

# *Promoting Integrated River Basin Management and Restoring China's Living Rivers*

Lessons learned from international IRBM experiences

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Environment and Development

September 2004



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**Accompanying Parts:**

- 1: Summary and recommendations
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# 1. Introduction

The first World Summit on sustainable development held in Rio de Janeiro in 1992 (from which Agenda 21 emerged) highlighted that water is a social and economic good, an integral part of an ecosystem, a natural resource and, whose quantity and quality determine the nature of its use. In 2003 in Johannesburg when the world leaders met again at the World Summit on Sustainable Development (WSSD) they reinforced the central role of water, and its sustainable use, in combating poverty, improving human health and feeding the people of the planet. In particular, the Millennium Development Goals adopted by that summit consider (among others) the eradication of extreme poverty and hunger, reductions in child mortality and improvements in maternal health, and moving toward environmental sustainability. Goal 7 and Targets 9, 10 and 11 (see below) are especially notable in the context of this report.

<b>Goal 7: Ensure environmental sustainability*</b>		
<b>Target 9:</b>	Integrate the principles of sustainable development into country policies and programmes and reverse the loss of environmental resources.	Proportion of land area covered by forest; Ratio of area protected to maintain biological diversity to surface area; Energy use per unit of GDP; Carbon dioxide emissions (per capita) and consumption of ozone-depleting chlorofluorocarbons; Proportion of population using solid fuels.
<b>Target 10:</b>	Halve, by 2015, the proportion of people without sustainable access to safe drinking water.	Proportion of population with sustainable access to an improved water source.
<b>Target 11:</b>	By 2020, to have achieved a significant improvement in the lives of at least 100 million slum dwellers.	Proportion of people with access to improved sanitation Proportion of people with access to secure tenure

\* The selection of indicators for Goals 7 and 8 is subject to further refinement

At its 7<sup>th</sup> Conference of the Contracting Parties held in Kuala Lumpur in February 2004, the Convention on Biological Diversity considered the WSSD's Millennium Development Goals in the context of its programs of work. The following extracts from document COP/7/20/Add.1 of that meeting are relevant here.

*“The World Summit on Sustainable Development acknowledged the important role of biological diversity to sustainable development. Biological diversity is a resource that is used directly at present (as represented, for example, by the food we eat, or the products of animals and plants we rely upon such as timber). It has a future direct value (for example in increasing food production or as a source of new drugs). It is also important (both now and in the future) indirectly through providing essential ecosystem services (such as recycling nutrients essential to agriculture, maintaining the natural water balance etc.) and is important culturally, socially and aesthetically. Sustainable development, by definition, requires that future generations be able to benefit from resources in the same fashion as we can now.*

*In effect, the loss of biodiversity is perhaps the best indicator of unsustainable development. The conservation of biological diversity and truly sustainable development go hand-in-hand, but this by no means ensures that activities undertaken under the auspices of sustainability actually achieve it. Compatibility between sustainability and development requires the analysis of often complex linkages between objectives, activities, causes and effects and often presents challenging policy options. Within this process, biodiversity and the wider environment are at stake, and with them sustainable development itself.”*

The People's Republic of China, the most populous nation on earth, has a great numbers of rivers that provide water resources for the nation's development and the wellbeing of its people. China's history has seen a slowly evolving process of harnessing and exploiting these rivers, mainly through engineering and technical means. Since 1949, after the founding of the PR of China, the nation has moved to draw together the management system of water resources with river basin and regional management. Despite these positive trends, which were further advanced by the new Water Law adopted in 2002, China shows clear signs of unsustainable use of its water resources and related ecosystems. Devastating flooding, mud slides, declining water quality and fish catch and loss of biological diversity are but some of the signs that the management systems for water, rivers and lakes in China have some way to go in order to achieve true sustainability.

China is not alone with fighting these issues. More than one billion people worldwide do not have access to clean freshwater. Over two billion do not have adequate sanitation services. Every year, over three million people die of water borne diseases. Flood and drought, often brought on by poor management of river basins, claim thousands of lives and cause billions of dollars of damage to communities. Projections of trends into the future are not encouraging either. Barring some dramatic changes, the number of people without adequate access to freshwater is expected to double by 2025.

Ecosystems and biodiversity are suffering also. Scientists generally acknowledge that species dependent on freshwater ecosystems are the world's most endangered group. Freshwater ecosystems contain less than 0.01% of the earth's water, but account for a much larger percentage of the earth's biodiversity. Approximately 12% of all animals live in freshwater, including 40% percent of the world's fishes. Habitats adjacent to rivers and lakes, and dependent on them for their viability, are equally important. Wetlands are vital habitat for countless species and serve as the nurseries for some of the world's most important fisheries. Fifty percent of wetland habitats worldwide have been destroyed or heavily altered. Dams and other hard infrastructure have dramatically altered the amount, timing, and temperature of flows in most major rivers. Riparian habitats - forests and grasslands found along the banks of rivers and lakes - are critical for conserving biodiversity, and also play important roles in preventing soil erosion, and with filtering run-off.

Confronted by these challenges, the world has sought solutions; mechanisms to provide people with food and water, to promote economic advancement and to also protect natural ecosystem and biological diversity, and to do this in perpetuity. Thus, the concept of sustainable development has taken on the mantle of the way forward, and today's challenge is to apply this concept across the landscape.

The primary factor that has undermined efforts to deliver the ideal of sustainable development in the past has been sector-based management; the process whereby those with vested or narrow interests pursue those without regard for the broader consequences on the economy, society or the environment. Exacerbating this problem, governments the world over choose to organize public administration along sectoral lines also, with barriers building up between economic, social and environmental policy, laws and administration. The world has slowly come to recognize the failure of sector-based thinking and administration and today the word "integration" is seen as the cornerstone of sustainable development.

With pressure on water resources growing in all corners of the planet, practitioners have designed a management framework that allows for the integration of economic, social and environmental factors, with sustainable development being the outcome sought. Integrated river basin management (IRBM) is now increasingly recognized as the way of the future.

IRBM is a process of coordinating the management and development of water, land, biological, and related resources, across sectors within a river basin, so as to maximize the economic and social benefits in an equitable way while at the same time conserving freshwater ecosystems and species.

The river basin management approach is a participatory mechanism for solving conflicts and allocating water between competing users, while recognizing that natural ecosystems are in part the suppliers of that

resource and the fundamental 'natural infrastructure' that delivers it to human users. Natural ecosystems are also key providers of a range of ecosystems services (flood mitigation, water quality improvement and fish production for example) which previously were overlooked in water resource management. IRBM is about managing water resources and rivers for win-win-win outcomes; economy, society, environment.

This three part report, prepared by the IRBM Task Force of the China Council on International Cooperation for Environment and Development, reviews the current status of IRBM in the PR of China, examines international experiences and lessons learned in this field, and then provides recommendations for how China can move to apply these lessons for the future. It has also taken into consideration the Asian Development Bank funded report "Strategic Options for the Water Sector of the People's Republic of China" (1999) and The World Bank funded report "Agenda for Water Sector Strategy for North China" (2001). Part 1 of the report provides a summary of the conclusions and consolidation of the recommendations. Parts 2 and 3 present the key background information that was considered in formulating these conclusions and recommendations.

## 2. Concepts of Integrated River Basin Management (IRBM) and the ecosystem approach

### 2.1 What is Integrated River Basin Management and why it is important ?

In many countries of the World today, especially those that have large populations, there is growing pressure on Governments to provide water for a range of needs. These include for human and livestock consumption, crop and fish production, the generation of electricity and transport; in short, for economic development and poverty reduction.

One of the most important health hazards, particularly for urban dwellers in developing countries, is faecal contamination of water and food due to poor or non-existent sanitation systems and inadequate hygiene, compounded by unreliable and unsafe drinking water supply. Industries and agriculture are increasingly affecting the quality and the quantity of water.

Natural climatic variability also means that the management of rivers has to take into consideration protecting human populations from flash floods and droughts. With climate change scenarios now generally accepted, Governments are also starting to plan for these impacts in the way water resources are managed.

The third area of concern is that of biodiversity loss due to river modifications and regulated stream flows. Species dependent on freshwater ecosystems are the world's most endangered group. Aquatic ecosystems have been significantly modified or converted (in the case of floodplain wetlands) to other uses. Habitats adjacent to rivers and lakes, and dependent on them for their viability, are equally important. These include wetlands, forests and grasslands. Experience has shown that when these habitats are lost, river management challenges grow. Water quality declines, fish populations are less plentiful, flash flooding is more common, eco-tourism suffers etc, etc.

Some fear that protecting the environment may hinder development, while more and more evidence shows that environmental protection and development are mutually reinforcing. Environmental problems hit the poor hardest and constitute a significant cause of poverty.

The growing view is that unless the human species can learn to utilise fresh water in a way that is equitable and ecologically sustainable, then major conflicts will emerge as water resources become more and more scarce and the quality of the resource declines.

The major failing with managing river systems has been to separate economic, social and environmental agendas, and to create sector-based management along these lines so that priorities are competing with one another rather than being dealt with through integrated approaches. There has also been a strong tendency to use engineering solutions exclusively rather than a suitable blend of engineering and non-engineering (natural) technology.

Water resource managers are now advocating a shift to integrated river basin management as a tool to support this move to the equitable and ecologically sustainable use of fresh water resources. There are many definitions for this term 'integrated river basin management' or IRBM, however, the following, adapted from a definition developed by the Global Water Partnership, possibly describes it with greatest clarity.

*Integrated river basin management (IRBM) is the process of coordinating conservation, management and development of water, land and related resources across sectors within a given river basin, in order to maximize the economic and social benefits derived from water resources in an equitable manner while preserving and, where necessary, restoring freshwater ecosystems.*

(Adapted from Integrated Water Resources Management, Global Water Partnership Technical Advisory Committee Background Papers, No. 4, 2000.)

As stated in *Managing Rivers Wisely* (WWF, 2003), IRBM is predicated on the fundamental ‘...*principle that naturally functioning river basin ecosystems, including accompanying wetland and groundwater systems, are the source of freshwater. Therefore, management of river basins must include maintaining ecosystem functioning as a paramount goal. This ‘ecosystem approach’ is a central tenet of the Convention on Biological Diversity. River basins are dynamic over space and time, and any single management intervention has implications for the system as a whole.*

The concept of IRBM is closely linked to that of Integrated Water Resources Management (IWRM) although this latter term does not necessarily convey the sense of using the river basin as the geographical management framework. IWRM can simply refer to resource sharing among water use sectors at any scale.

Experience has now shown (see section 1.2) that using the river basin as the management unit has significant environmental, social and economic advantages over more piece-meal, sector-based approaches. It is important to note that this same management approach is equally effective for those rivers that drain into lakes rather than oceans; lake basin management being very important to several countries in Africa most notably.

## 2.2 What is an ecosystem approach ?

At the second meeting of the Conference of the Parties to the Convention on Biological Diversity (CBD) in 1995 it was agreed that the ecosystem approach should be the primary framework for implementation of this global treaty. The ecosystem approach aims to recognise and balance the three objectives of the CBD; conservation, sustainable use, and fair and equitable sharing of the benefits arising out of the utilisation of genetic resources.

The ecosystem approach was subsequently defined by the signatories of the CBD as “*a strategy for the integrated management of land, water, and living resources that promotes conservation and sustainable use in an equitable way. The ecosystem approach is based on the application of appropriate scientific methodologies focused on levels of biological organization, which encompass the essential processes, functions, and interactions among organisms and their environment. It recognizes that humans, with their cultural diversity, are integral components of ecosystems.*”

At the 5th CBD Conference of Contracting Parties (in 2000), the 12 principles of the ecosystem approach were adopted as follows through Decision V/1.

The goals of IRBM and the ecosystem approach are essentially the same. IRBM is a mechanism or tool for implementing the ecosystem approach. These 12 principles are important in the context of this report and its recommendations ; they provide a check-list of issues and concepts that help define the form of IRBM applied to any specific river basin.

“The following 12 principles are complementary and interlinked.

**Principle 1:** *The objectives of management of land, water and living resources are a matter of societal choices.* Different sectors of society view ecosystems in terms of their own economic, cultural and society needs. Indigenous peoples and other local communities living on the land are important stakeholders and their rights and interests should be recognized. Both cultural and biological diversity are central components of the ecosystem approach, and management should take this into account. Societal choices should be expressed as clearly as possible. Ecosystems should be managed for their intrinsic values and for the tangible or intangible benefits for humans, in a fair and equitable way.

**Principle 2:** *Management should be decentralized to the lowest appropriate level.*

Decentralized systems may lead to greater efficiency, effectiveness and equity. Management should involve all stakeholders and balance local interests with the wider public interest. The closer management is to the ecosystem, the greater the responsibility, ownership, accountability, participation, and use of local knowledge.

**Principle 3:** *Ecosystem managers should consider the effects (actual or potential) of their activities on adjacent and other ecosystems.*

Management interventions in ecosystems often have unknown or unpredictable effects on other ecosystems; therefore, possible impacts need careful consideration and analysis. This may require new arrangements or ways of organization for institutions involved in decision-making to make, if necessary, appropriate compromises.

**Principle 4:** *Recognizing potential gains from management, there is usually a need to understand and manage the ecosystem in an economic context. Any such ecosystem-management programme should:*

- a) Reduce those market distortions that adversely affect biological diversity;*
- b) Align incentives to promote biodiversity conservation and sustainable use;*
- c) Internalize costs and benefits in the given ecosystem to the extent feasible.*

The greatest threat to biological diversity lies in its replacement by alternative systems of land use. This often arises through market distortions, which undervalue natural systems and populations and provide perverse incentives and subsidies to favor the conversion of land to less diverse systems. Often those who benefit from conservation do not pay the costs associated with conservation and, similarly, those who generate environmental costs (e.g. pollution) escape responsibility. Alignment of incentives allows those who control the resource to benefit and ensures that those who generate environmental costs will pay.

**Principle 5:** *Conservation of ecosystem structure and functioning, in order to maintain ecosystem services, should be a priority target of the ecosystem approach.*

Ecosystem functioning and resilience depends on a dynamic relationship within species, among species and between species and their abiotic environment, as well as the physical and chemical interactions within the environment. The conservation and, where appropriate, restoration of these interactions and processes is of greater significance for the long-term maintained conditions and, accordingly, management should be appropriately cautious.

**Principle 6:** *Ecosystem must be managed within the limits of their functioning.*

In considering the likelihood or ease of attaining the management objectives, attention should be given to the environmental conditions that limit natural productivity, ecosystem structure, functioning and diversity. The limits to ecosystem functioning may be affected to different degrees by temporary, unpredictable or artificially maintained conditions and, accordingly, management should be appropriately cautious.

**Principle 7:** *The ecosystem approach should be undertaken at the appropriate spatial and temporal scales.*

The approach should be bounded by spatial and temporal scales that are appropriate to the objectives. Boundaries for management will be defined operationally by users, managers, scientists and indigenous and local peoples. Connectivity between areas should be promoted where necessary. The ecosystem approach is based upon the hierarchical nature of biological diversity characterized by the interaction and integration of genes, species and ecosystems.

**Principle 8:** *Recognizing the varying temporal scales and lag-effects that characterize ecosystem processes, objectives for ecosystem management should be set for the long term.*

Ecosystem processes are characterized by varying temporal scales and lag-effects. This inherently conflicts with the tendency of humans to favour short-term gains and immediate benefits over future ones.

**Principle 9:** *Management must recognize the change is inevitable.*

Ecosystems change, including species composition and population abundance. Hence, management should adapt to the changes. Apart from their inherent dynamics of change, ecosystems are beset by a complex of uncertainties and potential "surprises" in the human, biological and environmental realms. Traditional disturbance regimes may be important for ecosystem structure and functioning, and may need to be maintained or restored. The ecosystem approach must utilize adaptive management in order to anticipate and cater for such changes and events and should be cautious in making any decision that may foreclose

options, but, at the same time, consider mitigating actions to cope with long-term changes such as climate change.

**Principle 10:** *The ecosystem approach should seek the appropriate balance between, and integration of, conservation and use of biological diversity.*

Biological diversity is critical both for its intrinsic value and because of the key role it plays in providing the ecosystem and other services upon which we all ultimately depend. There has been a tendency in the past to manage components of biological diversity either as protected or non-protected. There is a need for a shift to more flexible situations, where conservation and use are seen in context and the full range of measures is applied in a continuum from strictly protected to human-made ecosystems

**Principle 11:** *The ecosystem approach should consider all forms of relevant information, including scientific and indigenous and local knowledge, innovations and practices.*

Information from all sources is critical to arriving at effective ecosystem management strategies. A much better knowledge of ecosystem functions and the impact of human use is desirable. All relevant information from any concerned area should be shared with all stakeholders and actors, taking into account, inter alia, any decision to be taken under Article 8(j) of the Convention on Biological Diversity. Assumptions behind proposed management decisions should be made explicit and checked against available knowledge and views of stakeholders.

**Principle 12:** *The ecosystem approach should involve all relevant sectors of society and scientific disciplines.*

Most problems of biological-diversity management are complex, with many interactions, side-effects and implications, and therefore should involve the necessary expertise and stakeholders at the local, national, regional and international level, as appropriate.”

### 2.3 What does taking an holistic approach mean ?

Efficient Integrated River Basin Management requires an holistic approach. The European Union <sup>1</sup> defines a holistic approach to water resources management as one that encompasses “*environmentally-sound water management; food security especially for the poor; private sector involvement; reduction of subsidies; decentralization of decision-making to the lowest appropriate administrative level; user participation in services; institutional reform and regulatory frameworks; and cost recovery and pricing*”. <sup>2</sup> A holistic approach requires balancing the competing demands on the resource – domestic, municipal, agricultural, industrial and environmental.

