworthy in that it promoted institution building in tandem with physical infrastructure development, so that villagers themselves could operate and maintain facilities and collect tariffs through water management committees.

Among JICA's activities that paid special attention to gender issue are the livelihood improvement project in Sumba, East Nusa Tenggara Province (Indonesia), and the study on rural water supply and sanitation improvement in northwestern Laos. Both project succeeded in promoting the active involvement of women.

JICA has many projects designed to train water engineers, including the long-term program for the Thai National Waterworks Technology Training Institute (NWTTI), which was launched in 1995. This program's HRD initiative addresses not only the engineering aspect but also utility management, so that water utilities will achieve financially-independent management.

In Tanzania, JICA is involved in public finance management, so that JICA can identify priority issues in water and formulate and implement efficient aid projects.

Improving Flood Control to Protect Lives and Properties

1-3 Improving Flood Control to Protect Lives and Properties

Of all the JICA's activities in flood control to date, those for *sabo* (erosion and sediment control) and debris flow control represent the largest share, followed by those for river flood control. Some projects deal with both of these two issues. By region, Asia, which are prone to debris flows and floods, accounts for the largest proportion. Specifically, Asia makes up 69 percent of all the JICA's projects and programs in flood control between 1974 and 2000 under the schematic framework of Grant Aid, Development Study or Project-type Technical Cooperation (now "Technical Cooperation Project"). JICA's technical cooperation projects in particular are expanding their scope to include the non-physical ("soft") as well as physical aspects. Some of them are aimed at

increasing coordination between government agencies and local communities, with a view to promoting community-based preparedness.

Institution Building for Disaster Preparedness

1-3-1 Institution Building for Disaster Preparedness (Case No. 43-50)

JICA's assistance in this subsector is aimed at establishing models and systems to prevent or mitigate natural disasters, putting flood forecasting and warning systems in place, and preparing hazard maps. It also includes such components as institution building, human resources development, and disaster awareness of local residents. It should be noted that some of JICA's projects in this subsector focus on promoting community preparedness, increasing coordination among stakeholders through workshops, or accommodating the poor, among other issues.

Strengthening Erosion and Sediment Control for Landslide Disaster Mitigation

1-3-2 Strengthening Erosion and Sediment Control for Landslide Disaster Mitigation (Case No. 51-54)

JICA's development studies have often addressed not only planning for physical measures including the construction and upgrading of flood control and *sabo* structures, but also non-physical aspects such as improving land use regulations, putting in place flood forecasting and warning systems, tree planting, and institutional improvement. In the process of these studies, JICA has transferred technologies to the counterparts in recipient countries. One of the studies (the study on the planning of flood control and *sabo* for the Chamelecon River and its tributaries) produced positive results in coordination with the assignment of *sabo* experts on a long-term basis. The recommendations made by this study gave rise to the grant aid project titled Project for Flood Control and Sabo in the Choloma River.

Promoting Flood Mitigation

1-3-3 Promoting Flood Mitigation (Case No. 55-57)

JICA has conducted many development programs and projects in river flood control. Development studies in this subsector have often led to grant aid projects or loan aid projects. For example, the Project for Flood Mitigation in Ormoc City (grant aid project) was a result of the "study on flood control planning for selected cities" (development study). Likewise, recommendations in development studies gave rise to the "program for rainwater drainage development in Dacca" and the Project for Flood Protection and Drainage Improvement in the Municipality of Phnom Penh (both of them were grant aid projects).

Promoting Coastal Protection

1-3-4 Promoting Coastal Protection (Case No. 58-59)

JICA has relatively little experience in coastal protection. Yet the JICA's efforts to construct seawalls in Male Island constituted a long-term program

including a grant aid project (1987-1989), a development study (1991-1992) and another grant aid project (1993-1999).

Conserving the Water Environment

1-4 Conserving the Water Environment

Among the keywords in the area of the water environment is a "sound hydrological cycle." The idea fits in the context of integrated water resources management (IWRM), which is aimed at sustainable development. Based on this idea, JICA has provided assistance in planning sewerage development to control water pollution, promoting institution building in relation to water environment management, and raising public awareness (environmental education). A typical JICA program or project in this subsector tends to address two or more of these issues.

Improving the Capacity for Water Environmental Management

1-4-1 Improving the Capacity for Water Environmental Management (Case No. 60-63)

JICA has helped China, Chile and other countries with environmental conservation centers tasked with monitoring water quality regularly, evaluating monitoring results, issuing regulations as appropriate, and raising community awareness about the environment. (Note that this assistance in this subsector is part of larger activities of JICA.) In addition, JICA called for the capacity development of implementing agencies involved in water environment management in its development studies on integrated river management.

Developing Wastewater Treatment Facilities for Appropriate Treatment

1-4-2 Developing Wastewater Treatment Facilities for Appropriate Treatment (Case No. 64-66)

JICA has conducted many development studies on sewerage development in cities. Yet only a small proportion of them were put into practice as urban sewerage development costs a lot of money.

In contrast to assistance in end-of-pipe technologies for existing plants and equipment, JICA conducted a development study on the promotion cleaner production for Malaysia. Cleaner production is an effective approach to controlling industrial wastewater because this production system is aimed at recycling materials within the production cycle as much as possible so as to minimize the emissions of pollutants. Cleaner production is a win-win approach: it is designed to control industrial pollution and increase production efficiency at the same time by reviewing the whole production processes.

Promoting Water Quality Conservation in Public Waters

1-4-3 Promoting Water Quality Conservation in Public Waters (Case No. 67-71)

JICA has conducted many development studies with the aim of preventing and mitigating water pollution in urban areas and closed public

waters (Guanabara Bay, Havana Bay, etc.). These studies are not limited to the activities necessary for sewerage development such as: research on the sources of pollutants; and analysis of water pollution in rivers, lakes and bays (including simulation and modeling). They also address the non-physical aspects. For example, some development studies emphasize the importance of water environmental conservation through awareness raising activities and environmental education programs for local communities.

There is growing interest in water environments among the recipient countries of JICA. To date, over 1,000 people from these countries have came to Japan to receive training in this subsector. Between 1990 and 2000, this kind of trainees take up the second largest share of all the trainees who have received training in Japan, following the group of trainees in the field of Irrigation, Drainage and Reclamation Engineering.

Box A1-1 Water supply development in Phnom Penh

The reconstruction process of water services in Cambodia – a country which had been devastated under the Pol Pot regime and more than one decade of civil war thereafter – started with the development of a master plan by JICA in 1993. In early 1990s, water services in Phnom Penh were in a miserable state. The water supply capacity of Phnom Penh was only 63,000 cubic meters per day, compared with 155,000 cubic meters per day during the 1960s. In addition, the water leakage rate was more than 70 percent. Based on the JICA master plan (long-term plan), Japan started to provide aid under a various kinds of schematic frameworks. Other donor countries and multilateral financial institutions launched their aid initiatives in coordination with Japan.

The first in the series of Japan's grant aid projects to support physical measures in Phnom Penh was the first water supply development project for Phnom Penh. The products of this project included the upgrading of the Phum Prek Water Treatment Plant, the construction of distribution reservoirs, and the upgrading of elevated tanks. Under the second program of 1997 distribution pipes (a total length of 67 kilometers) were installed and water meters were provided. The Project for Expansion of Phum Prek Water Treatment Plant in 2001 succeeded in building an additional facility with a capacity of 50 thousand cubic meters per day and upgrading the existing facility.

Japan's assistance in non-physical measures (human resources) was provided by a number of expert assignment projects, including: dispatching JICA experts in water supply systems, machinery and equipment, and electric equipment on a short-term basis between 1999 and 2001; dispatching Japan Overseas Cooperation Volunteers (JOCVs) in charge of water examination in and after 1998; and dispatching experts (in purification process control and water microorganism) from Thailand to Cambodia between 1998 and 2000. These personnel contribute to adequate operation and maintenance of facilities developed under the grant aid projects. Through expert assignment projects, both the Kitakyushu Municipal Government and the Waterworks Department, Osaka Prefectural Government forged friendly relationships with the Phnom Penh Water Supply Authority (PPWSA). This is a good example of international cooperation initiatives by local governments. Since 2001, the Kitakyushu Municipal Government has been implementing a small-scale partnership program (designed to putting a telemetering system in place) in Phnom Penh. This initiative is attracting attention as one type of public participation in cooperation activities.

In addition to these efforts by Japan, the World Bank, UNDP, ADB and France supported both physical and non-physical measures in Phnom Penh and other areas in Cambodia. As a result, the capacity of PPWSA was markedly improved in terms of water supplies, human resources and financing standing. To expand the impact of such assistance to the whole country, JICA launched a project to develop human resources in water supply in 2003. This project is aimed at further developing human resources at not only PPWSA but also the Ministry of Industry, Mines and Energy (MIME), which is in charge of waterworks in regional cities with better training systems and other means. This project is made up of a wide range of components, including: technology transfer from the capital to the regions within Cambodia; expert dispatches, trainee acceptance and equipment provision under the schematic framework of JICA Technical cooperation Project; good use of utilization of the National Waterworks Technology Training Institute in Thailand; and cooperation activities by the Waterworks Bureau, the Kitakyushu Municipal Government and the Waterworks Department, Osaka Prefectural Government.

In sum, Japan and other donors efficiently supported water utilities in both physical measures and the development of human resources, which were extremely scarce as a result of the prolonged civil war. And the donors' efforts paid off.

Sources: Japan International Cooperation Agency (1993a) (1993b), Institute for International Cooperation, JICA (2001), Yamamoto, Keiko (2000)

Box A1-2 IWRM projects for the Brantas River Basin

The Brantas River is the second largest in Java with a catchment area of some 11,800 square kilometers. At the river mouth is Surabaya, the second biggest city in Indonesia. The river basin is a political and economic center in East Java Province, and it is of strategic importance for the country. The development of the river basin dates back more than three centuries to the period when Indonesia was a colony of the Netherlands. However, irrigation facilities and flood control structures were extremely in bad repair by 1950s. Eruptions of the Kelud Volcano often caused flood and debris flow hazards.

Against this background, JICA implemented a series of aid project every decade or so:

1961: First master plan (M/P) (study on the comprehensive development plan for the Brantas River basin by OTCA, forerunner of JICA)

1972: Second M/P (study on water resources development in the Brantas River basin; study on the Surabaya river improvement plan)

1984: Third M/P (study on Widas river basin development plan)

1997: Fourth M/P (Study on the Comprehensive Management Plan for the Water Resources of the Brantas River Basin)

The first and second master plans focused on physical measures, including the construction of multi-purpose dams and river improvement works designed for flood control and irrigation. The third master plan, though building on physical measures, included recommendations on non-physical measures as well, including the development of the river law; the establishment of a river management committee, the installation of flood forecasting and warning systems, and other elements of institution building. The fourth master plan effected a shift in focus from physical measures toward IWRM aimed at managing the whole basin with emphasis on non-physical approaches. It also defined the goal of water resources management (providing water as necessary in terms of timing and location) and targets (water resources conservation, flood control, low water management, water quality management, and river environment management). Then the fourth master plan identified four basic principles of water resources management: (i) the principle of one-river, one-plan and one management body; (ii) the principle of full cost-recovery; (iii) the user-pays principle; and (iv) the principle of service delivery in exchange for payment.

In this manner, the concept of Brantas River basin development has changed with the times. At any rate, a total of over 100 billion yen has invested based on the master plan discussed above, including war reparations and loans from Japan, loans from the World Bank and ADB, and grant aid and loans from Australia. As a result, the unit yield of rice in the river basin has jumped to 8.23 tons per hectare (compared to the national average of 5.67 tons per hectare in 1993). The electrification rate in the basin reached 85 percent in 1993 (from less than 10 percent in the 1960s), contributing to local industrialization and raising the living standards of communities. In addition, a great many of the Indonesian engineers who have engaged in these projects and obtained expertise are now playing a pivotal role in integrated river management plans aimed primarily at flood control elsewhere in Indonesia.

Sources: Japan International Cooperation Agency (1994), Institute for International Cooperation, JICA (2001) (2002), Nippon Koei Co., Ltd. and KRI International Corp. (1997)

Box A1-3 Water supply program in Senegal

Senegal, located at the western edge of the African Sahel, has only a small amount of surface water. Many of the rural communities depend on shallow water wells. These shallow wells are prone to contamination by pathogenic organisms in the surface layer of earth. In addition, they are likely to dry up in the dry season. Up to 1970, the Senegalese government drilled deep wells across the country, but many of them remained underused because it did not have enough resources to construct water supply facilities.

To rectify the situation, JICA launched in 1979 a grant aid project for rural water supply using existing deep wells as its source. Including this project, JICA carried out a total of 17 grant aid projects (with total funds of some 11.5 billion yen) over a period of 20 years. Thanks to these projects, new water supply facilities were constructed in 106 villages, and existing facilities were upgraded in ten villages. The increased amount of water supplied because of these projects accounted for 24 percent of total water supplies in rural Senegal. Some 280,000 people benefited directly from the projects. In addition, the projects improved the heath and economic productivity of the newly served people and freed many children from water drawing labor, thus providing better access to education.