The European Commission also stresses that “*The protection of the ecosystem and natural resources upon which all forms of life on earth depend should be regarded as an obligation (...) and include investments in environmental protection of vulnerable areas such as wetlands, coastal zones and fisheries, marginal farming lands, deserts, areas vulnerable to flooding and/ or soil erosion.*”<sup>3</sup>

The holistic river or lake basin and ecosystem approach is a combination of all the sustainable approaches mentioned in this report.

A holistic, river or lake basin management methodology using the ecosystem approach should be adopted, as the best way forward for integrated and sustainable water resources management. There is an urgent need to implement what is now generally recognized as the best way forward for water management. This entails the adoption and implementation of key operational principles and the allocation of funds for river/lake basin management.

The following principles should be given a top priority in all river basin and water management activities. Their implementation should be seen as a *sine qua non* condition of success of water management activities.

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<sup>1</sup> European Commission, 1999. Towards Sustainable Water Resources Management : A Strategic Approach

<sup>3</sup> European Commission, 1999.

1. **Sustainability.**  
Water policies must take hydrological and natural processes into account, protecting ecosystems that are indirectly related to water such as mountain forests as well as leaving the amount of water for other ecosystem types.
2. **Coherence.**  
The Monterrey Conference on financing for development concluded that policy coherence is a prerequisite in all development activities. Coherence is also important at national levels, between ministries and/or development agencies.
3. **Equity.**  
All human beings deserve and should receive enough water of good quality to enable them to live decently. The central governments should speak for the major rivers and defend their interests, making sure that their policies are properly implemented. Within a framework of access to information, water should be managed in a participatory way at its lowest level to ensure that the targeted user groups, especially women and children, effectively benefit from water development programmes.
4. **Equitable utilization.**  
Water should be equitably shared between all users and stakeholders, including for energy production, agriculture, industrial uses, human basic needs and nature, in particular for the directly or indirectly water-related ecosystems that should ensure healthy hydrological processes.
5. **Efficiency.**  
Increasing water productivity is central to producing food, to fighting poverty, to reducing competition for water and to ensuring that there is enough water for nature.<sup>4</sup> In other words what is needed is *better* water rather than *more* water. This can be done through a series of improvements through improved technologies for water use (drop by drop irrigation system, recycling, providing sanitation etc.), as well as through the improvement or substitutions of crops, improved cultural practices, etc.
6. **Correction of market failure and managing demand.**  
All water users should pay the full price of water provision. External costs for water services should be internalized. Environmental services should be valued in economic and financial terms. Unsustainable subsidies for agriculture should be replaced by cross-subsidies to enable the poor to get access to water.
7. **Practice the holistic approach.**  
Unite all skills in managing water, considering nature as our first partner in the effort towards poverty eradication in the long run rather than trying to dominate nature in the short term with long-term damage.

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<sup>4</sup> Ibid.

## 2.4 What relevance does IRBM have for the PR of China

China has about 1500 rivers covering an area of approximately 1000 km<sup>2</sup>. The seven largest rivers ; the Yangtze, Huanghe, Zhujiang, Huaihe, Haihe, Songhuajiang and Liaohe rivers, provide close to 60% of the total water needs of China.

River management in China has a history of over 4000 years. Past dynasties attached great importance to water management and in the 1930s, the Chinese government established the Huanghe Hydraulic Committee and water resources committee for the Yangtze and Huaihe Rivers.

After the establishment of the People's Republic of China in 1949 the central government established the Ministry of Water Conservancy, however hydropower, water use in rural areas, inland river navigation and urban water supplies were managed by other Ministries. Later, seven river management units were established ; these being for the Huanghe, Changjiang, Huaihe, Haihe, Zhujiang, Songliao and Taihu rivers. They were responsible for monitoring water availability, planning, hydraulic engineering and management. A high priority for the river management units was flood management and there were conflicts between departments over water usage. The river management units did not have the overall responsibility for, and were unable to pursue, integrated management approaches.

In China today, there are many symptoms illustrating a failure to adequately allocate and plan for sustainable land and water use along and surrounding rivers (see Part 1, Section 2). These same symptoms can be seen in many countries around the world where there has been a failure to manage rivers in an integrated way, taking full account of their social, economic and environmental values. In many of these countries, IRBM is being applied as the administrative framework to see enhanced integration of economic development, community well-being and environmental sustainability into decision-making. Section 4 of this report details international experiences in applying IRBM.

### 3. Water Management Systems and IRBM in China

#### 3.1 History of water management systems in China

In many dynasties of ancient China the Central government established special agencies to be responsible for water affairs. Specialised agencies were established to take responsibility of the major rivers, such as the Yellow River, and the local officers in provinces, cities and counties along the rivers were responsible for water course management and flood control, etc.

In the past, China established water departments in the Sui and Tang Dynasties and water administration authorities in the Min and Qing Dynasties. In the early days, water affairs were managed by the Ministries of Interior and Industry and Commerce and then in 1927 the construction of water infrastructure projects was supervised by the Construction Commission. Farmland drainage and irrigation were managed by the Ministry of Industry, and river regulation by the Ministry of Communications.

In 1931, China's Water Engineering Association was established and it proposed an integrated approach to water administration nationwide. Then, in 1934, the State Economic Construction Commission established the Water Conservancy Department to be responsible for water management and river basins nationally. The State Water Resources Commission was established under the Executive Council in 1941 and it was reorganized to become an independent Commission in 1946. In 1947, the Ministry of Water Resources was established.

After the founding of the People's Republic of China in 1949, the central government established the Ministry of Water Conservancy. However, hydropower, water conservancy in rural areas, inland river navigation and urban water supplies were managed by the Ministry of Fuel Industry, Ministry of Agriculture, Ministry of Communications and Ministry of Construction, respectively. An integrated administration system for water management was not formed.

In 1952, the Rural Water Conservancy Department was transferred to the Ministry of Water Conservancy from the Ministry of Agriculture, and the management of rural water and erosion control become the duty of the Ministry of Water Conservancy. Later the Ministries of Water Conservancy and the Ministry of Electric Power were incorporated into the Ministry of Water Conservancy and Electrical Power.

In 1958, responsibility for rural water management reverted back to the Ministry of Agriculture and then in 1965 it was again transferred back to the Ministry of Water Conservancy and Electrical Power.

In 1979 the Ministry of Water Conservancy and Electrical Power was divided into separate Ministries of Water Conservancy and Electric Power. Then in 1984 the two Ministries were reunited again and became the comprehensive management agency for the nation's water resources. However, responsibility for water management related to construction, public health, environmental protection, agriculture and communication were still managed by different departments.

In 1988, the first water law of China was promulgated and put into force (see more about this below). The law specified that China's water resource management system should be "*one combining integrated management with management by different levels and different sectors*". While this law reflected some integrated river basin management concepts it did not specify the management system. Key water use sectors continued to be managed by separate departments and this did not facilitate progression towards more integrated approaches.

Today, the Ministry of Water Resources (MWR) is responsible for integrated management of the nation's water resources while other agencies retain responsible for related specific water affairs under their

jurisdiction. There are also local water resource agencies and departments that play a role in specific areas of water resource management.

Since the founding of the PR of China, the local water administrative system has been gradually completed and strengthened and divided into three levels, i.e. provincial (autonomous region, and municipality) level, prefecture (autonomous prefectures, league) level and county level. Since 1986, township government has sat under county level administration.

The new water law that came into force on 1st October 2002 clearly specifies the integrated management system and the mechanism for combining river basin management with regional management. In addition, it supplements articles on the planning, protection and saving of water resources, and authorizes the river basin agencies to implement the law.

### ***3.1.1 Establishment of River Basin authorities***

Before the founding of People's Republic of China in 1949 the central government had established river basin water authorities in some large basins, such as the Yangtze River, Yellow River, Huaihe River and Taihu Lake Basin. These were retained after the founding of the PRC, but their nature and function has gradually changed over time.

Today, there are seven major river basin authorities in China, including the Yangtze River, Yellow River, Peal River, Shongliao River, Huaihe River, Haihe River and Taihu Lake. These are responsible for overall water administration within their designated areas as decentralized agencies of the Ministry of Water Resources. For this report it is vital to understand how these river basin authorities operate at present and so in section 3.3 below the Yangtze River basin authority is considered in detail.

### ***3.1.2 Water resources management system after the Institutional Reform in 1998***

The State Council of China was reformed again in 1998 with the aim of establishing a government with simple structure and high efficiency. The Ministry of Water Resources was retained after this reorganization with its function of promoting integrated water resource management being reinforced. The main functions of the Ministry of Water Resources, as approved by the State Council include:

1. Formulating water-related policies, development strategies and medium and long-term development plans. Organizing to draft water –related laws and regulations and supervising their implementation.
2. Implementation of integrated management of water resources, including the atmospheric water, surface water and groundwater, which includes formulation of national and inter-provincial development plans for water supply and demand and the schemes for water allocation, supervision of the execution of the above plans and schemes; assessment of water resources and flood risk and flood mitigation measures in relation to the overall planning of the national economy, urban planning and major construction projects; implementation of the water-taking permit system and the water resource pricing system, promulgate national water resources bulletin, etc.
3. Drafting policies and plans on water saving and preparing relevant standards; organizing and supervising water saving affairs.
4. Formulating water resource protection planning in accordance with related national laws, regulations and standards concerning resource and environment protection; demarcation of water function zoning and controlling the discharge of wastewater to potable water areas and other water areas; monitoring of the quantity and quality of water of rivers, lakes and reservoirs,

review and approval of the pollution loading capacities of water bodies and proposing the allowable limit of total wastewater discharge.

5. Organizing and instructing the supervision and enforcement of water administrative affairs; coordinating and judging the disputes of inter-sector and inter- province water affairs.
6. Formulating economic regulatory measures for the water sector; exercising macro-scale adjustment on the utilization of funds for water industry; providing guidance to economic activities related to water supply, hydropower and diversified development of the water sector; providing recommendations on regulation of water pricing, taxation, credit and financial affairs, etc.
7. Drafting and reviewing the proposals and feasibility study reports on construction of large and medium-scale water projects; organizing the implementation of key water related scientific research projects and the promotion of water-related technologies; Drafting, issuing and supervising the implementation of the technical standards, regulations and specifications for water works.
8. Organizing and instructing the management and protection of water conservancy facilities, water areas and its bank lines; the regulation, reclamation and development of major rivers, major lakes, estuary and beaches; handling of the foreign affairs of the international rivers; organizing the construction and managing the key controlling and trans-provincial water projects; organizing and instructing the safety monitoring and management for reservoirs and dams of hydropower stations.
9. Instructing the rural water conservancy; organizing and coordinating the construction of farmland drainage and irrigation, rural electricity supply and water supply for townships and villages across the countryside.
10. Organizing nation wide water and soil conservation, including formulation of engineering measures planning for water and soil conservation, organization of the monitoring and overall prevention and control of soil and water erosion.
11. In charge of the activities concerning science, technology and foreign affairs related to water resources; providing guidance to the personnel training in the water sector.
12. Responsible for the routine work of the State Flood Control and Drought Relief Headquarters, including the organization, coordination, supervision and instruction of nationwide flood control, and execution of operations of flood control and drought prevention for major river basins and key water projects.

The 1998 reform of the State Council also saw the river basin and local water administrative authorities at all levels reorganized. The water administrative authorities of all provinces, cities and prefectures have strengthened their roles and responsibilities in integrated water resources management.

As decentralized agencies of the Ministry of Water Resources, the seven river basin authorities have similar State-endorsed functions.

The PR of China now has, and is implementing a Sustainable Development Strategy, and the sustainable use of water resources is a central part of this approach.

### 3.2 Laws, regulations and policies relating to river basin management in the PR of China

As indicated above, there are at present seven major river basin authorities in China; these being for the Yangtze, Yellow, Pearl, Shongliao, Huaihe and Haihe Rivers and Taihu Lake.

In recent years, these river basin authorities have been given responsibility for implementing, applying and enforcing the range of relevant policies, laws and regulations. These laws include the *Water Law 2002*, the *Flood Control Law 1997* and the *Law of Prevention and Control of Water Pollution 1996*. Among the administrative regulations are the *Regulation on Riverway Management*, *Regulations on Water Drawing Permission*, *Regulation on Management of Sand Drawing in the Yangtze Channel* and *Interim Regulation on Prevention and Control of Water Pollution in the Huaibe River*, etc. Some of the relevant policies include documents issued by the Ministry of Water Resources on the management of permission to draw water, waterway management, water resource protection and water and soil conservancy. Further details about some of these are given below.

#### 3.2.1 Main laws and regulations relating to river basin management

##### *Water Law 2002*

The *Water Law* came into effect on October 1, 2002. This law clearly specifies for the first time that water resources management will integrate river basin and regional management. The river basin management bodies execute their duties and supervision of water resources as agencies of the Ministry of Water Resources; the Ministry with primary responsible for implementing the *Water law*. The river basin agencies are expected to undertake:

- the preparation, adjustment and approval of river basin water resources management planning;
- determinations on the minimum ecological flow;
- zoning of water activities;
- water drawing permission and water resources fee levying;
- mediation of water disputes; and,
- supervision and enforcement of water administrative affairs.

##### *Flood Control Law 1997*

The *Flood Control Law* entered into force in 1997 and clearly indicates that planning of flood control measures should be undertaken at the river basin scale, and implemented at appropriate regional levels. The law entitles the river basin authorities to:

- mediate, supervise and to determine the planned flood control scheme for major rivers;
- to manage major waterways;
- prepare flood control plans for trans-provincial rivers; and,
- to apply relevant administrative penalties.

##### *Law on Prevention and Control of Water Pollution 1996*

This law, came into force in 1984 and was then revised in 1996. It gives the river basin authorities an obligation to:

- prevent and control water pollution;
- inspect and monitoring the water quality at provincial boundaries;
- determine water quality standards for inter-provincial water bodies; and,
- undertake river basin planning to prevent and control of water pollution.

##### *Regulation on Management of Sand Mining in the Yangtze Riverways 2001*

This regulation, adopted in 2001, entitles the CWRC (Changjiang Water Resources Commission – see section 3.3) to supervise and inspect sand mining in the mainstem of the Yangtze River. Specifically, the CWRC is:

- entitled to plan sand mining activities in the Yangtze riverways;

- to approve sand mining activities in important inter-provincial sections;
- to levy the sand mining fee; and,
- undertake other relevant legal enforcements.

**Implementation Method on Water Drawing Permission System (is this an appropriate translation?)**

This entitles the CWRC to authorize/approve water drawing. This covers over 70% of the actual water drawing volume of the whole Yangtze basin.

**Regulation on Riverway Management**

The CWRC is entrusted to manage large-scale projects in major riverways.

**3.3 Yangtze River Basin case study**

(see also Part 3 of this report where the economic issues relating to this river basin are reviewed)

**3.3.1 About the Yangtze River basin**

The Yangtze River, the largest river in the PR of China originates in the Qinghai–Tibet Plateau and flows about 6300 km eastwards to the East China Sea. It has a catchment area of 1.8 million km<sup>2</sup>, representing 18.75% of the Chinese territory.

The main Yangtze River passed through Xizang, Qinghai, Sichuan, Yunnan, Chongqing, Hubei, Hunan, Jiangxi, Anhui, Jiangsu and Shanghai. The tributaries lie in Gansu, Shanxi, Guizhou, Henan, Guangxi, Guangdong, Fujian and Zhejiang. The Yangtze River is called the “Golden waterway” of China, with 70 thousand kilometers of channel suitable for navigation.



**Source:** Jones T, Phillips B, Williams C E and Pittock J (eds). 2003. *Managing River Wisely: Lessons from WWF’s work for integrated river basin management*. WWF International, Gland, Switzerland. For a more detailed see the end of this file.

About 418 million people, or 33.25% of China’s population, live in the Yangtze River catchment. The river basin generates GDP of 4434.6 billion China Yuan; 54.1% of China’s GDP. The Yangtze River catchment is therefore of national importance to China’s society and economy.

The Yangtze River basin receives mean annual rainfall of 1112 mm. The average annual mean discharge is about 961.6 million m<sup>3</sup>; twenty times greater than the Huanghe River and slightly less than the Amazon and Congo Rivers. The Yangtze River is the origin water for the “*transferring the water from south to north of China*” project, and plays a key role in overcoming the shortage of water in north China, especially in Beijing. This water is important for human well-being and economic development.

The Yangtze River basin has a monsoonal climate, with ‘wet’ and ‘dry’ seasons meaning flow patterns vary greatly throughout the year. The rainfall in the May to October ‘wet’ season accounts for 70-90% of the annual rainfall; at times resulting in severe flooding. This variability of flow presents a major challenge to water resource managers

The river basin also has important biological diversity values. China’s two largest freshwater lakes, Dongting Lake and Poyang Lake are found in the central Yangtze basin. These, and the expansive floodplains, provide habitat for 300 bird species, including migratory waterbirds such as cranes and storks. There are also two species of freshwater dolphins, more than 80 other mammal species, 200 fish species, at least 60 species of amphibians, and around 90 reptiles species.

The Changjiang river catchment consists of about 85% plateaus, mountains and hilly areas, 11% of plain and 4% of rivers and lakes. Land use and land cover within the catchment is as follows: arable lands 23.2 million ha (13.4%), forests 47.7 million ha (26.4%), grasslands 31.3 million ha (17.3%), water areas 7.5 million ha (4%), unused lands 19.8 million ha (11%), and others 50.3 million ha (27.9%).

Water resource exploitation in the Yangtze River basin accounts for only 18% of its average annual mean discharge. Exploitation of water for power generation only accounts for 25% of its total annual flow, if the Three Gorges project is included. The Yangtze River basin is China’s primary source of hydro-power, with 0.268 billion KW generated annually.

Within the Yangtze river catchment there many areas of importance for economic activity, with many large and medium-size cities. The management of river basin involves 19 provinces with 12 industries and departments also involved. All these factors combine to make river management an arduous and challenging task.

The Changjiang river catchment suffers from serious degradation (see below):



Fig.1 Environmental Issues in Changjiang River basin and Yellow River basin

### 3.3.2 Water resource and river basin management

In 1949 the State Council of China established the Yangtze Water Resources Commission and the former Prime Minister Zhou Enlai was its first director, while also continuing to be Prime Minister. In late 1956, the State Council also approved the establishment of the Yangtze Valley Planning Office. The affiliated organizations of the Yangtze Water Resources Commission were subordinated to the Office.

#### Changjiang Water Resources Commission

In October 1989, the State Council approved renaming of the Yangtze Valley Planning Office to the Changjiang Water Resources Commission (CWRC) and it became a semi-Ministry level agency. During institutional reforms in 1994, the Ministry of Water Resources ratified the CWRC as one of its river basin agencies. The main obligations of the CWRC are riverway management, water resources management and protection, water and soil conservancy and flood control, etc.

#### Water and Soil Conservation

Also notable is that in 1988 the State Council approved the establishment of the Water and Soil Conservation Commission of the Upper Yangtze. The Director of this Commission is the Governor of Sichuan province and the Vice Directors are leaders from the Ministry of Water Resources, the State Planning Commission, the Ministry of Agriculture, the State Forestry Bureau and other members from the Ministry of Finance, the State Land Bureau, the Poverty Relief Office of the State Council, Chinese Academy of Science and the CWRC.

The office of the Water and Soil Conservation Commission of the Upper Yangtze is located in the CWRC. The responsibilities of the Commission include organization and coordination of the issues on key projects of water and soil conservation of the upper Yangtze, and research of the key issues for the project construction. Local water and soil conservation activities at the provincial, prefecture and county levels are also managed by the commission.

In recent decades, the CWRC and the Soil Conservation Commission have played an important role in coordinating the control of water and soil erosion activities. This has assisted with progressing more integrated approaches involving public participation, other management sectors and local authorities in accordance with unified planning and in order to meet expected technical requirements and quality standards.

### **Flood Control and Drought Relief**

In 1996, the General Headquarters of Flood Control and Drought Relief of the Yangtze River was set up. The functions of the Yangtze headquarters include, strengthening flood management, defining the limitations of flow regulation, information reporting and feedback.

### **Water Resources Protection**

The Yangtze Valley Water Resources Protection Bureau was established by the Ministry of Water Resources in 1976. Then, in 1983, the Bureau was made subordinate to both the Ministry of Water Resources and the Ministry of Urban and Rural Construction and Environmental Protection. Since then the Water Resources Protection Bureau has evolved and now operates under the dual leadership by both the water and environmental protection administrations of the State Council. After the 1998 institutional reforms in China, some differences emerged in the administrative systems of the Ministry of Water Resources and the State Environment Protection Administration, however, the concept of water resource protection being carried out within a river basin framework has been widely accepted. One positive legacy of this dual administration arrangement has been that the Water Resources Protection Bureau has played an important role in coordination of water resource protection and water pollution control in the river basin.

Today there are a large number of commissions, agencies and other organizations that play a role in the management of the Yangtze River Basin. These include:

- Changjiang Water Resources Commission;
- Changjiang Fishing Management Commission;
- Changjiang Navigation Management Commission
- Yangtze Valley Water Resources Projection Bureau (Governed by Department of Hydrology and National Environmental Protection Bureau);
- Three Gorges Construction Commission;
- Head Company of the Three Gorges Construction;
- Office for the South Transferring of Water to the North
- State department
- Yangtze Maritime Agency
- Ministry of Communications
- Ministry of Agriculture
- State Environment Protection Administration

### **Key role of the Changjiang Water Resources Commission**

Approved by the State Council, the office of Central Institutional Organization Commission approved the adjustment of main functions, institutional organization and staff number of the river basin agencies of the Ministry of Water Resources in 2002. It defined that the river basin agencies, as a utility entity with administrative functions, are the decentralized agency of the Ministry of Water Resources and execute water-related administrative management functions in the basin or other authorized areas. It is

the first time that the river basin authorities in China have possessed this administration function since their establishment.

The approved public utility organization of the CWRC has 7081 personnel, including 851 personnel with administrative function (306 in the headquarter of CWRC, 60 in the Yangtze Valley Water Resources Protection Bureau and the rest are the water administrative supervision personnel).

The main responsibilities of the CWRC as are follows:

1. Administrative execution of the laws, administrative supervision and review. Investigation and treatment of water-related illegal behaviors.
2. Organizing the draft of the special plan of the basin; organizing the preliminary work for major water projects, such as basin-control water projects and inter-province water projects; technical review of large or medium scale local projects under authorization.
3. Integrated management of water resources in the river basin (including surface water and groundwater). Organizing the draft of the inter-province water allocation scheme and annual regulation plan and emergency scenario for water regulation during drought in the basin, implementing unified water regulation. Organizing and guiding the water resources argumentation of the key projects in the basin; guiding local water-saving affairs in the basin; organizing and coordinating the hydrological issues for major river and sections in the basin;; issuing basin water resources bulletin.
4. To be responsible for water resources protection of the basin and organizing the zoning of water function and control of pollution discharge to the drinking water source; reviewing the pollution receiving capacity of the water area and proposing the opinions on the limit of total pollution discharge; to be responsible for monitoring of water quantity and quality of inter-provincial water body (including inter-provincial rivers), important water body, rivers, lakes and reservoirs, etc. To be responsible for examining and supervising the pollutant discharge outlets in the major river reaches and in inter-province rivers or boundary river.
5. Implementing the regulation of important water projects for flood control and drought relief according to regulation and authorization; guiding and supervising the utilization of the flood storage area in the basin; organizing and guiding the argumentation on flood control for major water-related projects in the basin.
6. Guiding the harnessing and development of river, lake, estuary and coast beach in the basin; permission examination of the construction project in the managed river area under authorization; guiding the safety supervision and management of the water facilities in the basin. To be responsible for construction and management of the major state water projects, including the basin control project or inter-province project according to the regulations and authorization. Establishing the project legal entity; to be responsible for construction of the water projects with state investment and examination and supervision of its danger removing and reinforcing, supervision and management of water project construction market.
7. Organizing the dynamic monitoring of water and soil conservancy in the basin.
8. To be responsible for operation or supervision and management of the state-owned assets of the basin-control and inter-provincial water projects invested by the state; to work out the establishment and adjustment on pricing of water and electricity of the directly managed projects, as well as other charging items; to be responsible for use, check, examination and supervision of funds of the state invested water projects in the basin.
9. To be responsible for unified management, supervision and examination of sand mining in the Yangtze river ways, as well as its organization, coordination and guidance.

### **3.3.3 Limitations of the existing institutional arrangements**

Even though China's *Water Law 2002* clearly specifies that water resource management should be undertaken through a combination of river basin and regional management, it fails to indicate how this should be done. As a result, a continuation of the fragmented approaches to management of the past is expected.

While the CWRC has far-reaching roles and responsibilities (see above) these are focused mainly on water supply and sanitation, flood control and mitigation, economic development, pollution control and sand mining. True IRBM would also give prominence to issues such as agricultural practices, water use efficiency measures, environment protection and rehabilitation, biodiversity conservation and transport. The omission, or perception of lesser priority going to these issues, is a matter for concern given experiences in other countries (see section 4).

It is also obvious that despite the existence of the CWRC, there continue to be many arms of government with a mandate to operate within the Yangtze River Basin. The success of IRBM as a management principle relies on integrated approaches being taken. Unless the full range of sector-based interests are part of planning, and decision-making at the catchment level then fragmentation will continue.

## **3.4 Issues to be addressed to advance IRBM in the PR of China**

### **3.4.1 The *Water Law 2002* :**

1. The *Water Law 2002* does not specify how to ensure IRBM is implemented by providing the planning and administrative tools that are needed, and supporting them with the force of law;
2. It fails to draw into consideration the full range of management issues that IRBM should address, being based on issues such as water supply and sanitation, flood control, hydro-power and economic development, rather than the broader considerations of the overall health and productivity of the river, transportation, biodiversity conservation etc;
3. There remain too many pieces of legislation that 'compete' with the *Water Law 2002*; the Water Law (once amended as suggested in 1. above) should take legal and administrative precedence over these more sector-based pieces of legislation;
4. In order for the above to take place, and IRBM to be implemented with full effect, there has to be a recognition at the highest level of government (State Council) that the traditional sector-based ways of governing have contributed to the current problems and that IRBM requires Ministers, and senior government officials to integrate their approaches to policy formulation, budget allocations etc.

### **3.4.2 Basin level implementation of the *Water Law 2002* and IRBM:**

5. Despite what the *Water Law 2002* prescribes about integrated approaches and using river basins as a planning framework with implementation through established regional entities, it has not been possible to break away from regionally-based and sector-based approaches. This points to legal weakness of the *Water Law 2002* (see above), a lack of institutional authority for the river basin authorities, and possibly a lack of skills and capacity within the river basin authorities for how to implement IRBM;

6. There continues to be uncertainty about the respective roles and responsibilities of the river basin commissions and regional authorities, thus contributing to tension and competition. The basis of IRBM is that an overarching planning and management framework is in place in order to protect national interests as well as the interests of local people. IRBM will fail if one region gain precedence over another through these planning processes, or ignores the IRBM model and its associated plan. For this reason, raising awareness of the benefits of IRBM is an important part of the implementation process (see below).
7. While ever the *Water Law 2002* continues to overlook some key elements of IRBM (see above), the river basin authorities will in turn be unable to develop truly integrated plans for water resource management. A symptom of IRBM not yet fully in place is when there are a plethora of agencies, departments and organisations that are continuing to make decision that impact on water resources and river health, without a requirement to fall under the river basin master plan or have their activities reviewed (and endorsed) by the river basin management body;
8. River basin level planning has also failed to date to consider important issues such as water rights and fees, financial and other incentive measures, water use efficiency measures, biodiversity conservation, environmental flow allocations, the use of new technologies and the monitoring of river condition;
9. Because of the history of river basin commissions in China being focussed on a relatively narrow suite of IRBM issues, it is unlikely that these organisations at present have the personnel to adequacy and expertly address some of the issues that would be expected under a full IRBM management regime. Training, capacity building and targeted recruitment of skilled personnel will probably be needed to address this weakness;

### **3.4.3 Public participation and water rights:**

10. A core principle of IRBM is to engage stakeholders in planning and decision-making in appropriate ways. However, water users cannot participate in the decision-making of both the river basin and the regional water affairs at present. IRBM works best when local people understand the concept, how it operates, how they can participate and their own responsibilities as part of the catchment-wide management effort. Moving to engage the public in IRBM needs to be accompanied by education and public awareness, and it is also critical that the governments officials also understand and support the approach being taken;
11. At present there is no direct linkage between the wants and needs of local users of the water, the rivers, and the resources the rivers generate, and river basin planning. IRBM seeks to establish such links as a way to gain support but also to ensure equity for water and river users. Other countries have extensive experience in this area (see section 4) and China and its river basin commission can learn from and adapt these experiences to suit local needs and circumstances.

## 3.5 Real life examples of IRBM at work in China today

### 3.5.1 Wetland restoration of Dongting Lake, Hunan Province (WWF Yangtze Program)

#### *Background*

Dongting Lake is located at the north of Hunan Province, the middle reach of the Yangtze River. It's the second largest freshwater lake in China and four main tributaries of the Yangtze River flow through the lake into the river. Dongting Lake and the floodplains along the Yangtze provide important habitat for a rich biodiversity. They are home to more than 200 birds species, including endangered migratory species like cranes and storks, two species of freshwater dolphins, 200 species of fish, more than 84 species of mammals, 60 species of amphibians, and 87 species of reptiles. The lake also serves as nature reservoir for the Yangtze River for storing freshwater and reducing flood disasters.

However fifty years of intensive land reclamation and silting through deforestation and erosion have led to a loss of vast areas of floodplain wetlands. Dongting Lake has shrunk from its original size of 6300 km<sup>2</sup> to less than 2700 km<sup>2</sup>. As a result the wetland environment is fragmented, natural processes are disrupted and the buffering of high water levels is severely diminished. Some endemic species, such as the Yangtze Dolphin, the Yangtze Alligator and the Chinese Sturgeon are critically endangered and migrant birds are severely affected by the loss of wintering areas. Also each year, people that live in the Central Yangtze suffer from large economic losses as a result of the severe floods.

After 1998's destructive floods, China's Government announced policy initiatives for managing floods by protecting the forest watersheds and restoring river floodplains so as to increase the flood retention capacity of lakes and wetlands. The policy is a significant step in that it acknowledges the close link between flooding and ecological damage, and economic development in the Yangtze basin region. As a key area of the "Returning Farmlands to Lakes Project", 550 km<sup>2</sup> of polders have been evacuated in the Dongting Lake area by the end of 2002. Furthermore, the government of Hunan Province has incorporated the input of WWF in their 4350 Programme. (4350 km<sup>2</sup> was the size of Dongting Lake in 1950. The name of the programme refers to its goal of restoring Dongting Lake to its size in 1950 within 10 years. Namely, converting 1700 km<sup>2</sup> of reclaimed farmland to wetlands.)

#### **WWF's Partnership for a Living River Program**

WWF launched the *Partnership for a Living River* program in 1999. One of the three interventions of the program is field demonstration that aims to showcase to local governments how to balance the benefits of stakeholders while they conduct wetland restoration programs. WWF has been closely working with local governments, local communities and nature reserves in the region to seek efficient solutions to revive a living river. The program framework emphasizes restoration of the Dongting's wetlands and biodiversity through application of diversified flood adaptive farming and mobilizing participation of governments and individuals, so as to promote integrated river basin management.

#### **Demonstration sites**

WWF targeted four polders as demonstration sites. All of them were part of Dongting Lake before being reclaimed into paddy field in 1970s, and were included in the local government list of restoration sites. China's central government supported farmers to remove flood-affected houses to flood free grounds. WWF provided funds and technical assistance to facilitate alternative farming, including fish farming in floating cages, intensive livestock growing, aquatic vegetable and organic agriculture. Also, bio-gas cooking systems were installed, thus reducing wood collection and the impact of this on forest resource in the catchment. 600 rural families gained benefit from the projects. 1600 ha of farmlands were restored

to wetlands. Dykes of two polders were removed that re-established the hydrological linkages between polders and Dongting Lake.

## **1. Results so far**

### *Ecosystem recovery and biodiversity gains*

- Wetland restoration: 1600 km<sup>2</sup> of wetlands have been fully restored in Dongting Lake, which included 110 ha of wetlands in Xipanshanzhou Polder and 1100 km<sup>2</sup> in Qingshan Polder.
- Wildlife restoration: Restoration of four polder areas has also enabled conservation of threatened migratory water birds. With the massive wetland restoration in Dongting Lake, the wildlife has returned to the area dramatically. Endangered species like Siberian Cranes, swans and spoonbills have returned to the restored polders. 48 species of fish are now back to the restored Qingshan Polder.

### *Flood reduction*

In mid-2002 the annual Yangtze floods struck Dongting Lake six times. They were much less damaging this time, due in part to 550 km<sup>2</sup> of restored polders that safely hold floodwater, as a result of WWF's partnership with the villages and governments. Now residents of more polders are adopting WWF's approaches. They are allowing water logged in the polders taking it as resource for flood adaptive farming.

### **Better livelihoods for farmers and less disaster relief loads on local governments**

- In Xibanshanzhou polder, despite 110 ha of farmlands have converted to wetlands and the dyke around the polder has been removed, 150 families are safe from flooding and have increased their income through applying diversified flood adaptive farming. The average family income increase from 2000 yuan in 1999 before the intervention to 9300 yuan in 2003, one-fourth of it comes from flood adaptive farming.
- In neighboring areas, farmers and officials are developing plans to implement the approach demonstrated in Xipanshanzhou.
- Local governments have recognized the tourist value of Dongting Lake and perceive ecotourism as an alternative livelihood to balance conservation and development.
- Reduced investment needed for dyke repairs, dyke maintenance and water pumping. Less disaster relief compensation from government to farmers.

### **Capacity improvement for partners**

- WWF has facilitated many partnerships for the formation of the Yangtze River and Lakes Ecoregion Biodiversity Conservation and Action Plan. This process will produce a common vision for the conservation of the Yangtze River that can be shared by all stakeholders.
- The awareness of participatory decision making process is greatly enhanced among government agencies and individuals. Farmers gained skills and knowledge of how to better manage wetland resources.
- Decision makers now have greater conservation awareness.

### 3.5.2 Caohai Watershed Comprehensive Management

(Guizhou Province Caohai Watershed Research Project Group, Guizhou International Cooperation Center for Environmental Protection)

#### Background

Caohai is a fresh-water lake located in the northwest corner of Guizhou Province, in the east part of the Yunnan-Guizhou Plateau, southwest of Weining County. Ethnically, Weining is a Yi, Hui and Miao autonomous county. Its geographic coordinates are 104°10' N and 104°25' E.

Caohai is a typical karst-basin lake, positioned at a high elevation in the middle of the Yunnan-Guizhou Plateau. Its elevation is between 2170 and 2300 metres above sea level. From the lake, stream systems are distributed in a radial pattern and enter the rivers Hengjiang, Wujiang, Beipan and Niulan. By definition, Caohai is the biggest natural, freshwater lake on the Guizhou Plateau, which belongs to the upper reaches of River Luoze, River Hengjiang, Jinsa River tributary and Changjiang River system. Rainfall is the main source of water at Caohai, followed by groundwater. Hence, Caohai is regarded as an ecosystem of plateau-lake wetlands, chiefly supplied through rainfall. The surface area of the Caohai watershed is around 99 sq.km. Annual mean precipitation is 950.9mm and annual net water supply is 8 – 9 million cu.m.