These projects produced major achievements because they addressed not only physical measures but also institutional arrangements. Specifically, JICA constructed two headquarters and two centers for operation and maintenance so that the Senegalese can take full care of water supply facilities. The Agency also provided necessary equipment for this purpose. In addition, JICA supported the establishment of water management committees on rural water supply, and prepared operation and maintenance manuals for both relevant government agencies and communities. As a result, a majority of these communities can now cover the cost of operating and maintaining rural water supply facilities with tariffs collected by water management committees at the community level. These water supply services are increasingly on a sound financial footing without the need for government subsidies.

However, some of these water management committees are faced with management problems. To address these problems, JICA launched a support project for potable water and community activities in Senegal, which is aimed at providing approaches for sustainable operation and maintenance of water supply facilities over a period of three years with government agencies and rural communities working together. This project includes an innovative approach in which rural communities who have obtained relevant skills will share such skills with other communities. It is expected that this approach will prove effective in technology transfer.

Sources: Japan International Cooperation Agency (1997) (2002), Institute for International Cooperation, JICA (2002)

Annex Table: A List of Selected Water Resources Projects

No	Country	Project Name	Period	Type of Schemes	Mid-term Objective	Characteristics
1. Promoting Integrated Water Resources Management (IWRM)						
1-1 Institutional Strengthening to Promote IWRM						
1	Syria	The Establishment of the Water Resources Information Center (WRIC)	June 2002 - June 2005	TCP, GA	1-1 1-2 2-4	The main objective are: (i) to train staff at WRIC in hydro-meteorological observation, data collection, data processing and others, so that they can take charge of human resources development (HRD) themselves; and (ii) to ensure that necessary information on river basin management is provided through this water resources information system. Necessary equipment has been provided under the grant aid scheme.
2	People's Republic of China	Planning of the development of water rights systems	July 2004 - November 2005 (Phase I)	DS	1-1 1-2	The main objectives are: • To transfer technologies as part of efforts to strengthen both arrangements for water resources management and management capacities in order to promote the development of water rights systems in China • To conduct studies on the introduction of water rights systems, international comparison in such systems (including water market systems), case studies in the model area (the Taizi He river basin, Liaoning Province), and the drafting of plans to allocate water resources and water rights (new allocations or reallocations)
3	People's Republic of China	Human Resource Development Project for Water Resources	July 2000 – June 2005	TCP	1-1 3-1 3-2	The objective is to create courses at the Human Resource Development Center, Ministry of Water Resources to train 2,000 advanced engineers in such fields as water resources management, construction management, sabo (erosion and sediment control) and training management. These advanced engineers will in turn train primary and intermediate level engineers.
1-2 Promoting River Basin Management						
4	Indonesia	Study on the Comprehensive Management Plan for the Water Resources of the Brantas River Basin	1997-1998	DS LA	1-1 1-2 2-1 2-2 2-3 2-4 3-1 3-2 3-3 4-1	Launched in 1961, this project was completed with the fourth master plan. Many of the facilities based on this project were constructed under the loan aid scheme. The first and second master plans focused on physical measures. The third and fourth master plans, on the other hand, addressed such issues as river basin conservation management, flood control management, water use management, water quality management, and river environmental management. Toward the fourth plan, more focus was placed on: the principle of one-river, one-plan and one management body; the principle of full cost-recovery; the user-pays principle; and the principle of service delivery in exchange for payment.
5	Philippines	Master Plan Study on Water Resources Management in the Philippines	March 1997-July 1998	DS	1-1 1-2 2-1 2-2 2-3 2-4 3-1 3-2 3-3 4-1	With the target year of 2025, this study produced water demand projections, surface water development plans for some river basins and cities, recommendations on institutional improvements, and short-term regional strategies. This study was followed by the Study on Water Resources Development for Metro Manila.
1-3 Effective Management of International Rivers						
6	Thailand, Viet Nam, Laos, Cambodia	Study on the Hydro-meteorological Monitoring for Water Use Rules in Mekong River Basin	2000-2003	DS	1-1 1-3	This objective is to assess the flow regime of the Mekong River basin, support the Mekong River Commission (MRC) in drafting the rules governing water use, and build the capacity of MRC members from developing countries.

No	Country	Project Name	Period	Type of Schemes	Mid-term Objective	Characteristics
7	Thailand, Cambodia	Dispatch of experts to MRC	1993-	DE	1-1 1-3 2-4	Since the 1990s, JICA has provided experts (on a short-term or long-term basis) in hydroelectric power generation, river basin hydroelectric power development planning, hydrological technologies (as part of agriculutral and rural development), irrigation, and many others.
2. Ensuring Efficient and Sustainable Supply of Safe Water						
2-1 Controlling Water Demands						
8	Uzbekistan	The Study for Improvement of Management and Tariff Policy in the Water Supply Services in the Republic of Uzbekistan	1998-1999	DS	2-1 2-4	This study produced a water meter installation plan to charge water users based on their consumption and encourage them to save water. The serious problem of water leakage due to timeworn pipes was addressed. The study also produced recommnendations on better management of water utilities with improved water pricing and tariff collection systems.
9	Laos	Master plan study on water supply in Vientiane	March 2003-January 2004	DS	2-1 2-4	This study called for water-saving measures in tandem with waterworks development in light of the relatively high consumption of water per person. The study stated that confidence building between the water authority and users based on the former's commitment to better service is key to promoting water saving practices of the latter.
10	Philippines	Management of Unaccounted for Water/Improvement of a Non-Revenue Water	1994-1997	Dispatch of individual experts as a team	2-1 2-4	The overall objective was to support the stable supply of safe water in Metro Manila through pilot projects designed to reduce no-revenue water. The aid components included: the long-term assignment of experts (in reducing non-revenue water and replacing water pipes); the short-term assignment of experts (in reducing water leakages, pipe management, and pipe mapping); the acceptance of trainees (in reducing non-revenue water); and the provision of equipment (water leakage detectors, and software designed to support water-related work).
11	Americas	Water leakage control in Latin America	1998-2002	Training in Japan (country-focused training program)	2-1 2-4	The objective was to train mid-level engineers at water utilities in three Latin American countries where the leakage rate was high (Bolivia, Mexico and Honduras). This training program provided knowledge and expertise in water leakage control and overall operation and maintenance of water distribution and supply facilities, so as to contribute to stable supply of drinking water.
12	Syria	Master plan study on the development of the water supply system for the city of Damascus	1995-1999	DS→GA	2-1 2-4	Syria was urgently required to ensure stable supply of water during the drought period and appropriate response to growing water demand. Furthermore, the percentage of accounted-for water to the total water supply remained at 34 percent. Against these backgrounds, JICA's Social Development Study Department formulated an M/P. Then a F/S was conducted. During these processes, two major plans were developed: (i) a plan to introduce a block distribution system to the existing water distribution network as part of water leakage control; and (ii) a plan to develop a water distribution network for squatter settlements as part of water theft prevention. Under the grant aid scheme, piping materials to repair the timeworn pipes were procured. Between 1998 and 2000, JICA provided experts in water leakage control on a long-term basis.

No	Country	Project Name	Period	Type of Schemes	Mid-term Objective	Characteristics
13	Jordan	Project to promote organic forming that emphasizes community participation, environmental conservation and water saving and set up a promotion center in the area north of the Jordan Valley	2003-2006	JPP (grassroots partnership type)	2-1 2-3 2-4	This project aims to promote eco-friendly, water saving organic forming and economic productivity of local communities in South Shouna and Jerash districts. It also aims to establish expertise and develop human resources to promote this farming method. In permaculture farms, vegetables and trees will be planted in furrows developed along contour lines to save and retain water. The project therefore includes contour lining and necessary technical guidance. In this project, participating farmers will also be given technical guidance on "banana circles" and other techniques to introduce the water catchment system and reuse domestic wastewater.
14	People's Republic of China	Model Planning Project for Water Saving Measures in Large-scale Irrigation Schemes	2001-2006	TCP	2-1 2-4	This project, which is being implemented in model irrigated areas, is designed to standardize procedures for developing rational water management and operation plans and transfer technologies for collecting and managing facility management information and introducing water-saving irrigation to rice paddies (at the field level). The overall objective is to help China to implement water-saving and improvement projects effectively and efficiently.
15	Malawi	Master plan study on improving the technical capacity to develop small-scale irrigation schemes	2002-2004	DS	2-1 2-4	Objectives: to improve water use efficiency through the establishment of techniques for small-scale irrigation development; and to improve technical and institutional capacity of human resources involved in small-scale irrigation development. Targets for technology transfer: officials at the Ministry of Agriculture and Irrigation, NGOs involved in this study, and residents in the model project area.
2-2 Increasing Water Supplies with Water Resource Development						
16	Viet Nam	Master plan study on national water resources development	2001-2003	DS	1-1 1-2 2-1 2-2 2-4	This study was designed to establish the frameworks for using and managing water resources in an integrated and rational manner and in good coordination among government agencies involved in water resources. The study determined the order of priority
17	Zambia	Master plan study on national water resources development	1993-1995	DS, GA	2-2 2-4	JICA worked out a master plan for national water resources development between 1993 and 1995. This plan was aimed at increasing the percentage of people with sustainable access to safe water by promoting rural water supply and improving the sanitary environment. To put the plan into practice, a grant aid project, formally known as the Project for Groundwater Development and Sanitation Improvement in Drought Prone Rural Areas, was implemented. Under the project, wells equipped with a hand pump were developed.
18	Macedonia	Master Plan Study on Integrated Water Resources Development and Management	1997-1999	DS	1-1 1-2 1-3 2-4 4-1	This study was designed to address three major issues: (i) serious droughts; (ii) water-related diseases due to shallow wells contaminated by domestic wastewater; and (iii) the difficulty in managing three major rivers, which span national borders. The study produced a plan concerning the middle- to long-term development and management of water resources and a master plan for comprehensive development and management of water resources.

No	Country	Project Name	Period	Type of Schemes	Mid-term Objective	Characteristics
19	Burkina Faso	Groundwater development project	1993	GA	2-2 2-3 2-4	Under this project, JICA provided vehicle-mountable well drillers and other necessary equipment and developed water wells in 80 sites. This provision was efficient. It was reported that diarrhea incidences in children were reduced due to this groundwater supply. Yet this project did not result in improvements in other living conditions or the environment, as groundwater was used only during the dry season. This situation points to the need for better awareness-raising campaigns in collaboration with government agencies in charge of public health. Local communities should also be encouraged to operate and maintain these water wells themselves. For reference, an NGO installed pumps on condition that the local community in the project area establish a water management committee and present a certificate of deposit to cover operation and maintenance costs (a project under FY1996 Thematic Evaluation).
20	Cambodia	Study on Groundwater Development in Central Cambodia	2000-2002	DS	2-2 2-3 2-4	JICA started this study in FY1996 in response to the urgent need for safe water supply using groundwater in central Cambodia. Based on the assessment of available groundwater in two central provinces, a plan for sustainable groundwater development was formulated.
21	Bolivia	Project for Groundwater Development in Rural Areas (Phase I and II)	1996-1998	DS→GA	2-2 2-3 2-4	JICA provided well drillers and developed water wells and other water supply facilities in Santa Cruz and Chuquisaca provinces (Phase I) and in Tarija and Oruro provinces (Phase II) in such a manner that the technologies transferred could be applied to water well development in other provinces. This project also supported the non-physical aspects, including guidance regarding the operation of water supply facilities by a water management organization. The project significantly contributed to the efforts of the Bolivian government in groundwater development in other unserved areas in rural Bolivia.
22	Jordan	Study on Brackish Ground Water Desalination in Jordan	1993-1995	DS	2-2 2-3 2-4	Jordan depended most of its water supply resources on groundwater. Yet there was little room for further exploitation of underground freshwater. This situation called for desalination of available underground brackish water. This study found that both the quality and quantity of underground brackish water in Jordan were promising and recommended the reverse osmosis membrane method for desalination. Note that brackish water is now attracting positive attention as a new water resource in areas where water is scarce.
2-3 Conserving Water Quality (Both at Source and at the Tap)						
23	Bangladesh	Mobile Arsenic Centre Project for Mitigation of the Arsenic Contamination of Drinking Water in Bangladesh	2001-2004	JPP (grassroots partnership type)	2-2 2-3 2-4	This JICA-NGO partnership project is designed to provide safe drinking water for arsenic-contaminated areas and encourage arsenic control activities through awareness-raising and human resources development. The project includes the dispatch of exerts (arsenic control advisors) between 2000 and 2004.
24	Bangladesh	Study on Ground Water Development of Deep Aquifers for Safe Drinking Water Supply to Arsenic Affected Areas in Western Bangladesh	1999-2002	DS	2-2 2-3 2-4	This study was designed to formulate a master plan for arsenic control in three districts in western Bangladesh (Jessore, Jhenaidah and Chuadanga) with focus on the development of deep groundwater and pre-feasibility studies for priority projects. The study included: assessing arsenic damage; developing arsenic contamination maps (GIS data maps); conducting preliminary testing of arsenic removal units; drilling observation wells: performing a simulation of groundwater development; investigating the mechanism of arsenic contamination; and addressing the physical and non-physical aspects.