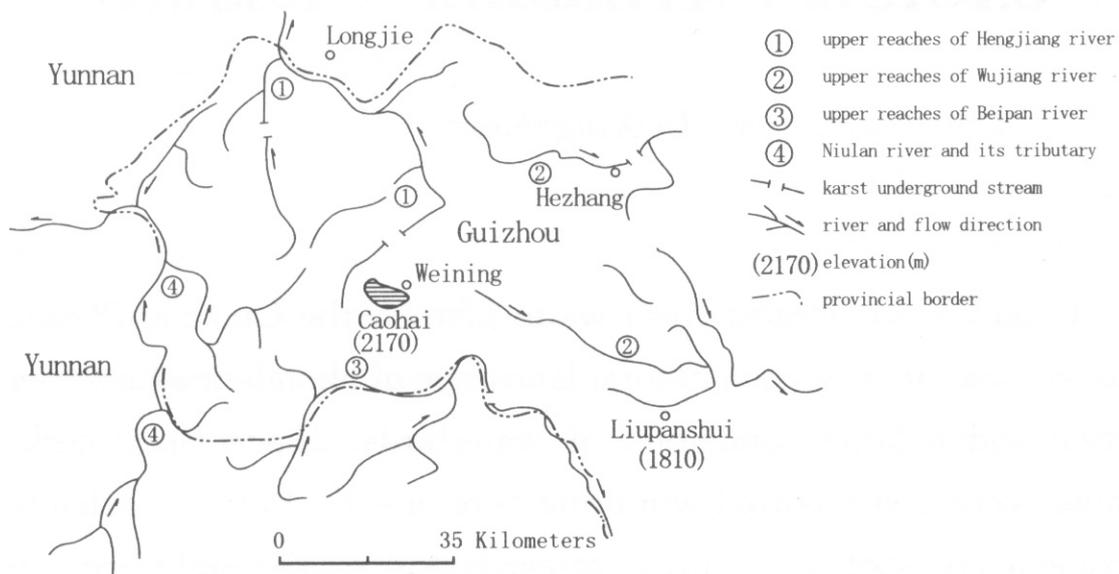


Figure 1. Upland rivers and streams at Caohai watershed.

Caohai is typical watershed, although small. The surface area is of relatively narrow profile, and associated closely with a range of rivers, towns and villages with ethnic diversity, hillsides, dams, streams and lakes and the interactions of rare plants and animals, bio-diverse habitats, industry, agriculture and commerce.

In placing Caohai in a research setting, as a model, particularly as an experimental area of comprehensive watershed administration, it promises a desirable result or lesson, with extensive nature and associated subjects.

Caohai has ten-year practical experience in community-based conservation and development, and is a model admired in China and the wider, international community. The departments and agencies related to Caohai have awarded it substantial attention, while many domestic and foreign organisations have shown concern for the environment and community, and played their part with both technical and financial support. Caohai can therefore be said to be relevant for countrywide issues, and the model

already possesses the quality to be a useful, credible example and transferable to other biodiversity-based, community challenges.

### *Evolution of the Caohai system.*

Before 1958, water in the Caohai watershed was connected with two other adjacent watersheds – River Yangwan and River Beimen. During the flood season and at that time in history, the water surface area was 45 sq.km. Floods were common during the “rainy” season. A drainage initiative commenced in 1958 and led to the area being reduced to 31 sq.km. A further, large-scale drainage continued in 1970 and by 1972, only 5 square kilometers of the lake was unaffected. This program seriously affected, and in some spheres, destroyed Caohai’s ecological environment and national disasters followed frequently. Finally, scholars and the public demanded restoration of the habitat, and the Guizhou Provincial Government decided in 1980 to restore the Caohai system.

The restoration began in 1981, and by 1982, the surface area of water had risen to 25sq.km. In 1985, nature reserve status was given, initially at provincial level and this was upgraded to National Nature Reserve status in 1992. After the lake was restored, the ecology was measured as - improving rapidly. Populations of aquatic plants, fish and water birds increased annually and significantly. The system became “vital” again, in the view of observers. Thus, as a model to learn from, Caohai was returning to a typical wetland from a period of human destruction of a perpetually fragile system.

However, the boundary of the reserve didn’t include the whole Caohai watershed. After the establishment of the reserve, the research, planning and management within the watershed had been focused on the Caohai nature reserve itself. Basically, there was almost no research and management at the watershed scale. With the rapid development of the areas adjacent to the reserve (1/3 of Weining Town belongs to the Caohai watershed), the safety of the ecosystem of the reserve and Caihai lake was facing serious threat. Therefore, to study and understand the comprehensive management of Caohai watershed became a top priority. The project group received support from the World Wildlife Fund (WWF) of China project office.

In 2003, the case study on Caohai watershed comprehensive management was carried out by the “CCICED comprehensive, watershed management project group”. This was to determine the status of Caohai watershed management and to analyze the prevailing problems relating to ecosystem, economy, society and coordinating management. Accordingly, through the study of solutions, CCICED comprehensive watershed management project group has been able to offer suggestions to the government, based on this case study. That research could also lay down a foundation for further planning and operation project about the Caohai watershed.

### *Management practices in Caohai watershed*

#### (1) The changes in administrative region.

The Caohai watershed historically belonged to three regions and five communes, before regional mechanisms were cancelled and villages merged in 1987. After that, the watershed was placed in the town’s administration. The original communes were changed to the equivalent of five councils, which was regarded as beneficial to a more centralized administration for Caohai.

#### (2) Land jurisdiction and administration in Caohai wetland.

Hence, with the changes in history, land jurisdiction of Caohai was also changing. From 1958 to 1979, land was in a collective ownership system in the countryside and land use was subject to decision by the government. In 1972, farms were established in the drainage basin and by 1980, the authority for using land, was placed with local farmers, with a formula based on population size. This followed a system of responsibilities for co-operative contracts of production. However, after the aquatic restoration in 1982, some 20sq.km of farms were flooded, and the farmers, not equipped with reasonable arrangements over land or any refunding measures, were not granted compensation.

(3) Monitoring sectors of Caohai.

Caohai is an important resource in Weining county, so many sectors in the local government and local villagers were involved and had an interest in the management and improvement of the Caohai watershed. Therefore, overlapping leadership and conflicting benefits appeared.

(4) Changes in management system.

From the restoration of Caohai, until the application of the first nature reserve status, the provincial government and local county actively participated in scientific investigations, through co-operation, joint initiatives and the creation of a reserve and monitoring stations. In 1985, with the first reserve designation, a dedicated county office was established and became directly subordinate to the Guizhou Environmental Protection Bureau (GEPB). In turn, GEPB entrusted local management to the administration office of Bijie District, but with technical and professional input remaining with GEPB. This was followed by a system of multilateral management for Caohai, with the advent of a national designation. To the present, from 1996, GEPB sought enhancement of the Bijie County role and now the management system is invested jointly in provincial and county tiers.

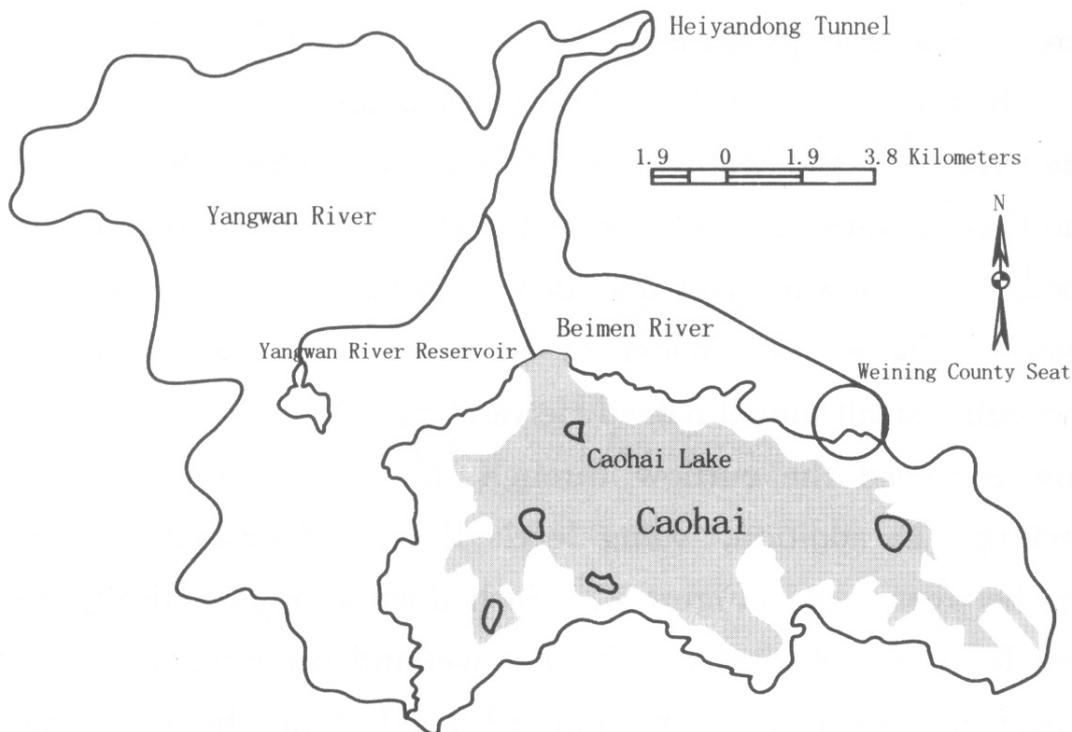


Figure 2. Caohai water area and main river locations

Problems and analysis of causes

Water resource –

Caohai lake has very limited water supply replenishment and so there is serious shortage of water supply during the dry season.

Water pollution -

(1) The sewage of Weining town - with the rapid increase of the township population, untreated sewage inputs increased dramatically, including direct flow into Caohai lake.

(2) Solid waste - from daily life and building construction.

There had been almost one hundred zinc smelter units, which had been closed at various times within the watershed. The toxic material left by the smelters affected water quality of the lake, particularly after rain-precipitated erosion.

(3) Solid waste - from the southeast corner of Caohai, where brick kilns were commonly located, with associated ore, mud brick, coal cinder and black dust causing pollution.

#### Pollution from agricultural production -

(1) Increasing amounts of fertilizer and chemicals were applied through the expansion of vegetable planting at Caohai.

(2) Discarded horticultural, plastic-film and other agricultural waste.

(3) There are sewage from production and the faeces of various domestic fowl.

(4) Pollution from tourism - with the increase in numbers of tourists, to view the bird life particularly, garbage thrown away by visitors included cans, bottles, candy paper, cigarette wrappers and butts, and plastic bags, contributing to significant pollution at Caohai.

#### Ecological problems of the environment -

The ecological environment of Caohai watershed includes Caohai wetland ecosystems, farming systems, wasteland and barren mountain slopes, in continual decline around the lake; also the more urban area made up of county, township and village within the watershed. Within the confines of 99 km of the watershed, there are about 100,000 wintering birds each year. The human population in rural areas living within the watershed is about 28,000 persons plus 1/3 of the population living in Weining town (about 16,000) officially within the watershed. Therefore, the total population living within the watershed approaches 44,000.

Since 1958, there has occurred large-scale, civil drainage three times and water conservation programmes twice. Those human activities caused great changes in the wetland ecosystem and influenced greatly the biodiverse environment. On one hand, for humans, drainage was initiated to create more arable land and complement the small, local production of grain. In respect of animals, the shrinkage of the wetland caused the living space of aquatic birds to reduce sharply. Those water birds relied on the wetland completely for survival, for example, cranes and wild geese. Now, the recovery of water level in Caohai has helped increase biodiversity, but flooding the farmland threatened the survival of local farmers. In Caohai watershed, the human population is relatively large compared with the limited proportion of farmland. Poverty is extensive and profound. Farmers depend on the limited farmland substantially and most of them reclaim wetland and mountain slope. Those factors directly lead to sharpening conflict between human and birds, jointly competing for the wetland. Therefore, when a large scale of soil erosion occurs, biodiversity reduces and the environment is polluted directly and indirectly.

In general, the problems with the ecological environment are essentially the issue of human factors, which include environmental protection, utilization of resources, relevant management, planning and implementation. All those problems are due to inappropriate management; for example, no comprehensive planning for the watershed as a whole, incomplete legal regulation of different sectors and unreasonable of development; also, ensuing internal contradictions and conflicts.

#### ***Problem and cause analysis on the product supply of Caohai watershed.***

Water supply - as a watershed, one of the most important functions is to collect rainfall water within the boundary of watershed and to converge runoffs and rivers in the watershed. The water supply might be used by industrial and agricultural production, as well as plants and animals. Although Caohai has a relatively rich water supply, from a position concerning the whole Caihai watershed, insufficient water remains a problem.

The source of drinking water - in the watershed, for humans and animals, is facing a serious threat. The main source for these two groups is well water. But the upper levels becomes arid now and then, and the

lower reaches, in some cases, have been influenced by environmental pollution in the watershed, with the underground water suffering contamination of varying degrees. In addition, because of the influence of various building projects and exploitation of the land, the water level is falling available drinking water reducing.

Water for field irrigation - in the watershed is facing certain threat, due to general shortages and contamination, in part.

***Production by agriculture, forestry, stockbreeding, non-farming and fishery.***

In the Caohai watershed, the average grain produced per person is only 171kg each year; that amount of grain is mainly consumed by farmer themselves. Part of the produce is sold for some income in form of cash. The production of forestry is close to zero. In respect of stockbreeding, a relatively small number of animals are bred; it is concluded to be difficult to form large-scale stockbreeding enterprises that produce acceptable profits. Fish yields have decreased, as it becomes increasingly difficult to satisfy the economic survival needs of local fishermen. The main reasons are the following:

- a. The shortage of grain is significant. Firstly, the population has grown fast but the source of farmland has been reducing. Secondly, crop planting now depends too much on fertilizer and chemical inputs and the farm workforce has been degraded. Thirdly, the local agricultural activities are not incorporating sufficient scientific technology, so production techniques are considered to be backward. Thus, the annual yield per unit area of cultivated land is relatively low.
- b. Lack of forest and forestry products. In the Caohai context of human survival, destruction of forest and severe reclamation of upland has been hard to avoid. The essential causes are partly due to lack of communication among sectors and ineffective coordination. For example, farm households have not received any compensation for the loss of their farmland, caused by the restoration programmes. There is little reasonable, general planning about land utilization. Furthermore, each sector or industry does things in its own way, based on their biased targets. Some projects overlap with others but each has tended to act on its own. Investment is in a state of disorder; a large amount of manpower and money has been ill-used.
- c. Stockbreeding and its products has been limited in scale. The concepts and techniques for stockbreeding are short on scientific influence and business orientation.
- d. The fish yield has decreased. First, intense human activities influenced the situation. Second, the natural condition became unfavorable towards proliferation of fish stocks. Third, the water area has been polluted and over-fishing has occurred.
- e. Non-farming projects are few and the local market is limited. Although some villagers in the watershed can sell self-made iron stoves, for example, different factors - limited market, backward technology and fund shortage - have influenced development towards large-scale and high-grade production. In addition, since the local policy for investment lacks a certain vitality, few large-scale enterprises even consider the area. As a result, it is difficult to form effective, mainstay industries, which can fuel economic development and take up spare, redundant labor.

***Tourism; there are problems in management and the causes mainly lie in:***

(1) Tourism development is in relative disorder – for example, boat tours on the lake, and fishing, lack united planning and management. A small package of measures lacked rules and regulations and either, not being obeyed or both. All these lead to a disordered tourist provision, unhealthy competition, wastage of resources, and even damage to resources.

(2) Severe benefit conflicts among different sectors – link to divisions in sectors, varied departments and rotating power. Individualism is regarded as the norm, ignoring the whole and extensive interests.

(3) A lack of objective, scientific attitude and efficient planning and management ideas - on the one hand, the planning methods are old, failing to combine quantitative and qualitative analysis together with PRA methods, which can lead to better use of the land and planning of relevant programmes; failing to give consideration to interests of all sectors and linking the benefits of the different parts, such as resources, departments and communities all trying to make the best of the human and natural resources. On the other hand, encouraging publicity isn't very successful, failing to convince.

***Invisible resources and benefits - protection, investigation, research, teaching and tourism:***

The environmental education base - because of insufficient linkage between the management departments of Caohai Reserve and relevant educational departments, the local government has yet to make full use of the functions and status of Caohai as an education base of environment protection.

Research base - Caohai, as a typical, small, wetland valley with resources including town and countryside, mountain, river and lakes, agriculture, industry, trade and nature reserve, is very rare in China; perhaps even in the world – in that ratio of factors. Thus it has good representative characteristics and important value for observers. As yet, local government and related departments has not arranged to make full use of these advantages as an education base.

Brand factor (cachet) - Caohai is widely known in China and overseas, but a possible trademark, registered to use the name of “Caohai” or related names is not yet fully established or appropriately exploited. There are some products named “Caohai” or related names, such as, Caohai cigarette, black-neck crane parka, Caohai Chun alcohol, Caohai hotel, and black-neck crane mineral water, but they failed to be strong in their sectors.

***Public policy - analysis.***

A lot of documents and decrees have been issued by all levels of governments and departments, such as Weining County People's Government, Bijie District Administrative Office, Guizhou People's Government and the State Council, since Caohai Nature Reserve was founded in 1985. However, most of them are limited in their own duties and authorities, they haven't regarded Caohai watershed as a whole unit or community.

Definitely, all these documents and decrees have had positive effects in management and protection, but with the development of the regional economy and extension of the urban areas towards Caohai watershed, Caohai Nature Reserve is being threatened more and more seriously by those areas – which occupy less than 1/30 of the total watershed. Conflicts and contravention among different sectors was becoming sharper. These problems mainly lie in environmental protection and exploitation of resources, especially contradiction between tourism and urban construction, since at present there are no appropriate laws and policies to standardize and coordinate these relations.

***Successful experience and implications (both government and non-government)***

Environmental protection has never been a single problem; it closely relates to activities such as people's lifestyle, education, economy development and social life. As a result, it needs to combine with the lives and evolution of local people. Proposed by relevant departments and staff, a series of programmes both at home and abroad have been carried out at Caohai and many experience of success has been accumulated in nature protection and social development.

Since 1993, through PRA methods, many domestic and foreign mechanisms have been applied in a series of programmes, such as stockaded planning, micro-credit, village level planning, small village management and environmental education. Through all this work, the awareness by villagers of environment protection has improved significantly, and they achieved the goal of combining nature protection and community development. These programmes were honoured as “the Caohai Model” of

nature protection and community development. To the satisfaction of PRA facilitators and the departments, the project group was told that boatmen in Xihai village had established its own organization to protect the environment of Caohai. They have formulated regulations for the village and required that each boat, for example, had a garbage bag on the boat. The boatman is responsible for taking garbage back to the lake bank and its removal. This is a typical case of co-management and action between nature reserve and community. If this case could be promoted to watershed management, it would be a valuable progression.

### **Conclusion and Recommendations**

In some summary, the essential cause of problems occurring in Caohai watershed is not entirely within the reserve but including the whole watershed. Various factors in all the water areas make great impact on lake environment and regional economy; for example, the industrial structure, the situation of farmland utilization, crop planting pattern, the lifestyle, educational background, economic condition and relevant public policy. Moreover, being short of relevant laws, regulations and policy, and weak feasibility or ineffective management, there appear still a lot of urgent problems, which cannot be neglected or delayed. Those problems are mainly caused by man-made factors. Consequently, the project group has submitted the following suggestion after careful study:

#### **To establish viewpoint of watershed management and enhance the relevant knowledge.**

When Weining County Government, Caohai Nature Reserve Management, Caohai Township and the other connected departments manage natural resources and initiated new jobs, they should set up the concept of lake management (precedented by coastal zone management). Beginning from the base of the general situation and with long term benefits in view, they should execute both administration and resource utilization as a whole, for the watershed, unifying ideas and coordinating management through a core of policy formulation and project planning and implementation.

#### **Strengthening research and formulation of related laws and regulations in Caohai watershed.**

When governments and departments of different ranks formulate or revise relevant policies, laws and regulations, they should invite the related offices to join in the discussion, investigation and analysis of the clauses of other individual laws and regulations. After a draft is ready, broad opinion and suggestions are then publicly sought. Then, the legislative mechanism is approved, announced and implemented. When enforcing laws, supervision should be taken effectively in different ranks, so as to ensure that there are reliable laws, but based on enforcement of violation, if necessary

#### **To establish the management mechanism of Caohai watershed and facilitate coordination and cooperation among sectors in government.**

The "Caohai Watershed Management Committee", whose members are the leaders of the Territory Management Bureau, City Construction Bureau, Environmental Protection Bureau, Bureau of Forestry, Animal Husbandry Bureau, Family Planning Committee, Poverty Support Office, Caohai Town Government, Caohai Reserve Office and some other departments, carries through coordination of policy on construction, development and protection of the Caohai watershed, to achieve the goals of division of labour and cooperative fulfillment of measures.

#### **Formulation and implementation of general planning of Caohai watershed in the management strategy.**

When formulating the general planning of Caohai watershed, project plans of other relevant departments for the Caohai watershed should be coordinated well and improved. The government should call those departments together to implement research, overall planning and arrangement, to divide the ranges of responsibility and be signatures to their accountability, in order to avoid waste and loss of jobs, or financial resources, or material resources, and realize a complementary mix in respect of the types of jobs and continual development of the Caohai watershed.

#### **Other suggestions on the management strategy.**

The important factor in protecting biodiversity, is to raise and keep a certain water level in Caohai and leave it to rise and ebb naturally.

Facing up to the challenges in reserve management, the relation between protection and development should be dealt with carefully:

- (1) The reality of humans and birds coexisting ought to be faced squarely. It's a historical fact that human and birds in the locality both rely on the natural resources of Caohai for living.
- (2) Poverty pressure should be alleviated in the protection of natural resources in Caohai.
- (3) The solutions to problems ought to be explored actively. And the opportunity for employment should be increased and created for local people. The resources in community need to be protected and utilized by all.

The main tasks of the Reserve should be clarified and the coordination among different aspects ought to be well applied:

- (1) To safeguard habitats for birds, especially migratory bird species.
- (2) To guarantee a certain water level of Caohai lake and the extent of surrounding wetland.
- (3) To maintain the quality of lake water and control pollution.
- (4) To maintain and regain natural landscape surrounding Caohai lake.
- (5) To resolve conflicts between natural conservation and development.

Promoting the nature protection mechanism of co-management with the community:

Establish the nature conservation concept on base of community - the mechanism of co-management and co-development with the community is very important for effectively protecting the Caohai wetland and the ecological environment of the whole watershed.

Facilitating the development of community eco-tourism - Caohai as the “plateau pearl” ought to play a leading role in the development of tourist resources, which should be included in the agenda of local government; also, making good use of Caohai as a brand to help improve the regional economy of tourism.

Resolving the threat of various pollution towards Caohai watershed - in order to control the pollution of Caohai, a comprehensive plan should be worked out to solve the crucial problems. First, the needs of local farmers in poverty should be taken into consideration; the ability for development in the local community and ability to survive ought to form the basis. Second, sewage will be discharged out of the town after being filtered and precipitated. The solid waste and discarded slag will be deeply buried at appropriate sites or separated to form new building materials. Third, to consider the plan to raise funds and the possible sources, with a certain percentage collected for sanitary fees or charges for sewage - these funds to be for controlling pollution.

Establishing mechanisms for ecological and environmental monitoring; and data sharing, as well as strengthening abilities construction for comprehensive watershed management. In order to protect and make good use of “Caohai” as a location of ecological importance, it is very necessary to conduct accurate monitoring and exchange information. Through establishing proper observation stations and equipping them with essential devices and equipment, key elements and relevant factors with ensure competent analysis of samples. Those key elements include atmosphere, hydrology, soil, key plants and animals, and so on in the watershed. To establish an information exchange platform, important information and feedback will be widely reported and notified to relevant sectors and community public.

### **3.5.3 Participatory Small Watershed Management, Jiangxi Province**

(Mountain-River-Lake Committee)

#### **Introduction**

The “Sustainable Development of Mountain Areas of Jiangxi Province (SMD-JP)” was formally launched in February 1996 with the signing of a formal government agreement between Germany and the PR of China. It aimed at improving the socio-economic status of farmers and the ecological condition of rural mountain areas, thus promoting their sustainable development.

Between April 1996 and February 2003 when the project ended work was undertaken in 9 small watersheds with a total of 15 villages in Ganzhou Prefecture. The project undertook participatory land use planning (PLUP), practiced sustainable resource management methodologies, strengthened the building of farmers’ self-help groups and provided micro-credit to farmer households through use of the participatory rural development approach.

## **Procedure of Participatory Small Watershed Management**

### **1). Participatory Survey for Small Watershed Development**

With participatory approach, RS, GIS and GPS means, the main stakeholders, including technicians, experts, local officials and local farmers, make joint efforts to conduct the baseline survey of society, economy, ecology and natural resources of the small watershed.

### **2). Participatory Dialogues and Evaluation of Small Watershed System**

With good use of indigenous Knowledge and advanced evaluation methods, evaluates the existing situation of natural resources, ecology, economy and society of the small watershed, in order to analyze the problems and their sources of small watershed development and management.

### **3). Participatory Small Watershed Management Planning**

With the help of experts, the main stakeholders apply indigenous knowledge, bio-technique, computer science and “3S “technique, formulates the small watershed management planning which integrates the common concerns of the main stakeholders.

### **4). Formulating the Action Plan for Small Watershed Management**

Based on Participatory Small Watershed Management Planning, the main stakeholders discuss and make the action plan for small watershed management.

### **5). Participatory Project Management and Implementation**

Set up a coordination body which consists of the main stakeholders for small watershed management, formulate management regulations and use economic means to implement the project activities.

### **6). Participatory Training**

With different tools of participatory approach and the two-way training method, to stimulate and advise the trainee to participate in the training activity in order to learn each other between the trainer and the trainee or among the trainees.

### **7). Participatory Monitoring & Evaluation**

During the implementation of small watershed management, setting up the monitoring & evaluation system, in which the main stakeholders participate, in order to find the issues and problems timely, the solutions and further to improve the small watershed planning.

### **8). Evaluating the Benefits of Small Watershed Management**

The main stakeholders conduct the evaluation of social, economic and ecological benefits of Small Watershed Management together.

## **Project result and effect analysis**

### **1) Watershed-based PLUP**

The unified project plan and management was possible only if the small watershed was taken as the basic working unit and the administrative boundaries of villages, townships even counties were ignored.

In the past seven years, the participatory approach was introduced and applied. Local farmers were mobilized to analyze their own problems and opportunities. They were facilitated by the project to participate in the whole project process of selecting measures, project design, land use planning and implementation, monitoring and evaluation.

The PLUP manual was developed through summarizing the experiences gained with hands-on experience in PLUP. The improvement of the infrastructure in the pilot watersheds, especially the remote sub-villages that were neglected in the past, enabled the local farmers to accelerate their economic development processes by providing easy access to the market. Moreover, since the project mainly supported the poorer populations and communities, the pressure of over-using the forest resources in the mountains decreased. The water and soil erosion has been controlled and the environment improved, by measures such as extending the pig-biogas-orchard model, improving irrigation conditions and reforestation, etc.

## **2) Cooperation with RCCs strengthened and MC system mechanized**

Through several years of testing the project has developed a new, much more sustainable credit delivery mechanism, in which the handling of financial services pertaining to micro-credit shifted from the project to the RCCs.

The components of this mechanism are very similar to the recently issued PBC guidelines on micro-credit for China. Through the implementation of micro-credit, SMD-JP has developed sustainable and replicable instruments, which will have far-reaching influence on the rural lending environment.

In the course of the co-operation with SMD-JP, RCCs have realized that it is feasible to lend to lower and middle income HHs, which will be reflected in their credit activities in the future. The positive attitudes to the “bankability” of women have been formed during the cooperation between the RCCs and SMD-JP is sustainable. In the implementation of micro lending encouraged by PBC nationwide, RCCs rely on VC members for credit grading of individual households. All VIC members have had micro-credit training and since so many of them are also members of the VC, the operational knowledge and skills that they received regarding micro-credit will continue to have a positive effect on the credit grading work they should do according to the new PBC guidelines. More than 400 poor households who never received loans from the RCCs in the recent years diversified their income generating activities by using the project revolving funds. The yield and income of their agricultural products are increased, so that their attitudes to develop themselves became more positive. Among these borrowers, 30% are women. Since women have the priority to get small loan to participate in the income generating activity, their status in their family as well as in their community improved.

## **3) Community development**

The project has been active in establishing Community-Based Organizations, including Village Implementing Committees, a Watershed Coordinating Committee, and many user groups to plan, implement and monitor the subsidy measures in the villages. A good benefit of the projects’ support for village asset creation with the responsibility with the VICs is that the villagers feel that the asset created is the property of the village or the particular group of beneficiaries, not the project, the Township nor even the VC. The feeling of ownership expressed in the villages was quite high and translated into more effective maintenance regimens for the assets created. The Township Authorities also pointed out that there have been some positive demonstration effects on self-help for other villages in the area. In Longgou Township, for example, the Township Party Secretary mentioned that after the successful construction in 1997 of the Miaodian Bridge in Longgou Satellite Village (the Township Centre), those farmers have been mobilized to construct another six bridges at different locations within the Township following similar self-help procedures. Thus, the project promoted self-reliant development capacity of farmers in pilot areas.

#### **4) Human resource development and the institutional capacity building**

The project has successfully introduced, improved and used participatory rural development approaches and methodologies, and try to make great efforts to establish, develop and perfect necessary organizational, structural and operational mechanisms at the grass root levels and in the management systems of the project areas, and integrate them into the Chinese rural community construction and governmental experiment on structure reform. Therefore, the project has carried out a series of activities related to human sources development. The capability of MRLDO in different ranks has been strengthened. Through training at home and abroad and on-the-job training, the project staff at different levels was enabled to understand and apply participatory approaches. MRLDO's seconded staffs in the project area gained rich experiences and their quality are improved. The Rural Regional Development Center (RRDC) of MRLDO is playing an important role by providing training and RS/GIS services for the project. Now with more professional services and increasing market orientation, RRDC can cater for a wider range of clients. Through exchange and communication, disseminating project documents and training materials, the cooperation relation between MRLDO and line agencies improved and the coordination function of MRLDO strengthened.

#### **Recommendation**

In the implementation of small watershed management, it is recommended that the participatory approach should be adopted and the small watershed management mechanism with the participation of the main stakeholders should be set up.

Considering the small watershed as a basic unit instead of the administrative boundary, the main stakeholders can fully participate in the implementation of small watershed management. Particularly, they make joint efforts to participate in problem-analysis, development opportunity-identification, planning formulation, project management, monitoring & evaluation, in order to plan and manage the small watershed in a comprehensive and scientific way.

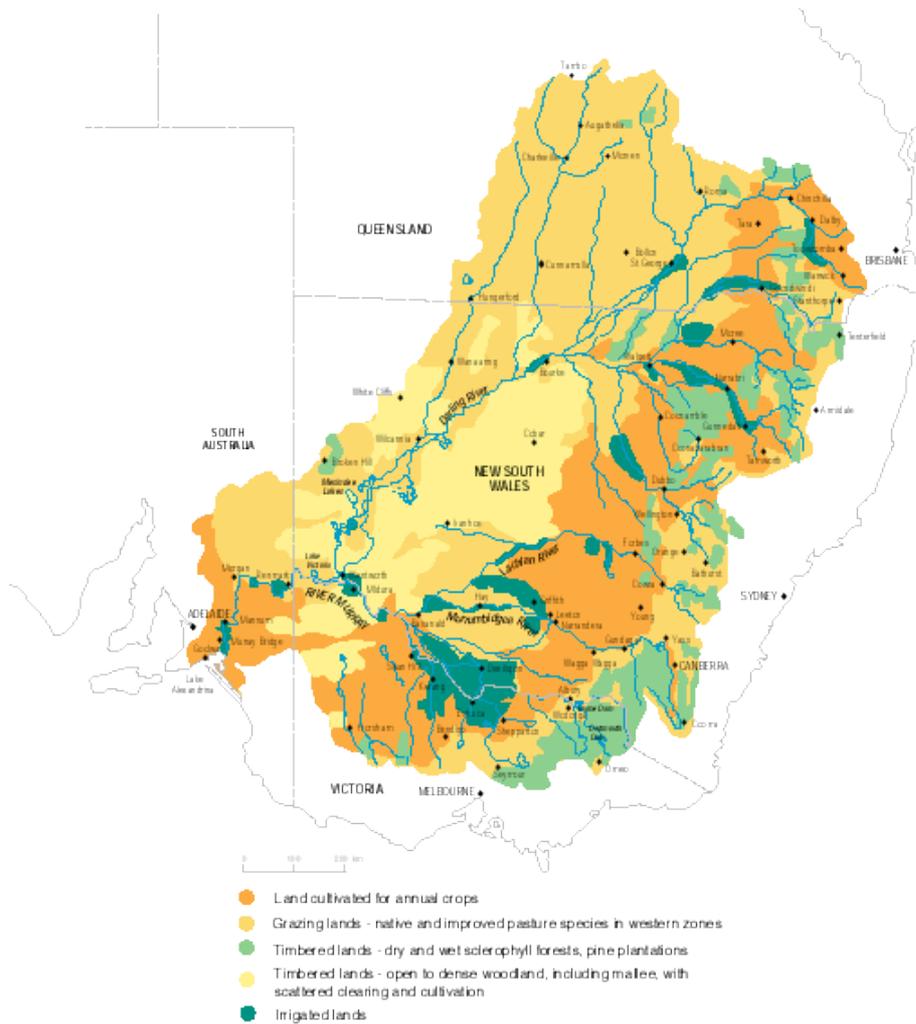
## 4. Lessons learned from international IRMB experiences

### 4.1 Case studies

The IRBM Task Force of the China Council on International Cooperation for Environment and Development assessed a large number of case studies from around the world in order to identify lessons that may be of relevance to the People's Republic of China. The following case studies and regional or global overviews were selected as they highlight key issues.

#### 4.1.1 Murray-Darling River Basin, Australia

The basin of the Murray and Darling Rivers covers a seventh of the continent (42 million km<sup>2</sup>) and is of similar economic importance to Australia as the Yangtze Basin is to China.



Land use in the Murray-Darling Basin (based on reference MDBMC 1987) Map reproduced with the permission of the Murray-Darling Basin Commission. [http://www.mdbc.gov.au/education/encyclopedia/Land\\_Use/Land\\_Use.htm](http://www.mdbc.gov.au/education/encyclopedia/Land_Use/Land_Use.htm)

The basin includes parts of five Australian provinces. In the 1980's it became apparent that the uses of this river basin for drinking water, irrigated agriculture, fishing, floodplain forestry and conservation of biodiversity were under threat. Increasing diversions of water for agriculture threatened to dry out the river, deforestation was resulting in pollution from increasing salt, soil and nutrient concentrations, and

dams were eliminating the water flows needed to sustain fisheries, floodplain wetlands and forests and wildlife.

In response, from 1985, the five provincial and the federal (national) government through reciprocal legislation agreed to the Murray Darling Initiative, and formed the Murray Darling Basin Commission to progressively implement this program (see [www.mdbc.gov.au](http://www.mdbc.gov.au)).