No	Country	Project Name	Period	Type of Schemes	Mid-term Objective	Characteristics
25	Tanzania	Project for Rural Drinking Water Supply in Hanang, Singida Rural, Manyoni and Igunga Districts	2000-2003	GA	2-2 2-3 2-4	Earlier, JICA conducted a development study on groundwater development (1997-98) and formulated a basic plan for water supply using groundwater in targeted areas. This grant aid project was implemented to put part of this basic plan into practice. The project centered around the construction of facilities designed to ensure sustainable supply of safe water for about 20 thousand people in the four districts. The "soft" components of this project included research and improvement of small-scale fluorine removal units and 6-month demonstration testing of such units at four households.
26	Mali	Rural water supply project for guinea worm control	1993-1994	GA	2-2 2-3 2-4	This project was designed to eradicate the guinea worm disease. (Guinea worms are parasites that live in water fleas as its intermediate host.) A total of 500 water wells were drilled in 262 villages to provide freshwater not contaminated with guinea worms. Well drillers and other equipment were procured for this purpose. This project dramatically reduced the incidence of the disease. The ex-post evaluation (FY1996 Thematic Evaluation) report stated that the project had produced synergy effects with the efforts of UNICEF, UNDP and USAID to raise public awareness and promote the use of water filters. On a negative note, the report raised concern about the future operation and maintenance because of a limited number of engineers at executing agencies of Mali. The report also pointed out that the water management committee placed too much emphasis on awareness-raising about public health, leaving room for improvement in its guidance on the operation and maintenance of the pumps.
27	Jordan	Project for Water Pollution Monitoring System	2002-2002	GA	2-3 4-1	In the project, JICA supported the establishment of water quality monitoring stations and the procurement of water quality analyzers in response to the serious pollution of major water sources in northern Jordan. The major causes of this pollution were: (i) the scarcity of water resources; (ii) the flow of agricultural and industrial wastewater into the river system; and (iii) the flow of domestic wastewater directly into the river system because of the significantly inadequate capacity to treat wastewater.
2-4 Ensuring Equitable Water Allocation						
28	Jordan	Study on Water Resources Management	1999-2001	DS	1-1 1-2 2-2 2-4 4-3	This study produced an IWRM plan designed to strike a national balance in demand between municipal water and agricultural water in the context of sustainable water resources development. The IWRM was formulated based on the existing water policy in each water-related sector in Jordan, with attention paid to both water resources management and water resources development management.
29	Cambodia	Water supply development in Phnom Penh	1993-2003	DS→GA	2-4	Objective: To develop a master plan and an emergency repair plan for water supply in Phnom Penh. Outcomes: Based on the master plan, a serious of water supply projects were implemented, including: upgrading the Phum Prek Water Treatment Plant (the capacity was increased to 100 thousand cubic meters per day); constructing distribution reservoirs; replacing distribution pumps; repairing elevated tanks; improving part of the water distribution network in central Phnom Penh (7th January and Toul Kork districts), including equipment provision and piping work; procuring water meters; building an additional facility (capacity: 50 thousand cubic meters per day) and upgrading the existing facility at the Phum Prek Water Treatment Plant.

No	Country	Project Name	Period	Type of Schemes	Mid-term Objective	Characteristics
30	Zambia	Water Supply Project in Satellite Area of Lusaka	1993-1999	GA	2-1 2-2 2-4	The water supply facility development project under this grant aid program installed a pipeline-type water supply system that uses deep wells as the water source. In addition, efforts have been made to develop institutional arrangements to operate and maintain the facilities and raise the awareness of the users about hygiene. In collaboration with CARE, JICA and the executing agencies mounted a campaign to promote community involvement in the operation and maintenance of water utilities. Under the framework of its community empowerment program, JICA launched in FY1999 a participatory water supply project designed to promote community initiatives (a project under FY1998 Thematic Evaluation).
31	Mongolia	Master plan study on water supply in Ulan Bator	1993-1997	DS→GA	2-1 2-2 2-4	This study, which was started in 1993, produced a water supply master plan with the target year of 2010. This grant aid project was based on this emergency repair plan. The implementation of the pay-for-use charging system encouraged water saving practices and resulted in a reduction in power consumption. Under the project, water flow meters were installed on apartment buildings.
32	Philippines	Master plan study on the integrated development of waterworks and sewerage in Metro Manila	1994-1995	DS	2-2 2-3 2-4 4-2	This study produced a master plan for the integrated development of waterworks and sewerage in Metro Manila. In the waterworks section, the study focused on the issues of securing water sources, developing trunk lines, and developing a water distribution network. In the sewerage section, interceptor sewers were installed to collect sewage for economic efficiency. The basic plan for sanitation facility development, formulated during this study process, called for the construction of sludge treatment plants in five locations. Pending the completion of these plants, the basic plan permitted the option of dumping sludge into the ocean.
33	Kenya	Master plan study on the development of waterworks and sewerage in Kisumu	1997-1998	DS	2-2 2-3 2-4 4-2	This study produced a master plan for the simultaneous development of waterworks and sewerage. The mater plan included the repair and upgrade of existing water purification plants. As for sewerage, the plan focused on the functional rehabilitation of existing key facilities.
34	Kazakhstan	Detailed design study on the coordination development of waterworks and sewerage in Astana	July 2002-December 2003	DS→D/D	2-2 2-3 2-4 4-2	Based on its F/S in 2001, JICA conducted both a basic design study and a detailed design study for a yen loan project. In the study process, JICA transferred technologies to the implementing agencies of Kazakhstan involved in the waterworks and sewerage plans.
35	Senegal	Regional waterworks development program (phases I-XII); rural water supply program; program to expand rural water supply facilities (phases I-III)	1979-2001	GA	2-2 2-3 2-4	A series of 17 grant aid projects between 1979 and 2001 were designed to make better use of existing water wells. JICA constructed two headquarters and two centers for operation and maintenance so that Senegal can take full care of water supply facilities. At the rural level, water management committees took charge of the operation, maintenance and tariff collection regarding such facilities. It was reported that JICA's efforts to organize local residents paid off (according to the FY1996 Thematic Evaluation).
36	Lesotho	Water Supply and Sanitation Project for Primary Schools	1995-1996	GA	2-2 2-4	Background: Many primary schools lacked restrooms or water supply facilities, and 82% of households did not afford school-related expenses. Outcomes: 71 water wells equipped with a hand pump, 10 small-scale water supply facilities, and 27 restrooms were constructed. Some 30,000 pupils gained access to drinking water (including water for school lunch) and irrigation water. The program thus contributed to the "plan to build self-reliant schools."

No	Country	Project Name	Period	Type of Schemes	Mid-term Objective	Characteristics
37	Morocco	Project for Rural Water Supply in the Pre-Rif Area in Morocco	1997-1999	DA-GA	2-2 2-4	Following its development study between 1994 and 1996, JICA conducted this project, in which groundwater was pumped into service tanks on high ground and then distributed to each village through pipelines. The end distribution outlets were public taps installed in and around the villages.
38	Laos	Study on Rural Water Supply and Sanitation Improvement in North-West Region	1998-2000	DS	2-2 2-4	As part of this study, JICA conducted a pilot project for 50 villages with the aim of planning and constructing a gravity flow water supply system that used springwater and river water as its sources. In addition, 928 units of public flush toilets (PFTs) were built. With advice from the study mission, local residents selected the types of water supply systems and toilets. They also participated in the construction work. What was special was the participatory approach that went further than just inviting residents to participate in sanitary workshops. This approach gave priority to the poor and people in remote areas and took into account the issues involving women and ethnic minorities.
39	Indonesia	Livelihood improvement project in Sumba, East Nusa Tenggara Province	February 1999-March 2001	Community Empowerment Program	2-2 2-4	JICA's preceding projects for water supply in the regency gave rise to this project, which was implemented in collaboration with a local NGO to improve the livelihoods of local residents. In the physical aspect, the project resulted in the construction of water supply facilities. The non-physical components of these projects included: the formation of a water users group; hygiene education for locals; guidance on accounting and the operation and maintenance of water supply facilities; and other kinds of support for livelihood improvement.
40	Thailand	Thai National Waterworks Technology Training Institute (NWTTI)	1985-1999	GA, TCP, DE	2-1 2-2 2-3 2-4	This program was designed to train water engineers with a mix of grant aid, project-type technical cooperation, dispatch of exerts and other types of scheme. Phase I of the program focused on key technology transfer in such fields as: water supply planning, water utility management; water purification and water quality control; operation and maintenance of distribution pipes; and electric and mechanical equipment. Phase II focused on advanced technology transfer in such fields as training, R&D, information exchange.
41	Viet Nam	Water technology training program for Viet Nam	January 2000-January 2003	TCP	2-1 2-2 2-3 2-4	Objectives: (i) to ensure the efficient development and operation of waterworks by reducing the amount of non-revenue water and introducing a stand-alone management system and advanced technologies; (ii) to establish training courses in water distribution planning, non-revenue water control, and water utility management.
42	Tanzania	Study on public expenditure review in water	2003-2004	Aid efficiency promoting program (overseas project formulation study)	1-1 1-2 2-3 2-5 4-3	Public expenditure review (PER) is undertaken by the working group on budget execution review at the Ministry of Finance of Tanzania. With active involvement in this PER process, JICA supports Tanzania in public finance management. By doing so, JICA will be able to identify priority issues in water and formulate and implement efficient aid projects.
3. Improving Flood Control to Protect Lives and Properties						
3-1 Institution Building for Disaster Preparedness						
43	Indonesia	Integrated Sediment-related Disaster Management Project for Volcanic Areas	April 2001-March 2006	TCP	3-1 3-2	Objective: to plan and implement activities designed to mitigate debris hazards based on cooperation between local communities and government agencies. Project components: the establishment of an integrated disaster prevention model; the establishment of the local disaster prevention framework; training of engineers; the establishment of a skill training program; and others.

No	Country	Project Name	Period	Type of Schemes	Mid-term Objective	Characteristics
44	Nepal	Disaster Mitigation Support Programme Project	September 1999-August 2004	TCP	3-1	Objectives: promoting participatory activities, education and awareness-raising about disaster prevention; improving arrangements and establishing techniques for research and rehabilitation regarding natural disasters; and raising the disaster awareness of government officials and local residents.
45	Philippines	Project for Enhancement of Capabilities in Flood Control and Sabo Engineering	January 2000-June 2005	TCP	3-1 3-2 3-3	Objective: capacity building for the Department of Public Works and Highways (DPWH) in planning, designing, constructing and managing flood control and sabo facilities to cope with water-related disasters.
46	CDERA members (16 countries)	Caribbean Disaster Management Project	August 2002-August 2004	TCP	3-1 3-2	Background: Because the member states of the Caribbean Disaster Emergency Response Agency (CDERA) are small economies, they have difficulty in responding to natural disasters on their own. Project components: (i) Strengthening the capacity to develop community disaster management plans with focus on the preparation of hazard maps; (ii) developing a disaster information network in the region.
47	Honduras	Study on Flood Control and Landslide Prevention in the Metropolitan Area	2000-2002	DS	3-1 3-2 3-3	Objectives: To develop a master plan to prevent and mitigate floods and landslides in the Tegucigalpa metropolitan area in both physical and non-physical approaches; and to conduct the subsequent F/S. Outcomes: The master plan was formulated based on improved coordination among relevant agencies and on the consensus among different stakeholders build through PCM workshops.
48	Bangladesh	Study Rural Development Focusing on Flood Proofing	2000-2002	DS	3-1 3-2 3-3	Objectives: To develop a integrated flood control plan with special attention to the poor vulnerable to floods. Outcomes: The plan that considered the livelihood improvement for the poor was formulated.
49	Bangladesh	Project for Construction of Multipurpose Cyclone Shelters (Phase V)	2002-2003	GA	3-1 3-2	The objective is to provide shelters for about 370,000 people residing in high-risk coastal areas along the Bay of Bengal. These shelters serve as schools in peace time. The project is also an attempt to improve the learning environment for children as part of social development in rural areas.
50	Around the globe	River and Dam Engineering III	2003-2008	GT	2-2 3-1 3-2 3-3	Objective: To introduce Japan's up-to-date technologies and expertise in river and dam engineering to engineers engaged in flood control and water resources development, so that they can play a more active role in planning, design, construction or technical development in this subsector.
3-2 Strengthening Erosion and Sediment Control for Landslide Disaster Mitigation						
51	Honduras	Project for Flood Control and Sabo in the Choloma River	1997	DS→GA	3-2 3-3	Background: This project came after the development study titled "the study on the planning of flood control and sabo for the Chamelecon River and its tributaries" (1992-1994). Outcomes: Flood control and sabo structures were repaired or newly constructed. Railway bridges over the river were replace.
52	Philippines	Study on Sabo and Flood Control for Western River Basin of Mount Pinatubo in the Republic of the Philippines	1996-2001	DS→LA	3-2 3-3	In the aftermath of the major eruption of Mt. Pinatubo in 1991, a donor conference was held to define the division of labor in rehabilitation efforts among Switzerland, the United States, Japan, the World Bank, Asian Development Bank and other international financial institutions. Japan took charge of rehabilitation efforts in the river basin west of the mountain, including the Sacobia, Bamban, and Abacan rivers. A development study was conducted, followed by a loan aid program.
53	Bolivia	Afforestation and Erosion Control Project in the Valley of Tarija Region	1998-2003	TCP	3-1 3-2 3-3	Objective: To improve and develop the existing sustainable approach to land erosion control with community participation in model areas along the El Monte and San Pedro rivers.

No	Country	Project Name	Period	Type of Schemes	Mid-term Objective	Characteristics
54	Indonesia	Forest Fire Prevention Management Project	1996-1998	TCP	3-1 3-2 3-3	Outcomes: Practical, sustainable and widely applicable measures for forest fire prevention and initial firefighting were taken in four model national parks using resources available in Indonesia.
3-3 Promoting Flood Mitigation						
55	Philippines	Project for Flood Mitigation in Ormoc City	1997-2000	DS→GA	3-1 3-3	Following the study on flood control planning for selected cities (development study), JICA conducted this two-phased grant aid project to implement river improvement works and construct three slit dams designed to block woody debris.
56	Bangladesh	Storm and Water Drainage System Improvement in Dhaka	1990-1992	DS→GA	3-1 3-3	This program provided non-physical as well as physical solutions to save investment costs. Physical solutions consisted of structures for river blood control and those for urban drainage flood control. The program allowed for small-scale, short-time flooding. JICA advised Banglades authorities to permit land development on the periphery of the target area on condition that land developers build earth banks above the design high water level of receiving water or construct buildings with the floor elevated high above ground level.
57	Cambodia	Project for Flood Protection and Drainage Improvement in the Municipality of Phnom Penh	2000-2001	DS→GA	3-1 3-3	Between 1997 and 1999, JICA worked on the Study on Drainage Improvement and Flood Control for the Municipality of Phnom Penh. Following this development study, the Project for Flood Protection and Drainage Improvement in the Municipality of Phnom Penh was formulated and implemented. This grant aid project was aimed at reinforcing outer dikes and repairing and upgrading drains and drainage pump stations in southern Phnon Penh and other parts of the city.
3-4 Promoting Coastal Protection						
58	Maldives	Study for the planning of coastal disaster prevention on Male Island	1987-1999	DS	3-4	During the study process, a coastal disaster prevention plan was implemented. This plan was designed to prevent and mitigate storm surge disasters on the capital island of Male with the construction and upgrading of costal disaster prevention structures. Between 1987 and 1989, seawalls were constructed along the southern coast of the island as an emergency project.
59	Tonga	Project to expand the seawalls in Nuku'alofa	1987-1988	GA	3-4	Background: The 1982 cyclone seriously damaged the seawalls. Method: Masonry seawall (this method is unlikely to damage the coastal landscapes, inhibit fishery or swiming by residents and tourists, or entail high maintenance costs.) Outcomes: The upgraded seawalls allowed for green belts and nature trails ashore as an additional benefit.
4. Conserving the Water Environment						
4-1 Improving the Capacity for Water Environmental Management						
60	Chile	National Center for the Environment in the Republic of Chile (CENMA)	1995-2000	GA, TCP	4-1	JICA implemented a five-year program to support CENMA in such fields as air quality, water quality and waste management. CENMA, which was established by the University of Chile as a public entity, has four major functions: research, environmental information dissemination, HRD, and training and awareness-raising.
61	People's Republic of China	Model project for restoring the water environment of Lake Tai	May 2001-May 2006	TCP	4-1 4-2	Lake Tai, a precious water supply resource as well as tourism resource, was faced with serious water pollution. Due to the inflow of wastewater from nearby villages and hotels, the concentration of pollutants in the lake water has almost doubled for the past ten years. JICA responded by providing a technical solution—combining community wastewater treatment plants with an eco-purifiction system that takes advantage of aquatic vegetation for their natural purifiction capacity.

No	Country	Project Name	Period	Type of Schemes	Mid-term Objective	Characteristics
62	Egypt	Project for Supply of Equipment for the Regional Environmental Monitoring Network	1996-1997	GA	4-1	Background: The establishment in 1994 of the Environmental Law in Egypt set the stage for the newly reinforced Egyptian Environmental Affairs Agency to start monitoring the environment, including sources of pollution. To this end, Egypt decided to set up the Cairo Central Center and its five regional branches. JICA's cooperation: Provision of equipment for the center and branches. The equipment was largely designed to monitor and analyze the quality levels of the general environment and pollution sources; it can provide scientific data to be used for determining whether a legal regulation can be applied to a particular source of pollution. Outcome: The overall level of the environmental monitoring network in Egypt was upgraded.
63	Around the globe	Water environmental monitoring	2000-2004	GT	4-1	Background: In recent years, developing countries are faced with deteriorating water pollution associated with urbanization and industrialization. To address this problem, it is necessary to accurately assess water quality as the first step. Objective: To train technical officials capable of water quality monitoring by offering Japan's experience and expertise in water quality control.
4-2 Developing Wastewater Treatment Facilities for Appropriate Treatment						
64	Bangladesh	Master Plan and Feasibility Study for the Development of Sewerage System in North Dhaka; Construction and Rehabilitation of the Sewerage	1998-	DS→GA	2-3 4-2	North Dhaka was experiencing a rapid population growth and disorderly urbanization. The sanitary environment was deteriorating due to underdeveloped sewerage. This situation promoted JICA to conduct a social development study, followed by M/P and F/S. The resulting grant aid project focused on the area around Gulshan Lake, where water pollution was serious. The project has two major purposes. One was to promptly construct a sewer network to control the pollution of the lake. The other was to upgrade part of the existing sewer mains and introduce (better) cleaning equipment to restore their discharging capacity, so as to make the best of the existing final sewage treatment plants.
65	Thailand	Project on the Industrial Water Technology Institute (IWTI)	1998-2005	TCP	2-3 4-1 4-2	Background: The recent rapid industrialization in Thailand gave rise to two major problems in the water sector: land subsidence arising from soaring demand for industrial water, and deteriorating water pollution due to inadequate wastewater treatment. This situation prompted the Department of Industrial Works, Ministry of Industry of Thailand to establish IWTI aimed at providing technical solutions to private businesses as well as staff at the department in efficient water use, wastewater treatment and reuse, and industrial water supply. Objectives: To bolster IWTI; and to improve the technical levels of IWTI staff so that they can provide technical solutions.
66	Viet Nam	M/P study on industrial pollution control	1999-2000	DS	2-3 4-1 4-2	Background: The Ministry of Industry of Vietnam was slow to respond environmental degradation although the ministry was in a position to support businesses in industrial pollution control. Objective: To develop a framework and strategy to promote industrial pollution control toward sustainable development that strikes a balance between industrialization and environmental conservation. Outcomes: It was predicted that environmental stress arising from industrial wastewater will increase amid rapid growth of the industrial sector. This concern led to the development of a master plan for implementation by Vietnam. The master plan focused on measures that would produce quick results and incur relatively small costs for the Vietnamese government.

No	Country	Project Name	Period	Type of Schemes	Mid-term Objective	Characteristics
4-3 Promoting Water Quality Conservation in Public Waters						
67	Jordan	Project for Oil Spill Combat in Northern Aqaba Gulf	1995-1995	GA	4-3	Background: The Gulf of Aqaba is blessed with marine biodiversity with the world's unique ecosystem, including a coral reef running along the coast. Experts have long pointed out that if oil were to be spilt into the sea, it would remain there for long because of the wedge shape of the gulf. Outcomes: JICA provided equipment to prevent the polltion in the gulf, including oil barriers, oil collection tanks, oil collection machinery and boats for assisting collection. The EU conducted technical cooperation after the provision of equipment.
68	Croatia	Study on Water Pollution Reduction at the River Sava Basin	2000-2001	DS	1-2 2-3 4-2 4-3	JICA conducted a management plan for areas in and around the capital city of Zagreb in the wider river basin of the Sava River (international river) with the target year of 2015. Based on the plan, the Agency identified a priority project for sewerage development and conducted a feasibility study (F/S) for this project.
69	Cuba	Study on pollution control of Havana Bay	January 2003-February 2004	DS	4-2 4-3	This study is aimed at developing a M/P with a target year of 2020. The M/P includes a plan to upgrade the existing sewerage and another plan to construct new sewerage in the mid- to down-stream areas of the river basin including Luyano and Martin Perez rivers. The priority project includes the upgrading of the sewers and the construction of treatment plants. The overall objective is to reduce the pollutant load of the runoff into Havana Bay.
70	Brazil	Study on Management and Improvement of the Environmental Conditions of the Guanabara Bay	February 2002-October 2003	DS	4-2 4-3	The objective of this study was to develop a strategy plan designed to control the pollution of the Guanabara Bay with sewerage development and other means, based on the review of the existing master plan. JICA identified a priority project for sewerage development aimed at improving the water quality of the extremely polluted waters in the bay. Then the Agency conducted a feasibility study (F/S) for the project. This development study suggested that the Brazilian government should build its capacity for environmental administration and project implementation and operation.
71	A number of countries	Program to raise the environmental awareness of local communities	-	JOCV	2-3 4-3	JOCVs in such fields as environmental education, rural development, water examination, public health work to raise the awareness of communities about environmental conservation (water quality protection, etc.) in public waters, including lakes.

TCP: Technical Cooperation Project GA: Grant Aid DS: Development Study LA: Loan Aid DE: Dispatch of Experts
JPP: JICA Partnership Program D/D: Detailed Design Study GT: Group Training JOCV: Japan Overseas Cooperation Volunteers Program

Appendix 2 Basic Check List (Water Resources)

The table in Appendix 3 lists selected indicators and check items which are used to assess the situation in water resources in recipient countries. Although the indicators and check items concern water resources, they cover a wide range of issues (development objectives) as shown by the Development Objectives Chart, including integrated water resources management*, efficient and sustainable supply of safe water, flood control to protect lives and properties, and the conservation of the water environment.

To put it the other way around, the indicators and check items that reflect situations in these issues have been selected. These indicators for countries or regions are partly available from the following and other reports:

- World Bank: *World Development Report*
- WHO, and UNICEF: *Global Water Supply and Sanitation Assessment 2000 Report* [1]
- UNDP: *Human Development Report*
- World Resources Institute, UNEP, and UNDP: *World Resources*

In addition, general indictors for each country are available from the World Bank website[2]. Moreover, ADB's Water Utilities Data Book - Asian and Pacific Region (1993) and its second edition Second Water Utilities Data Book- Asian and Pacific Region (1997) offer valuable data, although they concern water services in Asia only.

The indicators here are only for providing an overview of water resources in recipient countries or regions. More detailed check items are required for specific aid projects.

[1] WHO, UNICEF (2000b)

[2] World Bank (2003b) World Development Indictors 2003 (http://www.worldbank.org/data/wdi2003/index.htm)

	Check items/indicators	Unit	East Asia and the Pacific	Europe and Central Asia	Latin America and the Caribbean	Middle East and North Africa	South Asia	Sub-Saharan Africa	Source
General									
1	Total population	million people	1,853	475	516	296	1,355	659	1
2	Urban population ratio	% of total	34	67	75	58	28	34	1
3	Population growth ratio	annual %	1.2	0.2	1.6	2.2	1.9	2.6	1
4	Population density	people per sq km	116	20	26	27	283	28	1
5	National poverty line: Population below poverty line	national %	-	-	-	-	-	-	
6	Population below international poverty line	million people	46	17	77	7	490	300	3
7	Gross national income (GNI)	billion US$	1,964	956	1,895	602	617	313	1
8	GNI per capita	US$	1,060	2,010	3,680	2,040	460	480	1
9	No. of household members		-	-	-	-	-	-	
10	No. of households								
11	Incidence of water-borne infectious diseases	per 100,000 people	-	-	-	-	-	-	
12	Ethnic distribution	-	-	-	-	-	-	-	
13	Rainfall	millimeters	-	-	-	-	-	-	
14	Sunshine hours	per 24 hrs							
15	Evapo-transpiration	millimeters per day							
16	Basic data for economic and financial evaluation	-							
17	Existence and description of the national development plan or other higher-order plan	-	-	-	-	-	-	-	
18	National organizational structures for water resources	-	-	-	-	-	-	-	
19	Availability of hydrologic data	-							
20	Distribution of rain gauges, water level gauges and flowmeters	-							
21	Availability of topographic maps, chorographies, geological data, etc.	-							
Water use									
22	Freshwater resources per capita (availability)	cubic meters per year	-	14,341	27,393	1,045	4,088	8,441	1
23	Annual freshwater consumption	billion cubic meters	-	-	-	-	-	-	
	for agriculture	%	80	63	74	89	93	87	1
	for industry	%	14	26	9	4	2	4	1
	for domestic	%	6	11	18	6	4	9	1
24	Proportion of annual freshwater consumption to freshwater resources	%	-	-	-	-	-	-	
25	Irrigated land	% of cropland	36.3	10.4	13.5	35.5	39.7	4.2	1
26	Proportion of the population with access to safe water	% of population	84	-	72	68	77	-	1
27	Proportion of the population with access to sanitation	% of population	29	-	46	-	16	-	1
28	Water service coverage	%							
	Water supply coverage	%							
29	Under-five mortality rate	per 1,000	44	26	38	54	99	159	1
30	Daily water demand per capita	1pcd	-	-	-	-	-	-	
31	Non-revenue water* rate	%	-	-	-	-	-	-	
32	Untreated/tap water quality	-	-	-	-	-	-	-	
33	Groundwater availability	cubic meters per day	-	-	-	-	-	-	
34	Ability to pay for water	-	-	-	-	-	-	-	
35	Willingness to pay for water	-	-	-	-	-	-	-	
36	Tariff collection rate	%							
37	No. of hours spent on fetching water	hours							
Flood control									
38	Catchment area	km^2	-	-	-	-	-	-	
39	Riverbed slope	% or in fraction	-	-	-	-	-	-	
40	Availability of river survey data	-	-	-	-	-	-	-	
41	Annual deforestation	km^2	29,956	-5,798	57,766	800	1,316	29,378	1
42	Land use plan	-	-	-	-	-	-	-	
43	No. of annual natural disaster occurrences		-	-	-	-	-	-	
	No. of people killed	per year							
	No. of people injured	per year							
	Annual damages	US$							
44	Flood return period	-	-	-	-	-	-	-	
45	Current state of flood forecasting and warning systems	-	-	-	-	-	-	-	
Water environment									
46	Existence of environmental standards on water quality	-	-	-	-	-	-	-	
47	Existence of wastewater discharge standards	-	-	-	-	-	-	-	
48	Sewerage coverage	%	-	-	-	-	-	-	
49	Water quality monitoring	-	-	-	-	-	-	-	