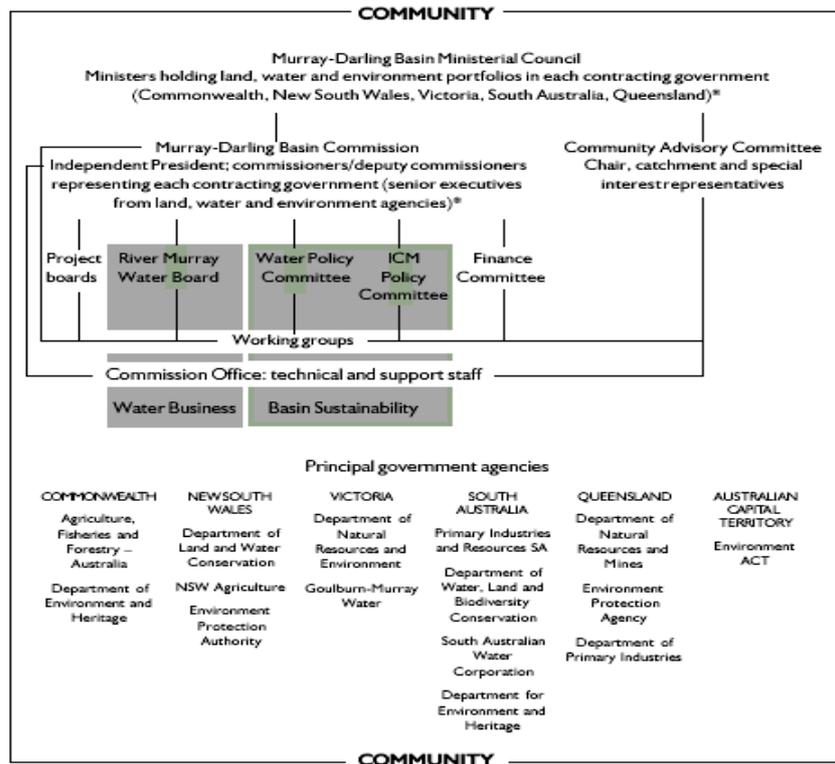
The Initiative has achieved a number of successes but has achieved slower progress than desirable and there are several lessons that can be learned from these delays. All the environmental trends in terms of water volume and quality remain negative, resulting in adoption of progressively tougher and more expensive policies by the governments.

The Commission structure is complex (see below). Regular meetings of a Ministerial Council of two ministers from each government, one environment and one natural resources minister, provide top level political leadership and ensure a range of economic and environmental values are considered in decisions. A Commission of heads of responsible environment and natural resources departments of the six governments direct the Commission's secretariat and their governments' departments to implement decisions.

The Commission and the Council are chaired by a respected statesperson. Also, on these bodies is a civil society chair of the umbrella committee for the 18 subsidiary catchment (tributary) management committees within the basin. These two chairs provide an independent voice for the river and people to help the different governments reach better than 'lowest common denominator' agreements. Better decisions are also reached through the appointment of multidisciplinary expert task forces to publicise key data then consult, study and recommend solutions to controversial problems. This structure has led to many good decisions but these decisions have often been taken too slowly. The federal government at times has failed to use its constitutional powers to override recalcitrant provincial governments to implement necessary reforms (for example to halt deforestation).

On water volumes the Ministerial Council decided to cap water diversions at 1995 levels, when 70% of the rivers annual flow was being diverted. The federal government led a 'micro-economic reform' program that used large payments to the provincial governments as an incentive for them to reduce subsidies for water services, to establish water rights separate to land title and establish markets for trading in water rights. This has created an incentive for more efficient use of water to produce higher value products. However, these programs were not properly designed to return water to the rivers in volumes sufficient to sustain fisheries, floodplain wetlands and forests and wildlife.

Governance of the Murray-Darling Basin Initiative.



\* Participation of the Australian Capital Territory is through a memorandum of understanding (see Section 1.1)

Governance of the *Murray-Darling Basin Initiative*. Figure provided by and reproduced here with the permission of the Murray-Darling Basin Commission. <http://www.mdbc.gov.au/about/governance/overview.htm>

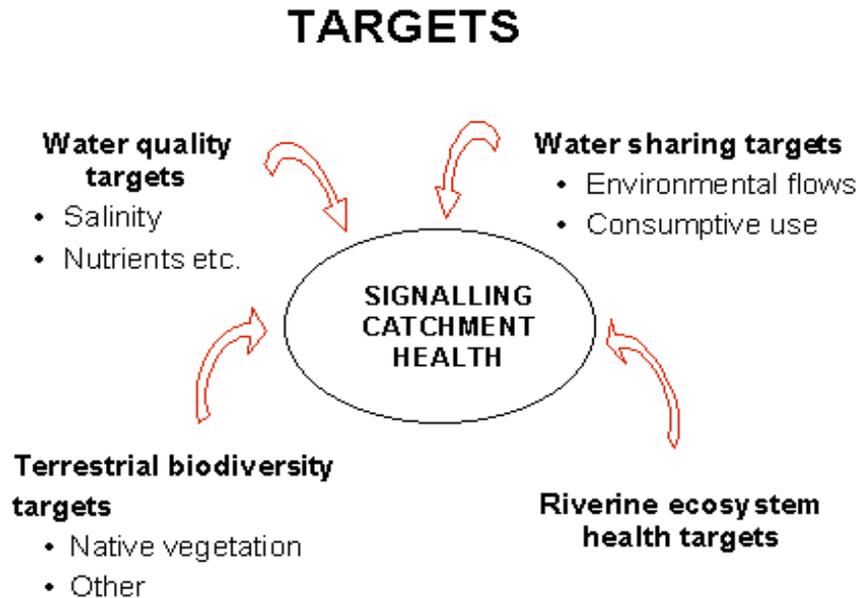
In 1990 the MDBC's Ministerial Council adopted the Natural Resources Management Strategy to provide the overarching strategic framework. It was replaced by the more detailed Integrated Catchment Management Policy in 2001.

As stated by the web site of Murray-Darling Basin Commission (www.mdbc.gov.au):

*“The ICM Policy outlines a framework for natural resources management in the Murray-Darling Basin for the decade 2001-2010. It includes goals, values and principles to guide community, industry and government partnerships aimed at improving the health of the Basin, and commits the Commission to setting and achieving resource condition targets that will limit the stresses placed on the Basin's natural resources. The policy includes a timeframe for setting Basin and catchment targets for water quality, water sharing, river ecosystem health and terrestrial biodiversity. Other key aspects of the policy include capacity building for all partners to play their part, knowledge generation and sharing, strengthening catchment approaches to planning, implementing and evaluating actions directed at achieving targets, linking catchment planning with land use planning, and articulating clear roles, responsibilities and accountabilities for the MDB Council and Commission, through all levels of Government, catchment and regional organisations, to land holders and managers.”*

The goals of the ICM Policy “...are to achieve: healthy rivers; healthy ecosystems and catchments; innovative, competitive and ecologically sustainable industries; and healthy regional communities.” (www.mdbc.gov.au).

The approach being taken is for catchment health targets to be set in each major river valley and these include consideration of water quality (salinity and nutrients); water sharing (consumptive / environmental flows); riverine ecosystem health; and terrestrial biodiversity – see below.

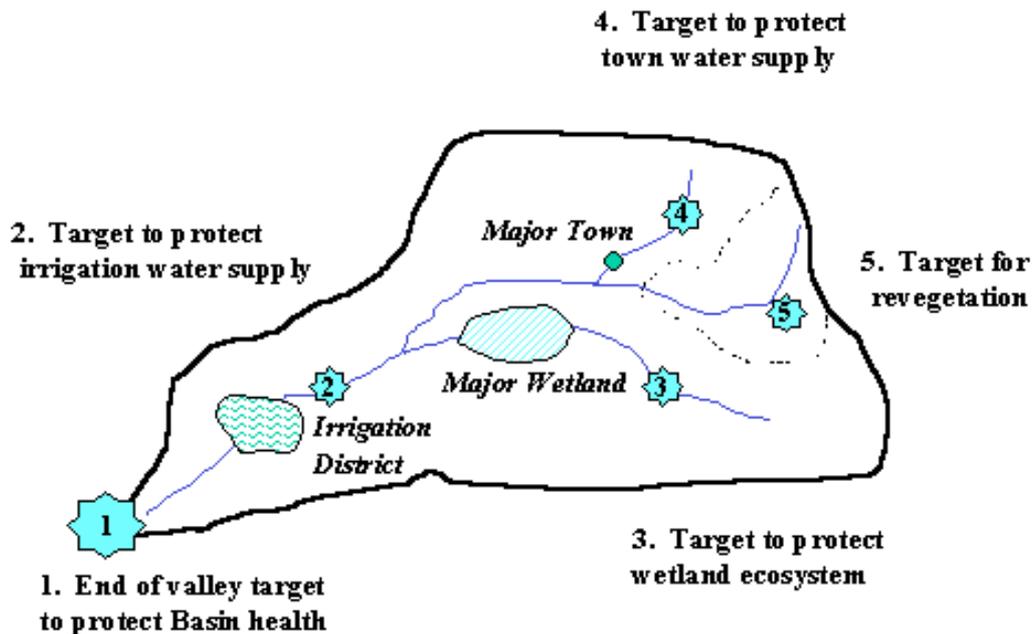


Schematic showing the four target areas for pursuing improved catchment ‘health’. Figure reproduced with the permission of the Murray-Darling Basin Commission.  
[http://www.mdbc.gov.au/naturalresources/icm/icm\\_framework.htm](http://www.mdbc.gov.au/naturalresources/icm/icm_framework.htm)

The intention is that these targets reflect the environmental, economic and social assets that stakeholders and the respective governments agree to protect within each major catchment, of which there are 26 in the Murray-Darling Basin. The figure below is a conceptualization of the how the approach is designed to work for each river valley.

The ICM Policy is a significant step forward for managing the natural resources of the Basin. It includes the following elements that are “.....designed to bring about change:

- *the focus on making **difficult choices** about the balance between the use of resources for production and the need to protect environmental health*
- *stronger **institutional arrangements** for catchment management, with clear roles and responsibilities, and **increased accountability***
- ***integrating land use planning and catchment planning***
- *more targeted use of **market based mechanisms** to drive change*
- ***accreditation** of catchment strategies and plans*
- ***reporting** to the Murray-Darling Basin Ministerial Council and the Australian public”*  
 (www.mdbc.gov.au)



Figure

Conceptualisation of the approach promoted through the MDBC's Integrated Catchment Management Policy. Figure reproduced with the permission of the Murray-Darling Basin Commission.  
[http://www.mdbc.gov.au/naturalresources/icm/icm\\_framework.htm](http://www.mdbc.gov.au/naturalresources/icm/icm_framework.htm)

On target setting to reduce salinity and restore fisheries and floodplain habitats, in 1997 the Federal Government allocated AUD 1 billion (~ USD 700 million) in grants for improved natural resources management through grants to provincial governments and community groups (largely but not entirely for the basin). This program largely failed to improve river management because funds were not spent in a strategic manner. In 2001 a further AUD 3.4 billion was allocated for new programs. In theory these will be targeted by delegating a portion of basin wide targets, such as on salinity levels, to be achieved by each of 18 subsidiary catchment management committees by drawing on local experience and developing locally beneficial solutions. In addition to this basin wide /national objectives, these more local committees are to identify local values, such as town drinking water sources or conservation of key wetlands, to be targeted in integrated river basin management programmes.

In late 2003 the governments allocated AUD 500 million for the Living (River) Murray Plan and this will invest in measures to return sufficient water to the river to protect an icon fish species (the Murray Cod), a keystone riparian tree species (the River Red Gum) and six key wetland habitat areas (Ramsar sites) along the river.

Regarding the impact of dams, the Murray-Darling Basin governments failed to learn from the US and French systems of periodically reassessing and licensing dams to reduce environmental impacts, maintain safety standards and maximize returns to the economy and society. Consequently a number of dams in the basin have become unsafe or are redundant without effective systems to identify and refurbish or decommission such structures. Further, most dams are only now being assessed to identify the modest structural changes that would minimize their severe environmental impacts. Addition of effective fish ladders or multiple-level water off-takes to reduce thermal pollution could restore river fisheries. An emerging success is the restoration of 'environmental flows': releasing the right volume of water at the

right time to replicate moderate floods for fish breeding, restoration of water quality and for floodplain forest health.

An inter-basin transfer scheme into the Murray River has recently been partly reversed to restore the health of the Snowy River. A new minimum flow of 28% of the annual natural flow is being restored, up 294 gigalitres from the 1% left after the scheme was completed in 1974. The federal and provincial governments have allocated AUD 300 million for ten years from 2002 to pay for water efficiency savings to compensate for this reduction of water supply into the Murray-Darling Basin.

This Australian example has many parallels with the situation in China in terms of the challenges in managing river basins involving many provincial governments and in terms of sustaining water quantity and quality, fisheries and dependant industries.

#### 4.1.2 Rhine River and the European Water Framework Directive

This case study considers management of the trans-boundary Rhine River, and uses this as an example of how the European Union's Water Framework Directive will be applied to set common standards for all jurisdictions to improve management of all rivers in Europe.

The Rhine River is the longest river in Europe. Its basin of 185,000 km<sup>2</sup> includes parts of nine countries and has a population of 50 million people. All manner of industries lie within the basin, including 20% of the total world production of chemicals, and the river is subject to a full range of human uses, including modification for navigation for 880 km from Basel to Rotterdam.

Severe problems with river pollution have been largely ameliorated through inter-government cooperation, as detailed below. However the progressive canalization and empoldering the floodplains for navigation, agricultural and urban development from 1800 to 1993 has largely eliminated river fisheries and caused severe flooding by leaving smaller and smaller areas to hold flood waters. Vast sums have been spent by the governments restoring the natural processes of the river, such as by breaking down dykes to restore floodplain areas to safely hold floodwaters, providing "room for the river". For example, the 1998 - 2020 Rhine Flood Action Plan is allocated USD 12 billion.

A number of intergovernmental agreements have been reached between basin states, establishing three intergovernmental bodies to reach common decisions for better river management. Among these is the Central Commission for Rhine Navigation.

Due to gross pollution of the river, an International Commission for the Protection of the Rhine was established in 1950 to improve river water quality. Further, an International Commission for the Hydrology of the Rhine was established focused on managing floods. Compared to other examples in this report, these bodies were established many years ago with mainly governments as members and consequently may not adequately engage user groups and civil society to achieve the best results.

The Rhine management bodies focus on the principle of 'subsidiarity', that is, they set common standards to be achieved and enforcement mechanisms but devolve responsibility for determining how the standards will be met to the governance structures closest to the people affected, in this case, national and provincial governments. Consequently the management responses are more likely to be accepted and successful as they are designed in the context of more local circumstances, cultures and values.

To ensure results are achieved the Rhine management bodies levy fines against national governments who exceed the commonly agreed standards, for example, by allowing too much pollution into the river. This has been an outstanding success in dramatically improving river water quality.

The European Union, drawing on this experience in the Rhine basin in 2000 adopted a new water law that will apply to all rivers in all EU member countries plus accession states and some neighbouring countries, that is, over 29 countries so far. The "Directive of the European Parliament and of the Council 2000/60/EC Establishing a Framework for Community Action in the Field of Water Policy" – known as the "EU Water Framework Directive" – entered into force on 22 December 2000. The Directive establishes a series of procedural and environmental obligations that each country must meet for each river. Eight "minimum compliance deadlines" have been set for each member government to operationalise the Directive, starting with transposing it into national laws by the end of 2003, to public consultation on basin management plans for each river by the end of 2006, among other tasks, through to achievement of environmental objectives by the end of 2015.

The Directive requires national governments to:

- a. establish river basin districts and a competent authority for basin, in collaboration with all basin governments;
- b. identify and agree key water management issues;
- c. design programmes of measures and river basin management plans for their implementation to achieve ecologically 'good status' of rivers;
- d. identify and protect water bodies used for drinking water abstraction;
- e. introduce water pricing policies that provide adequate incentives for efficient use of water;
- f. control of all pollutant emissions and discharges into surface waters; and
- g. specify controls for certain higher risk pollutants.

The Directive obliges member states "to encourage the active involvement of all interested parties in the implementation of this Directive" and is backed up by EU rules on access to data and provisions for the public to take legal action for the Directive's enforcement. As with the Rhine, the Directive works on the principle of subsidiarity, that is empowering local governments to take locally appropriate action to meet common standards. In the case of the Rhine, it means that with minor modifications the existing multi-lateral agencies established for river management are recognized as fulfilling the Directive's requirements. The Directive is enforced with tough fines levied by the EU on offending national governments.

This European example has a number of lessons for China in managing rivers basins that cover many government jurisdictions. It highlights the effectiveness of a system of financial incentives and fines for generating compliance with agreed standards. It also is a good example of setting common standards at the Basin or EU scale and devolving responsibility for achieving them to more local levels of government who can develop locally accepted solutions.

References:

Rhine River -

*[Leen/Toine – which one or two Rhine websites do you recommend?]*

Water Framework Directive -

<http://europa.eu.int/scadplus/leg/en/lvb/l28002b.htm>

[http://europa.eu.int/comm/environment/water/water-framework/index\\_en.html](http://europa.eu.int/comm/environment/water/water-framework/index_en.html)

[http://www.panda.org/about\\_wwf/where\\_we\\_work/europe/what\\_we\\_do/freshwater/initiatives/seminars.cfm](http://www.panda.org/about_wwf/where_we_work/europe/what_we_do/freshwater/initiatives/seminars.cfm)

### 4.1.3 Fraser River, Canada

The Fraser River basin covers a quarter (238,000 km<sup>2</sup>) of the Canadian Province of British Columbia and has 2.6 million residents. Economic activities in the basin account for 80% of the province's gross domestic product. The river is 1,400 km long, supports 70 fish species and is an important salmon fishery. Important natural resource management issues include flood management, river fisheries, and water quality, especially in relation to forestry and mining activities.