Sources: 1. World Bank (2002) World Development Report 2000/2001
2. World Bank (2003) World Development Report 2002
3. JICA (2003) Approaches for Systematic Planning of Development Projects - Poverty Reduction, September 2003

Key development indicators are available from the website of the World Bank (http://www.worldbank.org/data/wdi2003/index.htm)

WHO, and UNICEF: Global Water Supply and Sanitation Assessment 2000 Report can be viewed online. Available data include population and water supply and sanitation coverage (total, urban, rural) for Africa, Asia, Latin America and the Caribbean, the Oceania, Europe, and Northern America.
http://www.who.int/docstore/water_sanitation_health/Globassessment/GlobalTOC.htm

Appendix 3 Technologies Applicable to Developing Countries

This Appendix offers technologies or traditional techniques in which Japan excels and which can be applicable or replicable in the water sector in developing countries. These technologies and techniques are generally low-cost and practical. They range from those that have been introduced on a trial basis in developing countries to those that are still in their research phases.

As discussed in Chapter 3, Japan, while drawing on expertise from abroad in its modernzation process, has developed its own techniques for water resoruces development. Taking advangate of such experience, Japan has made significant achievements in its development assistance in the water sector in developing countries. Given this background, we have decided to add Appendix 3, hoping that it will help developing countries to solve their diversifing problems in the water sector.

Note that we do not necessarily intend the technologies and technologies mentioned here to be adopted in JICA's activities soon or promoted in developing countries.

Table A 3-1 Technologies Applicable to Developing Countries

Technologies/ techniques applicable to developing countries	Outline and features	Remarks
Flood control and river improvement work		
Fascine mattress (revetment work)	This technique makes use of giant wooden beds called "Fascine mattresses." Made of bushwood, the mattress is stuffed with rocks. The technique is said to have been introduced to Japan by Dutch engineers including de Rijke. It is an appropriate technology for Japan, where large rocks are not readily available and woods are easily obtained. This technique is still used in the Hokuriku region and elsewhere in Japan. The type of bushwood used in this technique is known as zatsuboku, branches of 7-10 year-old broad-leaved trees (deciduous trees) that are hard and flexible, such as Japanese oak, chestnut, evergreen oak, Japanese chestnut oak and magnolia kobus. These trees are grown in forests developed for this purpose. Such forests can provide zatsuboku on a permanent basis if demand for this natural material is controlled at an appropriate level. This technique is environmentally friendly in a number of aspects, including efficient use of forest products, CO_2 emissions control, and varies waterfront ecosystems. Efforts are now being made to partly introduce machinery in the construction process and to develop design guidelines.	http://www.mlit.go.jp/river/toolbox/10soda.pdf A Fascine mattress was constructed on an experiment basis in JICA's Study on Mekong Riverbank Protection around Vientiane Municipality, in the Lao People's Democratic Republic.
River/lake-assisted water purification (water environment)		
Shimanto-gawa system (eco-friendly water treatment system)	The Shimanto-gawa system is a new water treatment system developed based on the water purification mechanism of rice paddies. In other words, this eco-friendly water treatment system takes advantage of the natural purification function of the material circulation in a natural setting. This system does not use chemicals. Instead, it uses an optimal mix of filters made from natural materials, such as charcoal, deadwood and stones to purify water with the help of natural microorganisms. For the filter material, bed logs for growing mushrooms (waste logs) are used as part of efforts to recycle local resources. This system can not only reduce BOD (biochemical oxygen demand) and COD* (chemical oxygen demand), but remove nitrogen through the anaerobic process, SS (suspended substances).	http://www.pref.kochi.jp/~shimanto/4/mizu.htm Practiced in the Shimanto River basin, Kochi Prefecture
Wando (detention pond; embayment)	Wando refers to a pond-like place formed between groins. It provides a stable habitat for fish and other aquatic organisms. It is also home to various kinds of vegetation. Wando is now looked at in a more positive light as a viable option to regenerate biodiversity in and along rivers. In some cases, Wando has already been developed as part of revetment projects.	http://www.yodogawa.kkr.mlit.go.jp/shizen/wando/wando.html Wando has been developed along the Yodo River, Osaka Prefecture.

Technologies/ techniques applicable to developing countries	Outline and features	Remarks
Water purification using artificial lagoon vegetation (wetland)	This technique purifies water with the help of a lagoon artificially developed where a river flows into a lake. Such a lagoon: (i) Removes non-point source pollutants (pollutants from roads, residential areas, farmland, and other sources that cannot be pin-pointed), especially at the time of a flood. (ii) Provides habitats for fish and bird (iii) Help regenerate aquatic plants (both submerged and floating plants) Sediment accumulated in these artificial lagoons should be removed every few years.	http://www.ktr.mlit.go.jp/kasumi/hozen/wetland.htm Developed in Lake Kasumigaura
Vegetation-assisted water purification	This is a technique to purify water by filtering it through wetlands such as reed swamps. The technique was introduced to Japa long ago, but was not popular until recently becaue it took a large area of land. However, this technique is gaining popularity thanks to growing public awareness about the natural environment and to technical advances, including downsized swamp purfication faciliteies (e.g. the seepage flow system and the compat wetland system).	http://www.ktr.mlit.go.jp/kasumi/hozen/syokusei.htm This technique was introduced to China in JICA's technical cooperation project "the model project for restoring the water environment of Lake Tai."
Gravel contact oxidation process	The gravel contact oxidation process is designed to purify river water with the help of microorganisms on gravels. In this process, polluted water slowly runs through a channel whose bottom is paved with gravels. Then pollutants in the water settle between the gravels, and the microorgainsms decompose and absorb the pollutants. If the water is substantially polluted, air may be pumpted into the water to activate the microorganisms in a process called "aerated gravel contact oxidation."	http://www.ktr.mlit.go.jp/watarase/08_jmsho/0802_jigyo/5_1_1.htm The Infrastructure Development Institute-Japan's bulletin (IDI Shoho No. 3. August 2003) carries an article on a model demonstration plan in Malaysia using this process.
Biotope (conservation of ecosystems and the environment)	Biotope development is an environmental conservation solution that takes advantage of the ecological functions of nature. This technique is typically applied to mitigate the environmental impact of a dam. In such a case, a tributary that flows into the reservoir is dammed up with a weir to create a marshland as a second reservoir. This marshland, which is unaffected by the water level fluctuation of the main reservoir, provides a habitat for aquatic plants and animals as well as birds. As a biotope, the marshland thus maintains the diversity of local ecosystems.	http://www.ecosys.or.jp/eco-japan/
Intermittent aerohydraulic gun (aeration gun, aeration water circulator)	This system mixes the epilimnion with the hypolimnion to improve the water quality of lakes and reservoirs. During the warm season(s), warm water at the surface of the reservoir forms the epilimnion. Cold water below forms a hypolimnion. Between them is the thermocline, where the water temperature suddenly changes. The intermittent aerohydraulic gun generates water flows in the thermocline and thus moves phytoplankton from the epilimnion to the hypolimnion so as to control their growth with less light. These water flows also sent air to the hypolimnion to prevent nutrients produced by the decomposition of organic matter from moving up.	http://wwwsoc.nii.ac.jp/jdf/Dambinran/binran/Jiten/Jiten_14.html Aeration water circulator Research was conducted in China as part of a 2001 project by the Ministry of the Environment to study the applicability of decentralized water purification technologies of Japan to developing countries
Sanitation facilities and wastewater treatment		
Land treatment (land filtration)	This process treats sewage (or treated sewage) by passing such water through soil, taking advantage of the microorganisms in soil and the filtering and absorbing function of soil. During the winter, cold weather slows the activity of microorganisms, reducing the treatment capacity. Infiltered water, if it reaches the existing groundwater zone, may pollute clean groundwater there. This points to the need to assess the use of groundwater around the treatment site, carefully select the type of sewage to be treated, and monitor groundwater quality.	http://www.ktr.mlit.go.jp/watarase/08_jmsho/0802_jigyo/5_1_1.htm
Bio-toilet (eco-friendly sanitation facility)	A toilet that treats human excreta by taking advantage of the activity of microorganisms. Microorganisms growing in Japanese cedar chips feed on excreta in the toilet and decompose them into water and carbon dioxide, leaving almost nothing. Bio-toilets are used in mountainous areas and rive parks where it is difficult to install sewers and septic tanks for economic or other reasons. It is urgently needed to install bio-toilets in mountainous areas, because the impact of human excreta is beginning to reach water places due to a growing number of mountaineers in recent years.	http://eco.goo.ne.jp/ecoword/files/word/325.html Installed on Mt. Fuji and elsewhere.

Technologies/ techniques applicable to developing countries	Outline and features	Remarks
Septic tank; household wastewater treatment tank	The septic tank is, as it were, a small-scale wastewater plant, and a typical on-site/decentralized wastewater treatment system. The septic tank is generally composed of three units. The first unit removes relatively large impurities from the water. The second unit, or an aeration tank in which microorganisms are floating, purifies the water. The third unit settles sludge to gain the treated water. Some types of septic tanks are equipped with an anaerobic tank to remove nitrogen as well. Septic tanks are often divided into flush toilet wastewater treatment tanks, which treat only excreta, and domestic wastewater treatment tanks, which treats both excreta and non-fecal wastewater. In Japan, however, flush toilet wastewater treatment tanks are no longer regarded as septic tanks as defined by law. Effective from April 2001, newly installed septic tanks should be domestic wastewater treatment tanks. Domestic wastewater treatment tanks vary in scale, ranging from those for one household to those that cover hundreds of households. These tanks may be made of FRP or cast-in-place concrete. At any rate, they need sludge withdrawal and other types of maintenance. Japanese septic tanks are efficient but cost much in their operation, including electricity expenses for blowers and sludge withdrawal costs.	http://www.jsa02.or.jp/ Septic tanks for advanced treatment have been developed in a JICA technical cooperation project for China (model project for restoring the water environment of Lake Tai). The Japan International Corporation of Welfare Services has conducted the Promotion and Investigation Programme for Septic Tank Control Technology Transfer for developing countries.
Water well drilling: potable water		
Barrel well; “Manshu well”	Barrel wells are a kind of shallow wells whose curb is made of concrete or steel, 1-5 meters across, and up to 30 meters deep. Many barrel wells collect water from their bottom, but others collect water from their sidewall. Of barrel walls, those designed to collect groundwater with perforated pipes stretching from the sidewall in a radial pattern are called vertical (radial) collecting wells or “Manshu wells.” “Manshu well” was developed in 1934 by Dr. Motonosuke Shimizu, a leading authority on groundwater and director of the civil engineering department of the Kwantung provincial government. When Dr. Shimizu researched and developed the “Manshu well,” he was stationed in the Liaotung Peninsula in mainland China, where water resources were scarce. This well was named “Manshu well” by Dr. Mannosuke Yamaoka, who was then governor of the Kwantung provincial government and later became the third president of Nihon University. Dr. Yamaoka hoped that “Manshu wells” would spread all over the world, as “Man” in “Man-shu” meant “all” and “shu” meant “continent.”	Murahashi, Yoshio, “Manshu Ido no Kiso Suiri ni Tsuite [About Basic Hydraulics of ‘Manshu Well.’” Journal of Japanese Association of Groundwater Hydrology. May, 1984
Kazusa method of well digging	This method for digging deep wells was developed early in the Meiji Period (1868-1912) near what is now Sodegaura city, Chiba Prefecture. The method got its name because this region was called Kazusa at that time. It spread throughout the country. This method was based on Tsukibori, a method introduced from China. Around 1883, Takehigo, the biggest feature of the Kazusa method, was invented, making it possible to dig as deep as 200 meters. In 1886, Hanegi was devised – a labor saving technique, requiring only three to four people for well digging. In 1893, Shukumoku and Higo-guruma were devised. In 1896, the Kazusa method was completed.	http://www.chiba-muse.or.jp/KAZUSA/bunka/kzs_hori/index.htm A Japanese NGO dug wells using this method in Rwanda and Zambia. (Japan International Corporation of Welfare Services, ed. *Kaihatsu Tojokoku no Suido Seibi Q&A [Q&A about Water Supply Development in Developing Countries].* Japan International Cooperation Publishing, (1999) pp.501-502)
Seawater desalination	Seawater generally contains about 3.5% of salts of various kinds. Seawater desalination is a process of gaining freshwater by removing these dissolved salts. Among the methods on a commercial basis are: the evaporation process and refrigeration processes, both take advantage of phase change of water; reverse osmosis, which, using filters, removes salts by capitalizing on differences in osmotic pressure; and electrodialysis, which makes separation by taking advantage of potential differences. In Japan, remarkable progress has recently been made in the seawater desalination technology using reverse osmosis. This progress is highlighted by the desalination facilities at Chatan Water Purification Plant, Okinawa Prefecture (daily capacity of 40,000 cubic meters). The method used at this plant applies a pressure more than the reverse osmosis pressure on the seawater to produce freshwater. The operational pressure is as high as 5.5-7.5 Mpa. For this reason, this advanced technology is expensive in terms of both equipment and operation. Yet the running cost is lower than that for the evaporation process, etc. Consequently, this technology is now popular in Middle East and elsewhere.	Japan Water Works Association (2003) *Suido Yogo Jiten [Dictionary of Water Terms]*, 2nd edition. The Water Re-Use Promotion Center conducted a empirical study on seawater desalination as part of the New Energy and Industrial Technology Development Organization’s cooperation project on oil-contaminated SWRO desalination. http://www2.neweb.ne.jp/wd/wrpc-j/annai/an04.htm

Technologies/ techniques applicable to developing countries	Outline and features	Remarks
Arsenic removal	Simple methods for removing arsenic in water include: (i) chemical precipitation, whereby arsenic is coprecipitated with insoluble salts generated by iron chloride or other flocculants; and (ii) activated alumina absorption, whereby arsenic-contaminated raw water passes through the adsorption tower filled with activated alumina and the arsenic is absorbed and separated. In the second method, it is necessary to convert trivalent arsenic in the raw water to pentavalent arsenic with an oxidizer and implement pH control before passing the water through the tower. A variety of absorbents have been developed recently. Attention should be paid to the question of how to deal with the sludge produced by the precipitation process and wastewater resulting from cleaning the absorbent (to prevent incidental arsenic contamination).	Japan Water Works Association (1997) *Hiso ni Kansuru Chosa Hokokusho [Srudy Report on Arsenic]* http://www.hucc.hokudai.ac.jp/~m16032/gakkai/2003
Fluoride removal	Methods to remove fluoride, which tends to exist in large quantities in drinking water, include: the activated alumina process, the bone black process, and the electrolysis processes. Since all these processes are of low treatment inefficiency, water source change is recommended when the fluoride concentration is too high. UNICEF suggests two approaches: the Nalgonda technique, a precipitation process named after the village in India where the method was pioneered; and the technique that filters water down through a column packed with activated alumina, activated charcoal, or ion exchange resins. It says that these methods are suitable for both community and household use.	Japan Water Works Association (2003) *Suido Yogo Jiten [Dictionary of Water Terms]*, 2nd edition http://members.jcom.home.ne.jp/emura/newpage10.unicef..htm
Removal of iron by biological processes (iron bacteria method)	In water with an appropriate level of dissolved oxygen, iron bacteria oxidize dissolved iron and absorb it in the form of insoluble iron compounds. The iron bacteria method takes advantage of this process. In this method, raw water contacts with iron bacteria, which absorb the iron compounds. Then the iron bacteria are removed from the water by such means as sand filtration. Because of its easy operation and management, this method is suitable iron-removal solution especially for plants that purify groundwater.	Japan Water Works Association (2001) *Suido Shisetsu Sekkei Shishin Kaisetsu [Guidelines and Explanations on Waterworks Design]* Sadao Kojima (1985) *Oishii Mizu no Tankyu [Quest for Good Drinking Water]*, NHK
Improved cookstove	The improved cookstove is a symbolic technique in the Home Living Improvement Extension Service in rural Japan. Kesa Kishida, Senior Specialist at JICA, has disseminated this technique in Kenya. The improved cookstove has one fire hole with three burners (holes). The middle burner is for cooking and the other two burners are for boiling water. The idea is to make safe water always available (water desterilized by boiling).	Chikao, Umehara (2001) *Keniya ni Aio Komete [With Love for Kenya]*, Japan International Cooperation Publishing
Others		
Water purification using idle paddy field	Idle paddy field, like cultivated one, has a high capacity for denitrification and absorption, becaue of the nitrification process with oxygen provided by the surface flow 5-10 centimeters deep, and because of its soil rich in organic matter. This technique takes advantage of this capacity. The theory is essentially similar to that of the reed swamp water purification process of a surface flow type. In recent year, this technique is increasingly used to purify high-concentration wastewater. The technique has a number of advantages. First, it allows for efficient use of idle land. Second, idle paddy field used for this purpose can be readily converted to the original paddy field for growing rice. Third, non-point source polluted water can also be treated on-site in areas where paddy fields are highly developed. Fourth, it makes it possible to grow edible or ornamental plants in the idle field (material recovery), which may enable the field to be used as a public park. In this context, efforts should be made to improve water arrangements and even change the topographic feature to protect the natural landscapes or provide local residents and tourists with the opportunity to enjoy water environments. This technique is applied on a large scale at the Kahokugata Lagoon.	http://www.pref.shizuoka.jp/~oshirase/press/h11_9/h11_9_0605.html
Convertible paddy field	The technology enables paddy fields to be used also as upland fields when necessary by modifying the land base. This technology has been developed to maintain the supply-demand balance of rice, improve the nation's self-sufficiency in upland-field crops and achieve efficient use of land resources.	Japanese Society of Irrigation, Drainage and Reclamation Engineering (1979) *Hanyo Kochika no Tameno Gijutsu Shishin [Technical Guidelines on Convertible Farmland]*
Torii-support foundation	This is a kind of foundation for laying pipes in soft ground prone to irregular subsidence. The following steps are taken to complete this foundation: (i) drive foundation piles into the ground; (ii) fix the cross beam on these piles to form a structure whose cross-section looks like a torri or a gateway to a Shinto shrine; (iii) place the pipe on the beam and drive wedges between them (the wedges' concave surface fits the lower part of the pipe). Wood is ususally used for the material. Cramp irons are used to fix the beam.	http://www.city.yokohama.jp/me/green/gijutsu/images/sshishin4.pdf

References

1. Printed Materials

(1) Japanese

International Development Center of Japan (2002) *"Mizu" ni Kanren Suru Kokusaikikan oyobi Kaku Dona no Seisaku oyobi Enjo no Jittai ni Kansuru Chosa [Fact-Finding Survey on Policies and Assistance of Bilateral and Multilateral Donors in Water]*

Institute for International Cooperation, JICA (1996) *Mekon Gawa Iinkai no Genjo to Tenbo ni Kansuru Kenkyu Hokokusho [Study Report on the Current Situation and Prospects for the Mekong River Commission]*

——— (2001a) *Dainiji Kankyo Bunya Betsu Enjo Kenkyukai Hokokusho [Second Study on Development Assistance for the Environment]*

——— (2001b) *Kokusaitekina Mizu Bunya Kyoryoku no Choryu [Trends in International Aid in the Water Sector]*

——— (2002) *Mizu Bunya Enjo Kenkyukai Hokokusho: Tojokoku no Mizu Mondai Eno Taio [Study on Development Assistance in Water Sectors: Response to Water Problems in Developing Countries]*

——— (2003) *Bosai to Kaihatsu: Shakai no Bosairyoku no Kojo wo Mezashite [Disaster Prevention and Development: Working to Improve Society's Disaster Management Capacity]*

Iwanami Shoten (1998) *Kojien* (Japanese dictionary)

JICA (1993a) *Kanbodia Okoku Punonpen-shi Josuido Seibi Keikaku Chosa Saishu Hokokusho (Kinkyu Kaishu Keikaku Bubun) [Final Report on the Study on Waterworks Development Project in Phnom Penh, the Kingdom of Cambodia (for the Emergency Rennovation Plan)]*, Tokyo Engineering Consultants Co., Ltd., and Nihon Suido Consultants Co., Ltd.

——— (1993b) *Kanbodia Okoku Punonpen-shi Josuido Seibi Keikaku Chosa Saishu Hokokusho (Wabun Yoyaku) [Final Report on the Study on Waterworks Development Project in Phnom Penh, the Kingdom of Cambodia (Japanese Summary)]*, Tokyo Engineering Consultants Co., Ltd., and Nihon Suido Consultants Co., Ltd.

——— (1994) *Indoneshia Koku Burantasu Gawa Ryuiki Suisigen Sogo Kanri Keikaku Chosa – Saishu Hokokusho Yoyaku [Summary of the Final Report on the Study on the Comprehensive Management Plan for the Water Resources of the Brantas River Basin]*, Nippon Koei Co., Ltd., and NIKKEN Consultants, Inc.

——— (1997) *Senegaru Kyowakoku Chiho Sonraku Kyusui Keikaku Kihon Sekkei Chosa Hokokusho [Report on the Basic Design Study on Rural Water Supply Plan in the Republic of Senegal]*

——— (2001) *Kanbodia Okoku Punpurekku Josuijo Kakucho Keikaku Kihon Sekkei Chosa Hokokusho [Report on the Basic Design Study on the Project for Expansion of Phum Prek Water Treatment Plant in the Kingdom of Cambodia]*, Tokyo Engineering Consultants Co., Ltd., and Nihon Suido Consultants Co., Ltd.

——— (2002) *Senegaru Kyowakoku Anzen na Mizu to Komyuniti Katsudo Shien Keikaku Jissi Kyogi Hokokusho [Report on the Plan and Implementation and Consultations on the Support Project for Potable Water and Community Activities in the Republic of Senegal]*

——— (2003a) *Kaihatsu Kadai ni Taisuru Kokateki Apurochi: Hinkon Sakugen [Approaches for Systematic Planning of Development Projects: Poverty Reduction]*

——— (2003b) *Sekai no Mizu Mondai ni Torikumu JICA [JICA's Commitment to Addressing Water Problems in the World]* (a pamphlet distributed at the Third World Water Forum)

Kobayashi, Masahiro (2003) "Dai Sankai Sekai Mizu Foramu to Kokusai Kyoryoku [The Third World Water Forum and International Cooperation]," *Kokusai Kyoryoku Kenkyu, Vol. 19. No. 1.*

Nippon Koei Co., Ltd. and KRI International Corp. (1997) *Indoneshia Burantasu Gawa no Kaihatsu: Gijutsu to Hitobito no Koryu [Development of the Brantas River in Indonesia: Technologies and Person Exchanges]*, SANKAIDO Publishing.

Secretariat of the 3rd World Water Forum, ed. (2002) *Sekai no Mizu to Nihon [World Water and Japan]*, Japan Water Resources Association.

Social Development Study Department, JICA (2001) *Kaihatsu Chosa ni Okeru Keizai Hyoka Shuho Kenkyu: 14. Jishin Bosai [Study on Economic Evaluation Methods in Development Study: 14. Earthquake Preparedness]*

Water Resources Department, Land and Water Bureau, Ministry of Land, Infrastructure and Transport (2001) *Nihon no Mizushigen [Water Resources in Japan]*, Printing Bureau, Ministry of Finance.

World Bank (2000) *World Development Report 2000/2001: Attacking Poverty*

——— (2001) *World Development Report 2002: Building Institutions for Markets*

Yamamoto, Keiko (2000) "*Fukko Kara Kakudai ni Mukau Punonpen no Suido [Water Services in Phnom Penh in Transition: From Reconstruction to Expansion]*," JICA Frontier, No. 15. October 2000.

(2) English

Asian Development Bank (2003a) Water Poverty – Fighting Poverty through Water Management

——— (2003b) Water for the Poor – A Selection of Case Studies on Water and Poverty

Berkoff, Teremy (1994) "A Strategy for managing water in the Middle East and North Africa" World Bank

Central and Eastern Europe Regional Technical Advisory Committee, The (CEETAC) of The Global Water Partnership ed. (2000) "Water for the 21st Century: Vision to Action, Central and Eastern Europe"

DFID (2001) Addressing the Water Crisis: healthier and more productive lives for poor people

——— (2004) Water Action Plan- A DFID policy paper, March 2004

GTZ (2003) Tanzania – German Technical Cooperation, February 2003

GTZ India (1993) "Water Self Help Programme (WOTR)"

I. A. Shiklomanov (1997) *Assessment of Water Resources and Water Availability in the World*, WMO

Iraq Foundation, The (2003) "Building a Scientific Basis for Restoration of the Mesopotamian marshlands" (http://www.iraqfoundation.org/projects/edenagain/2003/dmay/5_report.html)

Sida (1999) Management and Use of Water Resources: A Summary of Sida's Experiences and Priorities.