The Fraser Basin Council was formed in 1997 and is comprised of four orders of Canadian government (federal, provincial, local and First Nations), the private sector and civil society organisations. The Council has a 36 member Board of Directors, including 14 government representatives and an additional 8 First Nation members. The unique aspect of the Council is that it is a not-for-profit, non-government organization and is without specific enabling legislation, and yet it is generating improvements to river management through voluntary 'collective governance'.

Member institutions are signatories to a "Charter for Sustainability" that commits them to understanding sustainability, caring for ecosystems, strengthening communities and improving decision making. The Council seeks to act as an impartial, trusted facilitator to generate more effective leadership for river management through consensus and joint action. In other words, it relies on generating non-legally binding agreements between member organizations

A key element of the work of the Council is the sharing of information to improve decision making of members organizations and the broader society, for example, through the "State of the Fraser Basin Report" that makes data public on social, economic and environmental attributes. To enhance transparency and public support, the triennial meetings on the Council's Board are also open to public observers.

This Canadian example illustrates the power of bringing together diverse government and non-government stakeholders together in a neutral forum designed to generate consensus for action. It also highlights how transparency in sharing information and in decision making can generate stronger support and participation of society for necessary management reforms.

Reference: [www.fraserbasin.bc.ca](http://www.fraserbasin.bc.ca)

#### 4.1.4 Water Act, South Africa

South Africa's 1998 Water Act is widely regarded as among the most progressive globally for integrating and achieving social, economic and environmental objectives.

At the time of the election of a democratic government in 1994, 12 million people lacked access to basic water services and 21 million people did not have access to basic sanitation. Water was privately owned by riparian land owners, a situation that marginalized millions of citizens. Furthermore, South Africa is a dry country whose water demand is forecast to exceed divertible water supplies by 2025. The new 1996 constitution included provisions guaranteeing the people of South Africa the right to access sufficient water and to a healthy environment.

The *National Water Act (No. 36 of 1998)*, based on the principles of sustainability, equity and public trust, radically changed this situation by nationalizing water ownership and reallocating water use rights by:

- a. broadening the definition of water use, for example, to include forestry plantations;
- b. providing for equitable access to water and the benefits of use;
- c. ensuring ecologically sustainable development and use of water resources;
- d. establishing new institutional structures and mechanisms for devolving decision making down to the lowest possible level;
- e. introducing new economic instruments, including charging water users.

The Act is based on recognizing the unity of the hydrological cycle and commits to managing water on a catchment basis. Consequently 19 river basin-based Water Management Areas have been established, with water resources in each one managed by Catchment Management Agencies who must each develop and implement a catchment management strategy according to local needs. The Agency Boards are comprised of 9-15 representatives of stakeholders and experts who “*must seek cooperation and agreement on water related matters from the various stakeholders and interested persons*”. At a more local level, Water Users Associations can be established to undertake water related activities for their mutual benefit consistent with the catchment strategy.

The Act promotes maintenance of water “resource quality” and defines it comprehensively to include the quantity, quality and timing of water flows, condition of in-stream and riparian habitat, and condition of aquatic biota. This has led to true integration of management, for example, to look at upstream to downstream linkages in managing and preventing problems, such as for water use by the forestry and agricultural industries traditionally excluded from water management programs.

A unique and progressive element of the Act is its reallocation of water use rights. For each river a reserve of water is set aside to meet basic human needs, to support aquatic ecosystems, and to fulfill South Africa's international obligations to other countries on trans-boundary rivers. An extensive process for determining how much water is needed to conserve key attributes of aquatic ecosystems has been developed.

Associated with the Act have been a number of world class programs. In seven years the Community Water Supply and Sanitation Programme has halved to 7 million the number of people without access to safe drinking water. The Working for Water and Working for Wetlands programs temporarily employ around 22,000 people on over 300 projects at any one time and are allocated a budget of around ZAR 330 million per year (~USD 170 million) to train and employ the most disadvantaged South Africans to restore natural watershed areas to improve water quality and quantity.

The South African Water Act and programs highlight the benefits to be gained by basing water management on the principles of sustainability, equity and public trust, and to allocate water use rights carefully. Associated with this law are excellent poverty eradication programmes. This case again

emphasizes lessons for public participation, for catchment-based management, devolution of responsibility to meet common standards to more local authorities and the gains from applying user/polluter pays financial mechanisms.

References:

<http://www.dwaf.gov.za/Documents/Default.asp?Legislation>

<http://www.dwaf.gov.za/default.asp>

<http://www.dwaf.gov.za/wfw/>

(This case study relies extensively on unpublished papers by Dr Heather MacKay).

#### 4.1.5 IRBM in Asia-Pacific

##### **Background:**

At its 6<sup>th</sup> Conference of the Contracting Parties (COP6) in 1996 the Ramsar Convention on Wetlands recognised the need for an integrated approach to the management of river basins through Resolution VI.23 *Ramsar and Water*. This Resolution noted “*the important hydrological functions of wetlands, including groundwater recharge, water quality improvement and flood alleviation, and the inextricable link between water resources and wetlands*” and promoted “*the need for planning at the river basin scale which involves integration of water resource management and wetland conservation*”.

In the lead-up to the 7<sup>th</sup> Ramsar CoP, the Global Environment Centre (based in Malaysia) worked with the Ramsar Bureau and several Contracting Parties to develop the ‘*Guidelines for integrating wetland conservation and wise use into river basin management*’. These were adopted by the CoP and now form Handbook No. 4 in the Ramsar Wise Use ‘toolkit’. They are available in French, English and Spanish.

In 2003, in order to promote broader application of these now widely accepted guidelines, the GEC with support from the ASEAN Regional Centre for Biodiversity Conservation translated the guidelines into four South East Asian languages; Indonesian, Malay, Thai and Vietnamese. Additional case studies from south-east Asia were developed to document application of the guidelines. The guidelines can be found at [http://www.riverbasin.org/ev\\_en.php](http://www.riverbasin.org/ev_en.php). The citation for the guidelines accessible through this web site is: Chew, O.M. & Parish, F. (Eds.). 2003. Guidelines on integrating wetland conservation and wise use into river basin management (Adapted for South East Asia region). Global Environment Centre, Kuala Lumpur.

##### **Relevance:**

These guidelines are based on extensive global experience that has shown:

- the values and benefits of applying IRBM; and,
- the importance to build into IRBM approaches efforts to protect and rehabilitate wetlands because of their ecosystem services.

Some of these ecosystems services are shown in the table below:

The full guidelines are organized under the following themes. For the purpose of this report, only the most relevant extracts are provided below.

1. Institutional frameworks
2. Assessment and enhancement of the role of wetlands in water management
3. Minimising the impacts of land use and development projects on wetlands and their biodiversity
4. Maintenance of natural water regimes to maintain wetlands
5. International cooperation

<b>Some of the ecosystem services of wetlands</b>
<b>Water services:</b>
Water for humans, livestock, wildlife, agriculture and industry Storage and delivery of water as part of water supply systems Flood mitigation Groundwater recharge Water quality improvements Transportation
<b>Production services:</b>
Fish (and a range of 'seafood' for tidal systems) Timber Livestock fodder Reeds Peat Honey
<b>Socio-cultural services:</b>
Aesthetics Recreation Tourism Education Research Indigenous cultural significance
<b>Biodiversity conservation services:</b>
Reservoirs of biodiversity Habitat for threatened species/assemblages Representative, rare or unique ecological community
<b>Bio-physical services:</b>
Shoreline stabilization and storm protection (tidal wetlands) Sediment and nutrient retention and export Organic carbon storage Micro climate change mitigation

## 1. Institutional frameworks

*See section 1 of this report where the preamble of this section of the guidelines has been reproduced to introduce the concept and benefits of IRBM.*

### *Integrated river basin management*

A1. Identify the key barriers to integrated river basin management and promotion of land and water use planning/management within a river basin and work to overcome them.

A2. Develop consultative processes which involve the various sectors and institutions responsible for water management, environmental protection and agriculture (at least) and a basin-wide plan for the conservation, utilisation and management of the water resources.

A3. Integrate wetland conservation into river basin management to benefit management goals, such as water supply, flood management, pollution mitigation and the conservation of biological diversity.

A4. Promote the protection and restoration of wetland areas, and their biodiversity, within river basins.

A5. Develop appropriate and socially acceptable cost-sharing mechanisms to cover costs involved in the management of river basins.

A6. Promote the establishment of appropriate mechanisms to bring together all major groups involved in river basin management such as government, municipalities, water regulatory bodies, academic institutions, industries, farmers, local communities, NGOs, etc., to contribute towards the management of the basin.

A7. Promote appropriate education and public awareness schemes as effective tools for integrated management of river basins. (Refer to Resolution VII.9 on the Convention's Outreach Programme and Resolution VIII.31, Ramsar COP8).

### ***Development and strengthening of policy and legislation for integrated water resources management***

B1. Incorporate wetland management issues into existing water or river basin management policies and also incorporate water resource management issues into National Wetland Policies and similar instruments (Refer to Resolution VII.6, Ramsar COP7).

B2. Review existing legislation and, as appropriate, develop new legislation to facilitate the implementation of key policy issues such as the establishment of River Boards and Commissions; introduction of economic incentives and disincentives, regulation of activities which may negatively affect water management (Refer to Resolution VII.7 on Laws and Institutions, incorporated in the Ramsar Handbook 3).

B3. Develop a comprehensive National Water Policy or National River Basin Management Policy to regulate activities within river basins and integrate wetland management into the policy and local strategies/action plans.

B4. Recognising that socio-economic development is often critically dependent on the protection of aquatic ecosystems, encourage different sectors (such as conservation, water, economic development) to collaborate in allocating or securing sufficient resources to implement policies and legislation for integrated water resources management.

B5. Develop appropriate incentive measures (Refer to Resolution VII.15, Ramsar COP7), such as demand management and water pricing strategies to promote water conservation and more efficient and socially acceptable allocation of water resources.

### ***Establishment of river basin management authorities and strengthening of institutional capacity***

C1. Set standards and objectives to be achieved (such as water quality and quantity, physical efficiencies in water use and healthy wetland ecosystems within a river basin) and determine the options and costs of achieving these objectives.

C2. Make multi-stakeholder river basin management authorities responsible for preparing river basin management plans;

C3. Where appropriate, the river basin management authorities should consider the development of cost sharing formulas (such as beneficiaries pay, river basin resident levies, government subsidies, environmental costs of degradation/ "impacter pays", etc.) to raise the funds needed for integrated river basin management, or alternatively seek these resources from the development assistance community;

C4. Develop mechanisms to facilitate the transfer of resources from downstream beneficiaries to the protection and management of upper catchments and other critical areas;

C5. Provide training for water/wetland managers at all levels to understand and implement the concepts of integrated water resource and river basin management, including the importance of wetlands;

C6. Provide adequate financial resources to ensure effective operation of organizations charged with planning and management of water resources, river basin management and wetland conservation and, as appropriate, seek resources from alternative sources, such as debt swap for nature arrangements and the establishment of national or local trust funds;

C7.Strengthen and maintain the capabilities of local institutions (universities, research institutions and water management agencies) to undertake comprehensive water demand assessments which include ecological water demands;

C8.Strengthen the protection of the upper catchment and other critical areas elsewhere in the river basin through their inclusion in protected area systems or development of special management strategies;

C9.Promote the inclusion of staff within river basin management authorities which have expertise in the ecological functions of wetlands.

### *Involvement of stakeholders, community participation and public awareness*

D1. Establish mechanisms to identify and involve stakeholders in planning and management of river basins and their wetlands, including a review of the land tenure arrangements within the river basin;

D2. Facilitate the active participation of stakeholders, responding to their particular needs, and sharing of authority and responsibility for resource management according to arrangements that are agreed by all parties;

D3. Provide fora for open discussion on river basin management between water management agencies and stakeholders, particularly local communities, to identify the issues, needs and problems of the community;

D4. Document and promote sustainable wetland and river basin management practices developed through traditional knowledge and skills;

D5. Support capacity building of community-based organizations and NGOs to develop skills for monitoring or management of resources within river basins, such as through the Green World Foundation, Thailand and Global Rivers Environmental Education Network (GREEN) model and programme;

D6.Develop and implement management plans which take into account the goals and aspirations of the local stakeholders, including the consideration of fair and equitable sharing of benefits, as the success of such plans depends on the effectiveness of public participation and support;

D7.Identify, design and implement community-based demonstration projects and provide additional economic incentives to the local communities;

D8.Design and implement communication, awareness and education programmes on the importance of wetland conservation to support water resources management, consistent with the guidelines set out in the Convention's Outreach Programme (Resolution VII.9, Ramsar COP7 and Resolution VIII.31, Ramsar COP8);

D9.Develop awareness campaigns to minimise those activities leading to the degradation of river systems, such as excessive and incorrect use of inappropriate pesticides and fertilisers, poor sanitation, drainage of wetlands, and clearance of forests in the catchment.

## **2. Assessment and enhancement of the role of wetlands in water management**

### *Assessment and enhancement of the role of wetlands for water management*

E1. Information on functional and biodiversity assessment methodologies and the means for their integration for wetland management should be compiled by the Scientific and Technical Review Panel (STRP) of the Convention and disseminated to Contracting Parties, for their adaptation to local situations.

E2. Undertake studies to identify the functions and benefits to water management which are provided by the wetlands within each river basin. Based on these findings, Contracting Parties need to urgently protect, through appropriate actions, the remaining wetland areas which contribute to water resource management.

E3. Consider the rehabilitation or restoration of degraded wetlands, or the creation of additional constructed wetlands within river basins, to provide services related to water management. (Refer to Resolution VII.17, Ramsar COP7)

E4. Ensure adequate consideration in river management programmes of non-structural flood control methods which take advantage of the natural functions of wetlands (for example, restoring floodplain wetlands or creating flood corridors) to supplement or replace existing flood control infrastructure.

#### ***Identification of current and future supply and demand for water***

F1. Undertake assessments of current and potential future water supply and demand for water resources within the river basin to meet both ecological and human requirements and identify areas of potential shortage or conflict.

F2. Undertake assessments to establish the economic and social costs which are likely to result if the ecological water demands are not met.

F3. Based on the above assessments, develop mechanisms to solve problems and conflicts over water quantity and quality at both national and river basin levels within the country.

F4. Develop appropriate demand management and water pricing strategies to assist in sustaining the ecological functions and values of water resources and wetlands.

F5. Review relevant incentive/perverse incentive measures and consider removing those measures which lead to destruction/degradation of wetlands; introduce or enhance measures which will encourage restoration and wise use of wetlands. (Refer to Resolutions VII.15 and VII.17, Ramsar COP7.)

### **3. Minimising the impacts of land use and water development projects on wetlands and their biodiversity**

#### ***Guidelines to minimise the impacts of land use projects on wetlands and their biodiversity***

G1. Develop integrated land use plans for each river basin as a means to minimise the impact of different activities and land uses on the river and wetland systems as well as local residents.

G2. Develop and enforce appropriate regulations to control land uses, especially forestry, agriculture, mining or urban waste management, so as to minimise their impact on river and wetland ecosystems.

G3. Carry out Environmental Impact Assessment (EIA) and Cost Benefit Analysis (CBA) studies for development projects which may have significant impacts on rivers and wetlands using independent multidisciplinary teams, and in consultation with all stakeholders, and consider alternative proposals including the no-development option.

G4. Disseminate the findings of any EIA and CBA in a form which can be readily understood by all stakeholders.

G5. Ensure that there are adequate control and mitigation measures to minimise, or compensate for impacts if development projects are allowed to proceed.

#### ***Reducing the impact of water development projects on wetlands***

H1. Ensure that proposals for water development projects are carefully reviewed at their initial stages to determine whether non-structural alternatives may be feasible, possible and desirable alternatives.

H2. Take all necessary actions in order to minimize the impact of water development projects on biodiversity and socio-economic benefits during the construction phase and longer term operation.

H3. Ensure that the project design/planning process includes a step by step process to integrate environmental issues, especially initial biodiversity/resource surveys, and post-project evaluation and monitoring.

H4. Incorporate long-term social benefit and cost considerations into the process from the very initial stages of project preparation.

#### **4. Maintenance of natural water regimes to maintain wetlands**

##### *Maintenance of natural water regimes to maintain wetlands*

I1. Undertake studies to determine the minimum and ideal flows and flow regimes (including seasonal modulation) required to maintain natural riverine wetland ecosystems.

I2. With this information (I1. above), establish the optimum flow allocations and regimes to maintain key wetlands and other key ecological functions of river basins.

I3. In situations where available information on biological parameters and physical habitat is inadequate for a definitive decision on the required optimum flow, use the precautionary principle to maintain the natural situation as closely as possible.

I4. Develop sustainable water allocation plans for the various resource users within the river basin, including allocating water to maintain wetlands.

I5. Regulate and monitor the impacts of major infrastructure developments (levees, embankments, roadways, weirs, small dams and cuttings) undertaken within river and flood corridors.

##### **Protection and restoration of wetlands and their biodiversity**

J1. Assess the status of wetlands and their biodiversity in each river basin and, where indicated, undertake the actions needed to provide better protection measures.

J2. In assessing the status of wetlands in each river basin, consider the inclusion of key sites in the List of Wetlands of International Importance (Ramsar List).