UNESCO (2003) *The UN World Water Development Report: Water for People, Water for Life*

USAID (1982) Policy Paper: Domestic Water and Sanitation

——— (2000) *USAID FY 2000 Accountability Report*

USAID Water Team (2002) Integrated Water Resources Management – A Framework for Action in Fresh Water and Coastal Systems

Water Support Unit, The Netherlands Ministry of Foreign Affairs (2001) Achieving Water Supply

WHO, UNICEF (2000) *Global Water Supply and Sanitation Assessment 2000 Report*

(http://www.who.int/docstore/water_sanitation_health/Globassessment/GlobalTOC.htm)
World Bank (2003a) The Water Resources Sector Strategy: An Overview
——— (2003b) *World Development Indicators 2003*
World Commission on Dams (2000) *Dams and development: a new framework for decision-making*
World Water Council (1999) *Vision on Water, Life and the Environment for the 21st Century, Regional Consultations, Central America and the Carribean*. Water Center for the Humid Tropics of Latin America and the Caribbean (CATHALAC).

2. Websites

ADB (Asian Development Bank) http://www.adb.org/
DFID (Department for International Development) http://www.dfid.gov.uk/
GTZ (The German Agency for Technical Co-operation) http://www.gtz.de/
Global Water Partnership http://www.gwpforum.org/servlet/PSP
Infrastructure Development Institute-Japan http://www.idi.or.jp/
Japan Meteorological Agency http://www.data.kishou.go.jp/climate/monitor/norm/norm_map.html
MFA (Ministry of Foreign Affairs of the Netherlands) http://www.minbuza.nl/
Ministry of Foreign Affairs http://www.mofa.go.jp/mofaj/gaiko/kankyo/wwf3/j_kyoryoku.html
Ministry of Land, Infrastructure and Transport http://www.mlit.go.jp/river/sabo/link03013.htm
Sabo (Erosion and Sediment Control) Department http://www.mlit.go.jp/river/sabo/index.html
Sida (Swedish International Development Cooperation Agency)
http://www.sida.se/
Third Tokyo International Conference on African Development
http://www.ticad.net/index.html
UNDP (United Nations Development Programme) http://undp.org/
UNEP (United Nations Environment Programme) http://www.unep.org/
UNESCO (United Nations Educational Scientific and Cultural Organization): Water Portal
http://www.unesco.org/water/
USAID (The United States Agency for International Development)
http://www.usaid.gov/
WB (The World Bank) http://www.worldbank.org/
WHO Water, Sanitation and Health (WSH) International norms (“guidelines”) on water, sanitation and hygiene
http://www.who.int/water_sanitation_health/norms/en/
World Resource Institute http://www.earthtrends.wri.org/
World Water, The http://www.worldwater.org/
World Water Council, The http://www.worldwatercouncil.org/
Water and Sanitation Program (WSP) http://www.wsp.org/

Terms and Abbreviations

Terms/Abbreviations	Definition/Description
Water Resources	
Activated Sludge Process	A process to treat wastewater biologically – taking advantage of activated sludge, which is nothing but a community of microorganisms. Originally, this process used only aerobic treatment (treatment using oxygen) to decompose organic matter. In recent years, however, the process uses anaerobic as well as anaerobic reaction tanks to biologically remove ammonia and phosphorus in wastewater. This process is the most popular method to treat wastewater in developed countries. However, it is introduced only partly in developing countries. For one thing, the operation and management is more complex. For another, the operation cost because aerators consume much electricity.
BOD and COD	Biochemical oxygen demand and chemical oxygen demand. Both are indicators for the mount of organic matter in water. They are used as environmental standards related to the conservation of the living environment involving rivers, lakes and waters. Generally speaking, BOD is used for rivers and COD for lakes and waters. The higher BOD/COD is, the more the water contains organic matter, in other words, more polluted.
Check Dam (Sabo Dam)	A dam design for *sabo* of erosion and sediment control; also called a soil saving dam. There are two types of check dams. A sediment trap dam is constructed across a stream with the main purpose of retaining sand/gravel runoff. A consolidation dam (small check dam) is designed to mitigate erosion of the river bed by reducing the discharge with a milder bed slope and to prevent the failure of hillsides on both sides of the stream by stabilizing the mountain foot with valley fills accumulated upstream. Some check dams serve these two types of purposes.
Cleaner Production	An industrial and environmental management method designed to improve productivity at all industrial processes, including the extraction of raw materials and the disposal and recycling of products. Cleaner production was initially advocated by the United Nations Environmental Programme in 1989.
Closed Water Area	A water area where seawater tends to say where it is. Tokyo Bay, Ise-Mikawa Bay, Osaka Bay, and the Inland Sea are all closed water areas. Such water areas are productive because large amounts of nutrients flow into them from rivers, etc. However, too much nutrient inflows cause pollution, including red tides.
Cyclone Shelter	The seawater surface raised by a cyclone is translated into high waves at the shore. As the waves may reach a few meters in height, coastal areas may be devastated. To mitigate such disasters, cyclone shelters are built above the designed highest level of such waves. A typical cyclone shelter is a two-story building of reinforced concrete construction with the floor more than five meters above the ground level. It holds 3,000 people or more, with a total floor area of some 500 square meters, including the rooftop. Normally it may be used as a school building.
Eutrophication	A phenomenon in which matter containing nitrogen or phosphorus flows into a closed water area and promotes the growth of algae and other aquatic plants there, progressively deteriorate the water quality.
Flood Return Period	An indicator for flood frequency expressed in the number of years. The flood return period of 100 years, or the 100-year flood means that a flood occurs at the frequency of once every 100 years. To be precise, flood frequency is expressed in the number of floods per year, but the flood return period is usually used for the sake of convenience. The flood return period also indicates the level of safety from floods. For example, 100-year flood control provides a higher level of safety than 50-year flood control. As this example shows, a flood control plan usually includes a designed flood return period.
Guinea Worm	Also called medina worm or Dracunculus worn. The guinea worm is found in West Coast of Africa, the Red Sea, Middle India, Iran and South America. The adult female measures 700-1,200 mm in length and 0.9-1.2 mm in width, compared to 12-40 mm in length and 0.4 mm in width for the adult male. Adult worms of both sexes live under the skin of a human, where they mate. Then the female moves to the end of a limb of the human body, where a blister develops and bursts when it touches water, releasing larvae. The larvae are eaten by water fleas, an intermediate host. The human being becomes infected when he drinks water containing the water fleas containing the worm larvae or when he intakes such water while swimming. The guinea worm larvae move and eat tissues inside the human body, causing an acute pain for the patient. The blisters thus developed may cause secondary infection. The number of patients of these serious diseases is estimated at as many as 10 million. Major steps to prevent these diseases include changing to well water or other water sources not contaminated with guinea worm, and filtering water before drinking.

Terms/Abbreviations	Definition/Description
Hand Pump	A pump used to collect water from a well manually. Without the need for electricity, hand pumps do not incur running costs unless they go out of order. For this reason, hand pumps are widely used in rural areas. Still, they have limitations in pumpage and pump head (pump lift).
Hazard Map	A map showing both the area thought to be affected by a phenomenon that causes disaster and the scale of that impact. For example, a volcanic hazard map illustrates the area on which volcanic ashes will fall and the levels of the impact in different colors.
Hygiene Education	Activity to raise the awareness of local residents about how water supply and sanitation relate to their health and about the importance of water management and hygienic practices. For this purpose, events and audio visual media and materials are used, including plays, movies, videos, picture books, and picture story shows. Hygiene education should be designed to accommodate local social conditions. Still, focus should be placed on: information about water-borne diseases, including how to cope with them; hygienic practices, including handwashing, appropriate disposal of solid waste and wastewater; and the importance of safe water.
Integrated Water Resources Management (IWRM) and Comprehensive Water Resources Management (CWRM)	Both IWRM and CWRM are defined as taking administrative and interdisciplinary approaches to integrate functional, hydrological and ecological aspects of water resources management in a defined geological area. They can take a number of forms, including: (i) integrated planning and management of water supply and wastewater treatment; (ii) integrated management of groundwater use and surface water use; and (iii) establishing a framework for cooperation and collaboration among different stakeholders to provide solutions to water shortages or sanitation problems in a particular area. What distinguishes IWRM from CWRM is the existence of a fully coordinated approach to water issues and of an established implementation framework for less duplication and better coordination among different government agencies.World Water Vision defines IWRM as: Philosophy that holds that water must be viewed from a holistic perspective, both in its natural state and in balancing competing demands on it – agricultural, industrial, domestic, and environmental. Management of water resources and services needs to reflect the interaction between these different demands, and so must be coordinated within and across sectors. If the many cross-cutting requirements are met, and if there can be horizontal and vertical integration within the management framework for water resources and services, a more equitable, efficient, and sustainable regime will emerge (Global Water Partnership, Framework for Action 1999).
Lagoon Process	A process to purify wastewater in an artificial lagoon through sedimentation and biological processes. The lagoon process is subdivided into the multi-stage process, aerated process, and others. It has some advantages, including the capacity to cope with load fluctuations and low construction costs. However, the lagoon process requires a large site and generates odor and flies. Because of its low operation costs, the process is commonly used in developing countries.
Non-revenue Water	Tap water for which tariffs cannot be collected. In Japan, non-revenue water is mostly leaked water and water for firefighting. In developing countries, non-revenue water is caused by not only water leakage and firefighting but also many other factors, including water theft, refusal to pay tariffs (often by government agencies themselves), and unreliable water meters. This term is often used where water meters are installed and the causes of “non-revenue” are identified to a certain extent. In other areas, the term “unaccounted-for water” tended to be used.
Nutrients	Generic term for matter that promotes the growth of phytoplankton and algae in lakes, bays and reservoirs. Generally, phytoplankton and algae require the same elements as land plants do. In the context of water quality of these types of water bodies, nutrients often refer to nitrogen and phosphorus, which are associated with the growth of phytoplankton and algae as limiting factors.
Oxidation Ditch Process	A process to treat sewage by making it stay for a long time in a field track-shaped oxidation pond (a relatively shallow pond, often made of earth, to retain wastewater). Organic matter in sewage is biologically treated when oxygen is provided naturally or by an aerator. This process is easy in operation and low in cost.
Pollutant Load	A type of load on the air and water – key elements of the environment. The environment originally has the capacity to purify polluted air or water. Environmental degradation will not occur as long as the pollutant load is below this capacity. If the load exceeds the capacity, the environment will be degraded irreversibly.

Terms/Abbreviations	Definition/Description
Polluter Pays Principle (PPP)	A principle that generators of pollutants should pay to take necessary steps for pollution control. This principle was first advocated by the Organization for Economic Co-operation and Development (OECD), an international club of advanced countries. The idea was to ensure fair trade by avoiding situations in which some countries demand businesses stricter pollution control than others. Now PPP is one of the guiding principles of environmental protection in many countries. Some people even argue that this principle should be applied to global environmental conservation as well.
Public Tap (Public Faucet)	A common water service installation. House connection supply, which is common in developed countries, is costly because of the total length of pipes. Public taps are often used in rural and peri-urban areas in developing countries.
Retarding Basin (Pond)	A catchment used to retain part of rainwater temporarily and thus reduce the peak discharge downstream. Floodplains upstream should all be regarded as natural retarding basins. Sometimes, riparian wetlands are converted into retarding basins.
Sanitation Facilities	Toilets, septic tanks, sewers or other facilities designed to treat and dispose of excreta and domestic wastewater appropriately and contribute to better health and livelihoods for local residents. In developing countries, sanitation facilities tend to be given low priority compared to water supply facilities. Promoting sanitation facilities demands not only extensive knowledge and expertise in sanitation but also consideration for social and cultural backgrounds on the ground.
Septic Tank (Household Wastewater Treatment Tank)	A unit that is designed to treat sewage in areas without assess to sewerage. There are two types of septic tanks. A flush toilet wastewater treatment tank treats only flush toilet sewage. A domestic wastewater treatment tank, on the other hand, treats not only flush toilet sewage but also all kinds of domestic wastewater, including wastewater from the kitchen, bath and others.
Strategic Environmental Assessment (SEA)	An environmental assessment that is made at the strategic, decision-making phases before project implementation. SEA covers three Ps: policy, plan and program. There has been policy debate on the introduction of SEA in Japan and abroad. Some countries are now phasing in SEA.
Surface Water	Same as river water in a narrow sense. In a wider sense, it collectively refers to river water, lake water, glaciers, and deposited snow.
Unaccounted-for Water	Tap water unaccounted for due to water leakage, water theft, and no water meters.
Ventilated Improved Pit (VIP) Latrine	A kind of “dry latrine,” a toilet that does not use water. Its component includes a pit (drop hole to contain excreta), a squat slab covering the pit (including the foot pads), a superstructure, and an air-vent pipe. This pipe is painted black so that the air inside is heated up by the sunlight and the resultant ascending air current allows the odor in the pit to be sucked out without staying within the superstructure. The vent pipe has a fly screen at the upper end so that phototactic flies go up in the pipe but cannot escape, only to die. Because of this high performance in mitigating the problems of odor and flies, VIP latrines are rapidly adopted in many developing countries.
Water Harvesting (Water Harvest)	The process of collecting and concentrating rainwater from a large catchment area into a lowland area with an acreage of a few percent of the catchment area to grow agricultural crops (including feed and forage crops, fruits, trees, miscellaneous cereals, wheat and barley, and vegetables where possible).
Water Leakage	Leakage of water from a water supply pipe or the water leaked. Water leakage is unavoidable even if water pipes are systematically connected and carefully managed. No country in the world is free from water leakage. Yet the leakage rate in many developing countries is a few times higher than developed countries (the leakage rate for Japan stands at 10% or so). This is because of inadequate management and decrepit facilities. Generally, water leaks from joints of water pipes or fissures of old pipes. Measures to prevent water leakage include: replacement of old pipes, optimization of the water pressure (the higher the pressure is, the more often water leakage occurs), improvement of leakage detection skills, and procurement of leakage detectors.
Water Resources Management and Water Management	In Europe and North America, the term “water resources management” encompasses water utilization, flood control, and the water environment when it is used a broad sense. However, in arid or semiarid areas such as Africa and the Middle East, the term is usually used in a narrow sense, covering only water utilization and the water environment. To make a clear distinction, it may be meaningful to use “water resources management” in the narrow sense and “water management” in the broad sense.
Water Right	A right to use water from rivers, etc. Water rights can be classified by use into agricultural and industrial water rights. They can be also divided into water rights granted under the river law and customary water rights.

Terms/Abbreviations	Definition/Description
Development, Aid, etc.	
Bilateral Aid	ODA provided directly to developing countries. It has a number of advantages over multilateral aid. For example, it can provide agile, flexible and accommodative aid. Moreover, under the bilateral arrangement, donor countries can directly impress recipient counties with their aid policies and performance, contributing to better relations with them.
Capacity Building	To build the autonomous capacity of project-implementers; to improve their ability to carry out and manage institution building.
Counterpart	Local technical experts who work with, and receive technical guidance from, JICA experts and Japan Overseas Cooperation Volunteers (JOCV) sent to developing countries.
Donor	A country or organization that provides aid. This term corresponds to the term "recipient," which refers to a developing country that receives aid.
Empowerment	The process of an individual enlightening himself, gaining the ability to make decisions on his own, and acquiring and exercising economic, social, legal, and political capabilities. More autonomy thus obtained may give rise to a collective initiative to overcome social inequality.
Gender Mainstreaming	The act of integrating gender aspects into development processes. Specifically, it is aimed at incorporating gender equality in all policies and programs, and at ensuring that both men and women participate in decision-making processes in relation to each development issue.
Infrastructure	Various forms of fundamental systems and structures that support economic activities. Also known as social capital. Infrastructure can be divided into two categories: economic infrastructure, such as energy, roads, ports, rivers, communications, agricultural foundations, railways, and airports; and social infrastructure, i.e., public sanitation, education, housing, water works and sewerage.
Millennium Development Goals (MDGs)	The MDGs, which drew on DAC New Development Strategy, were adopted at the United Nations General Assembly in September 2000. The MDGs to be achieved by 2015 include: (i) eradicate extreme poverty and hunger; (ii) achieve universal primary education; (iii) promote gender equality and empower women; (iv) reduce child mortality; (v) improve maternal health; (vi) combat HIV/AIDS, malaria and other diseases; (vii) ensure environmental sustainability; and (viii) develop a global partnership for development.
Multilateral Aid	ODA channeled through the World Bank and other multilateral institutions to be used for the development of recipient countries. It makes it possible to take advantage of high-level expertise, extensive experience and global aid networks of these institutions. Multilateral aid also allows donor countries to maintain political neutrality. Hence, this type of ODA can provide relief to refugees and displaced persons and address global environmental issues — activities bilateral aid is difficult to carry out. Multilateral aid can be effective even if adequate information is unavailable on target areas or aid modalities.
Multi-sectoral Approach	An integrated approach to cross-sectoral issues in contrast to the traditional single-sector oriented approach in technical cooperation. For example, this approach, when applied to water resources in rural development, may address not only irrigation as part of agricultural infrastructure development but also safe water supply as part of health improvement support.
Ownership	Self-help efforts of developing countries. DAC New Development Strategy includes ownership and partnership (with donor countries) as its guiding principles.
PFI	Private Finance Initiative: PFI is a new approach to take advantage of funds, management skills and technical capabilities of the private sector for the construction, operation and maintenance, and management of public facilities and others.
Pilot Project	The act of implementing an aid project on an experimental basis.
PRSP	Poverty Reduction Strategy Paper: As a solution to debt-strapped HIPCs (Heavily Indebted Poor Countries), the idea of PRSP was presented and agreed upon at the general meeting of the World Bank and the IMF in 1999. The aim is to divert funds generated by debt relief in exchange for PRSP to development and poverty eradication.
Public-Private Partnership (PPP)	A general term to refer to the initiative to open the public sector services to the private sector. In the water sector, the public and private sector have begun to work together to use water resources more effectively. PPP was discussed at the International Conference on Freshwater in December 2001, WSSD in 2002, and the WWF3 in 2003 in the context of sustainable development.
Sector Program	An approach for integrating aid projects hitherto implemented individually by each donor into a program targeting a particular sector, based on coordination between recipient countries and donors. The idea is to ensure efficient aid that addresses that particular sector as a whole.

Terms/Abbreviations	Definition/Description
U.N. Millennium Summit	The summit meeting held in September 2000 concurrently with the U.N. Millennium General Assembly. In light of the development goals agreed so far, the summit adopted the Millennium Development Goals.
World Summit on Sustainable Development	Also known as the Johannesburg Summit. This summit was held in Johannesburg, South Africa in August 2002, ten years after the Earth Summit (in Rio de Janeiro), the first international conference that discussed "the environment and development" in a holistic manner.
JICA Terminology	
Basic Design Study (B/D)	A study that JICA conducts in relation to grant aid projects. Based on this study, the Japanese government makes a go/no-go decision on such a project, including project details. B/D covers a range of issues, including basic design, construction costs, processes, alternative options, economic and technical relevancy, finance, and management arrangements. Then the feasibility of the project is examined and the optimal implementation plan is developed.
Community Empowerment Program (CEP)	CEP is the aid scheme that allows JICA to support NGOs on the ground working in such areas as maternal and child health, welfare for the elderly, the disabled and children, and poverty reduction. Originally launched in FY1997, CEP became part of another JICA scheme "Technical Cooperation Project (TCP)" in FY2002, based on the idea that support for local NGOs was one element of efforts to achieve the goal of TCP. Note that support for Japanese NGOs is grouped under the scheme "JICA Partnership Program."
Coordinated Detailed Design	Coordinated Detailed Design (D/D) is a D/D that JICA works out in cooperation with JBIC.
Detailed Design (D/D)	Detailed Design includes a detailed design plan, a bill of quantities, specifications, construction process charts, and bid-related materials. D/D generally constitutes part of the construction at the implantation phase of a particular project.
Feasibility Study (F/S)	Feasibility Study (F/S) seeks to determine the feasibility, relevancy, and investment impact of a particular project. It is usually aimed at demonstrating objectively that the project is feasible from the social, technical, economic and financial aspects. F/S plays a central part in JICA's development study.
JOCVs	Japan Overseas Cooperation Volunteers: A volunteer system established in 1965 for participants between 20 and 39 years of age. A total of some 23,000 JOCVs have been assigned to 76 developing countries.
Master Plan (M/P) Study	A study to draw up a comprehensive development plan at the national or regional levels, or a long-term development plan in a particular sector.
Project-type Technical Cooperation	A form of technical cooperation that is planned, implemented, and evaluated within a 3-5 year cooperation period. The scheme combines the dispatch of experts, acceptance of trainees, and provision of equipment. Starting in FY2002, several types of assistance are grouped together under the scheme "Technical Cooperation Projects."
Technical Cooperation Project	A JICA aid scheme that seeks to achieve a measure of success within a specific time frame. For this purpose, a logical relationship between the output/outcome and input/activities will be identified. Based on this relationship, the best mix of expert dispatch, trainee acceptance and equipment provision will be sought.
Third-Country Training Program	Training in a comparatively advanced developing country in which the training utilizes that country's personnel who have received training through Japan's technical cooperation and invites trainees from other developing countries.
Bilateral and Multilateral Donors	
ADB	Asian Development Bank
CIDA	Canadian International Development Agency
DAC	Development Assistance Committee. DAC coordinates the assistance policy of the OECD* (Organization for Economic Cooperation and Development) to developing countries. It is one of three major committees of the OECD, along with the Trade Committee and the Economic Policy Committee. Currently membership totals 23 countries.
DAC Senior Level Meeting	A meeting held once a year in which high-level assistance officials from each DAC country attend to discuss and adopt recommendations on particularly important development issues. The 1996 DAC High Level Meeting of the OECD* adopted the goal of halving the proportion of people living in extreme poverty by 2015.

Terms/Abbreviations	Definition/Description
DFID	Department for International Development (U.K.)
Global Water Partnership (GWP)	In 1977, the U.N. Water Conference, the first of its kind, was held in Mar del Plata. The 1980s was designated as the United Nations Decade of Water and Sanitation. In 1992, the Dublin Conference and the Rio Environmental Summit were held. After that, no global initiative was taken for the water sector. This fact led to the establishment in 1996 of the Global Water Partnership (GWP) as a global network opened to any organization working in the sector of water resources. The mission of GWP is to support countries in the sustainable management of their water resources. The GWP's objectives are to: (i) clearly establish the principles of sustainable water resources management; (ii) identify gaps and stimulate partners to meet critical needs within their available human and financial resources; (iii) support action at the local, national, regional or river basin level that follows principles of sustainable water resources management; and (iv) help match needs to available resources.
JBIC	Japan Bank for International Cooperation: JBIC was established in 1999 through the integration of the Export-Import Bank of Japan and the Overseas Economic Cooperation Fund.
JICA	Japan International Cooperation Agency
OECD	Organization for Economic Co-operation and Development: OECD was launched in 1961 with the reorganization of the Organization for European Economic Co-operation (OEEC), was established in 1948 for the reconstruction of Europe. Its objectives include economic growth, assistance to developing countries, and the expansion of multidirectional free trade. Membership totals 30 countries now.
Sida	Swedish International Development Cooperation Agency
USAID	The United States Agency for International Development
World Bank (WB)	The World Bank (WB) generally refers to two organizations, the International Bank for Reconstruction and Development (IBRD) and the International Development Association (IDA). The World Bank Group includes the above two organizations and the International Finance Corporation (IFC), the Multilateral Investment Guarantee Agency (MIGA), and the International Center for Settlement of Investment Disputes (ICSID).
World Water Council (WWC)	The World Water Council (WWC) is a non-profit, non-governmental organization launched 1996 as the International Water Policy Think Tank. In 1977, the U.N. Water Conference, the first of its kind, was held in Mar del Plata. The 1980s was designated as the United Nations Decade of Water and Sanitation. In 1992, the Dublin Conference and the Rio Environmental Summit were held. After that, no global initiative was taken for the water sector. This fact led to the establishment of WWC. The purpose of the establishment was information provision and policy advocacy in relation to the water crisis, which will deepen in the near future, under the integrated framework that transcends national borders, political division, and different levels of development. Multilateral donors (WB, ICID) and IWRA (International Water Resources Association) greatly contributed to the establishment of WWC. WWC regional centers were opened in Montreal, Cairo and New Delhi. France and Canada tried to lure WWC headquarters, which was finally established in Marseilles. One-fourth of the general budget is covered by membership fees (100 dollars per year) from 160 members. The remaining three-fourths are covered by subsidies from Marseilles.

Terms with * are listed in this chart.

Sources:

Infrastructure Development Institute-Japan (1993) *Kasen Sogo Kaihatsu Yogoshu [Glossary of Integrated River Development Terms]*

Maruzen (1997) *Mizu no Hyakka Jiten [Encyclopedia of Water]*

Japan Sewage Works Association (1988) *Gesuido Yogoshu [Glossary Wastewater System]*

Japan Society for Natural Disaster Science, ed. (2002) *Bosai Jiten [Dictionary of Disaster Terminology]*

International Development Journal (1998) *Kokusai Kyoryoku Yogoshu (Daini-han) [Lexicon of International Cooperation (2nd ed.)]*

Japan International Corporation of Welfare Services, ed. (1999) *Kaihatsu Tojokoku no Suido Seibi Q&A [Q&A about Water Supply Development in Developing Countries]*, Japan International Cooperation Publishing