J3. Ensure that management plans for Ramsar sites are prepared taking into consideration potential off-site impacts from within the river basin, as well as the site-specific issues. (Refer to Resolution 5.7, Ramsar COP5 and Resolution VIII.14, Ramsar COP8)

J4. Review and, where necessary, adjust regulations and procedures for conservation of wetland-related biodiversity, especially for fish and other aquatic species, to protect rare species and prevent over-exploitation of more common species. (Refer also to Annex 2 for Resolution VIII.16, Ramsar COP8 on “Principles and guidelines for wetland restoration”)

#### **5. International cooperation**

##### *Management of shared river basins and wetland systems*

K1. Identify and describe shared river basins, document the key issues of common concern in the basin (diagnostic study), and develop formal joint management arrangements or collaboration for development and implementation of action plans to deal with such issues.

K2. Where appropriate, establish or strengthen bi or multi-state river basin management commissions to promote international cooperation for shared water resources and wetland management.

K3. With regard to shared river basins, Contracting Parties should inform the Ramsar Bureau of the establishment of any joint management arrangements and also of actions by other party or non-party states which may lead to changes in the ecological character of sites included in the List of Wetlands of International Importance (Ramsar List) in their own portion of the basin.

*Partnership with relevant conventions, organizations and initiatives*

L1. Ensure that these guidelines, and other related guidelines under the Ramsar Convention, are brought to the attention of the relevant international conventions, organizations and programmes, with a view to ensuring that the aspirations of the Ramsar Convention are reflected in the activities of these other initiatives.

L2. Ensure close coordination at the national level between the Ramsar Administrative Authorities and the focal points for other international conventions and agreements related to these subjects.

L3. Ensure, as appropriate, adequate consideration of wetland related issues in the operation of any regional agreements related to shared river basins and water resources.

#### 4.1.7 *Managing Rivers Wisely* – lessons learned from around the World

In 2003 the Living Waters Program of WWF commissioned a review of its own involvements in various parts of the world that are designed to promote IRBM. The report detailing the findings of this review contained 14 case studies as indicated below.

Of note in the context of this report are the lessons learned from these 14 case studies, many of which have either direct or indirect application to the People’s Republic of China. An extract of these lessons learned is presented below.

### Global Case Studies



The order in which the lessons learned are presented below is only significant in that an attempt has been made to present them in a logical sequence. They are not given in order of priority, since judgements about prioritization need to be made on a case-by-case basis by local people and their institutions as they evolve, and there is no miracle ‘one size fits all’ recipe applicable to every river basin.

#### **Lesson 1**

##### **Long-term investment is needed**

- a. River basin-scale objectives cannot be tackled seriously within the scope of a typical three- or five-year project. IRBM requires long-term financial and ‘technical’ investment
- b. It also takes time to build sufficient trust and levels of understanding among stakeholders (see also Lesson 3 below) before implementation of IRBM activities can begin. Building the capacity of civil society organizations, developing sustainable livelihoods with local peoples, leveraging resources and implementing sustainable economic measures are critical.

- c. A long-term management framework, such as a river basin commission or authority, is required to provide the stability needed for IRBM to succeed.
- d. It is important not to generate unreasonably high expectations of quick results among partners and stakeholders who may become anxious and/or disillusioned if progress is slower than expected.

## **Lesson 2**

**River basin management requires an integrated, holistic and strategic approach, based on a clear vision and agreement on the values – natural, social, and economic – to be conserved and the sustainable livelihoods needed by the people of the basin**

- a. The aim of IRBM is to sustain and improve livelihoods and preserve biodiversity by conserving the ecosystems that support both. Ways must be found, through partnerships and engagement, to address the social, economic and political stressors that threaten ecological sustainability. This means integrating strategies that may be familiar to conservationists with strategies that are unfamiliar, such as those for poverty reduction in developing countries. Large-scale conservation of watersheds, ecosystems, or whole ecoregions will eventually require the involvement of a broad range of stakeholders and integration of social, economic and environmental measures.
- b. It is vital to identify and promote the long-term economic and social benefits of environmental protection and to incorporate this concept into planning and decision-making. Good governance, gender equity, human health, economic and socio-cultural development are important incentives for local communities to engage in conservation, and also contribute to the sustainability of river basin management initiatives.
- c. While it is important for those involved in the river basin planning process to share a common long-term vision, it must also be recognized that different stakeholders will have different and sometimes conflicting expectations, and that complete consensus may not be achievable. However, there should be sufficient agreement over priorities to ensure that scarce resources are used effectively. This can be achieved through a step-by-step process of identifying the basin values to be conserved, setting environmental targets, and establishing the actions needed to meet those targets. For example, these might relate to water quality, flow volumes and timing or land use.

## **Lesson 3**

**Biodiversity may have to take a back seat**

- a. While the ultimate objective of conservation organizations is the safeguarding of biodiversity through sustainable use of natural resources, biodiversity is unlikely to be at the forefront of concerns of many stakeholders in a river basin. In order to engage effectively, conservationists have to seek and promote solutions that provide socio-economic benefits first and foremost, with ecological benefits being an important, but secondary, element. Integrating wetland rehabilitation and habitat protection with poverty reduction, sustainable development and water resource management, and ensuring the necessary buy-in from government, industry, agriculture, and communities, is likely to bring far greater success than pursuit of a ‘traditional’ conservation agenda. This is an issue common to all regions and not developing countries alone.

## **Lesson 4**

**It is important to work at different levels simultaneously**

- a. Stimulating effective basin management means that it is necessary to work simultaneously at multiple levels – for example, field/site level, national level and basin level (the latter including cooperation with the basin authority, where one exists, regional donors, and policy drivers). At

the same time, multiple approaches are required, ranging from policy work to public awareness, and from field projects to lobbying of decision-makers.

- b. It is important to develop a sound reputation at field/project level to gain respect and attention at a national level. On the other hand, participation in international/basin-wide processes can provide you with the necessary influence to open doors at a more local level.
- c. Well-planned and adequately resourced demonstration or 'model' projects can be decisive in proving that the principles of IRBM can be translated into tangible action at field level. Begin with small, practical projects to create working examples for scaling-up and replication in other river basins.

## **Lesson 5**

### **Effective partnership building is an essential ingredient of IRBM and enables far more to be accomplished than by working alone**

- a. Successful partnership building requires:
  - knowledge and understanding of the region
  - deployment of experienced staff with interpersonal and diplomatic skills
  - an open, constructive and 'modest' approach when dealing with stakeholders
  - readiness to engage in long-term partnership and project activities, including with 'non-conservation' stakeholders
  - readiness to work with 'non-traditional' partners
  - readiness to assist, facilitate, catalyse and supervise, rather than to control and implement
  - readiness to involve local expertise and experience
  - readiness to assist with building the local capacity of people and organizations
  - readiness to provide concrete technical and financial support [multiple case studies], although a small number of people working catalytically with modest resources may have a significant impact.
- b. Non-governmental organizations can act as an 'honest broker' and/or bridge builder, attempting to identify workable solutions acceptable to stakeholders at different (e.g. local, national and international) levels. However, it is also important to recognize that NGO's are themselves stakeholders, with their own views, prejudices and priorities. It will always be a challenge to strike the right balance between acting as both a facilitator and a stakeholder. It is also important to be aware that there is likely to be a language/terminology barrier between bureaucrats and local stakeholders, and that a crucial starting point for a would-be facilitator and catalyst is to help groups to communicate with each other.
- c. Circulating key documents, reports and other information widely among project partners and river basin stakeholders generates cooperation.

## **Lesson 6**

### **Be ready to seize unexpected opportunities**

- a. While effective IRBM ultimately requires a focused, coherent and strategic approach, organizations advocating basin-wide solutions must also be ready to seize opportunities that arise unexpectedly from the course of events. These might be due to political circumstances (e.g. change of government, introduction of a new policy or law), or the consequence of an event receiving wide media coverage, such as a serious flood or pollution incident.

## **Lesson 7**

### **Sustained efforts are needed to raise public awareness and to gain the support of local communities**

- a. If the importance of taking a large ecosystem-scale approach is to register in the minds of the public, it is critical to establish some kind of recognizable identity or 'sense of place' for the region and to develop key messages about the ecosystem that resonate at all relevant levels. Similarly, flagship species can be an effective rallying point for local communities.
- b. Strategic use of the media is an essential part of getting the IRBM message across to local stakeholders, and may play a decisive role in securing their support.
- c. Before planning and implementing activities in a given river basin, it is important to understand and build confidence among the local stakeholders.
- d. The involvement of senior community figures, religious leaders, and other opinion formers may help to engender public understanding, acceptance and implementation of river basin conservation.

## **Lesson 8**

### **River basin conservation must build on a strong informational and science base**

- a. IRBM practitioners must invest in building the necessary informational base before planning and implementing field and/or policy interventions. This means forging partnerships with the scientific community and ensuring that arguments in favour of a given field or policy action are always supported by clear and accurate technical evidence.
- b. Information gathering should begin as early as possible and include, for example, ensuring that key stakeholder groups are accurately identified; land tenure systems, drivers influencing land management decisions, and existing official structures and processes relevant to IRBM are understood; and biodiversity values are properly assessed. On the other hand, it is essential that compilation of data does not become an end in itself or an obstacle to progress in other areas. This requires realistic judgement of when sufficient knowledge has been acquired for a particular purpose.

## **Lesson 9**

### **River basin management must be established as a political priority**

- a. Without support at a political level, it is impossible to convert the concept of IRBM into reality. Non-government and expert groups can have an important role to play in supporting the development and implementation of government policies that are favourable for river basin management and can contribute to enhancing government capacities.

- b. Public-private partnerships can be highly successful; governments need help from non-governmental organizations (NGOs) and vice versa. Government can be a powerful partner that can work for conservation and multiply the results of NGO efforts many times over. At the beginning this may seem impossible, but if river basin issues are presented in the right way, they can become central to government development plans.
- c. Effective management of transboundary basins requires international political agreement. International treaties (e.g. the Ramsar Convention) and basin-wide organizations (e.g. the International Commission for the Protection of the Danube River, or the Lake Chad Basin Commission) can provide the necessary institutional frameworks for reaching agreements. The potential use of Ramsar Site designations and the establishment of a river basin organization should be considered for inclusion in any international IRBM planning process. Ramsar listing, combined with application of the Ramsar 'wise use' concept can also make a significant contribution even when the basin is wholly within the territory of one country.

### **Lesson 10**

#### **Formal protected area designations may be vital for long-term underpinning of river basin management**

- a. Political support can be fickle and the economics of IRBM unstable. It may therefore be important that legislative protection (or alternative formal recognition, such as Ramsar Site designation) for freshwater ecosystems is sought to underpin the use of other tools and approaches.

### **Lesson 11**

#### **The conservation community can catalyse and demonstrate, but effective and sustained implementation of river-basin scale solutions depends on governments, the corporate sector, civil society, communities and individuals accepting and committing to the principles of IRBM**

- a. Conservationists must ensure the long-term viability of IRBM initiatives by building the capacity of civil society organizations, promoting cross-sectoral dialogue and policies, and leveraging resources.

**Source:** Jones T, Phillips B, Williams C E and Pittock J (eds). 2003. *Managing River Wisely: Lessons from WWF's work for integrated river basin management*. WWF International, Gland, Switzerland.

## **4.2 Summary overview of lessons learned**

From the international experiences outlined in the preceding case studies there are many lessons that can be learned. Below are some of the more obvious of these lessons. Reference to the case studies in section 4.1 provides more detail, and section 5 following looks in greater detail at the major themes considered below.

### **Policy, institutions and legislation**

#### **1. High level political leadership is needed**

High level political leadership is needed to require and facilitate cross-sectoral management of rivers. In most cases this means participation by and cooperation between ministers and the heads of their different Ministries. It is essential that these senior political and administrative figures fully understand and embrace the new paradigm which IRBM represents; a shift from sector-based thinking and actions to collaboratively implementing an integrated planning framework designed to balance economic, social and environmental aspirations and needs. Strong leadership by national governments is needed to ensure provincial governments and regional administrations are also integrated into the IRBM approach.

#### **2. Ensure the policy and legal framework supports IRBM principles**

A key lesson learned internationally is that an array of sector-based laws and policies (as most countries have) works against the full application of the IRBM model. An important step is to review, and possibly rationalize laws and policies so they work in favour of IRBM. This may require the enactment of new overarching legislation and policies (such as a national IRBM policy) to take precedence over the existing framework. It is also important that through this process river basin commissions gain a clear mandate to apply IRBM as a multi-sectoral management approach (see below).

#### **3. River basins commissions with the necessary legal and administrative tools are vital**

A single coordinating commission for each river (or lake) basin is required to ensure that individual sectoral interests collaborate rather than compete. In most cases such river commissions are statutory (although non-statutory commissions can be successful – see the section 4.1.3 - Fraser River case study). River basin commissions also need to be responsible in a planning and coordination sense for all activities that relate to the health, productivity and services provided by the river and its water. A failure to ‘capture’ all such interests will only serve to undermine IRBM. For the same reason river basin commissions need to have legal authority to regulate the actions of industry, local people, and provincial governments/regional administrations. See 3 and 4 below also

#### **4. Working to environmental targets**

Identifying the primary river management objectives based on maintaining and restoring environmental processes and services of rivers and setting targets (for example, water quality, size of fish populations, area of forests and wetlands etc) for achieving them is critical to achieving measurable improvements. Targets are also essential to planning and to enabling the right level of resources, especially funding, to be linked to specific outputs for example, to plan the number of hectares needed to be reforested to reduce erosion and to provide funds sufficient to achieve this target). Water quality targets are another component of this same issue.

#### **5. Delegating responsibilities**

Large river basins are too big and complex to be managed in a day-to-day sense effectively at only one scale. It is essential that a river basin commission agree on whole of river targets and assign portions of those targets to subsidiary catchment committees, river boards, provincial governments or regional administrations for implementation. This implementation needs to be to common standards but is most effective when it draws on local expertise to identify solutions that best meet local needs. This approach requires open sharing of data between governments and other stakeholders to improve decision making.

#### **6. Capacity building will be needed**

The adoption of IRBM is a significant shift in the way a country manages natural resources, economic development and social aspirations and needs. Experience shows that just as management approaches of the past have been sector-based, so to are the skills of most government officials involved in these areas. Staff training and capacity building is an important building block of adopting IRBM and should be factored into the plans for making the transition into an IRBM management framework.

#### **7. IRBM also works for river basins that cross international boundaries**

For those countries that share water resources (whether lakes or river basins) IRBM is now the proven tool for international cooperation in the sustainable use and development of these assets. Examples are operating in Africa, Europe, Asia and South America.

### **Stakeholder and public participation**

#### **8. Multiple stakeholders and public participation**

Maximum returns for society, the economy and the environment are achieved when all key stakeholders – governments, industry and other user groups, local communities and environmental representatives – formally participate in finding win-win solutions and feel ownership of the trade-off decisions inevitably required to manage rivers for sustainability. Open access to information and decision makers is pivotal to improving the quality of decisions and gaining public support for their implementation.

#### **9. Education, awareness raising and capacity building**

As with government officials (see above), IRBM works better if resources are directed at raising awareness of the benefits to be gained, and why this is a more equitable way to share the water and associated riverine resources. With a move to more engagement in the planning and management processes by the community, will come the need for capacity building. The involvement of the community in water quality monitoring has proven very successful in raising awareness of these issues and IRBM also.

## **Incentive and disincentive measures**

### **10. Regulating key users and user pays**

There are a range of measures being used in other countries that are designed to encourage certain activities that support IRBM, and discourage those actions that are counter to sustainable use of rivers and their resources. Licencing arrangements on water abstraction, water infrastructure and activities such as fishing can be used to regulate these activities but also to provide leverage for improved environmental performance. User-pays and polluter-pays approaches can also have a role. Providing incentives for improving the efficiency of water use can also be important. Imposing water prices that reflect the true cost of supply will encourage users to move to optimize their use of water, in so doing making more available for maintaining river health and economic development.

## **Innovative and ‘natural’ technology**

### **11. Use of ‘natural infrastructure’**

Experience in many countries has shown that not all river basin management problems require an engineering solution. The use of ‘natural infrastructure’ such as wetlands has been shown to be more cost-effective in most situations and has the added benefits of the other ecosystem services that are provided (flood mitigation, fish breeding habitat, biodiversity conservation etc). Many countries are now actively restoring wetlands as a key part of adopting IRBM.

### **12. Innovative technologies**

There are an ever increasing range of innovative technologies that can contribute to an overall shift in sustainable river management. These include engineering measures to make dams more fish-friendly (fish ladders, multi-level off-takes to reduce thermal pollution etc); simple rehabilitation technology for re-afforestation or reinstating wetland systems; low-cost GIS systems to guide planning and management and low-cost and user-friendly water quality monitoring kits for use by schools and river dwellers/users. A key role of river basin commissions is to investigate and then introduce these new technologies where they will assist IRBM.

## 5. International experiences – lessons for China

### 5.1 Institutions and legislation

The importance of having policy, institutions and legislation framed to support the implementation of IRBM cannot be overstated. A failure to do so will significantly limit and even undermine IRBM as sectoral interests will continue to operate outside an umbrella of integrated policy setting and management.

In section 4.2 a summary overview of the lessons learned from IRBM experiences in other countries was presented and the subject of policy, institutions and laws was considered. Reproduced in the table below (reproduced from Part 1 of this report) are the summarized findings that relate to institutions and legislation.

**Table 1 (reproduced from Part 1 of this report):  
Summary of international experiences in relation to river basin management and how IRBM offers solutions to these problems**

The problems	The solutions IRBM offers
<b>Institutions and legislation</b>	
<p><b>Sector-based approaches</b> Historically governments and societies have failed to appreciate the intrinsic linkages between economic growth, societal wellbeing and environmental sustainability, and have established decision-making, legal and administrative systems that serve to isolate, rather than integrate these pillars of sustainable development.</p>	<p>IRBM fosters a change in the way governments do business; moving away from sector-based institutions, policies and laws, to more integrated approaches.</p>
<p><b>Institutional weaknesses and lack of integration and coordination</b> Sector-based management and decision-making is a product of sector-based institutions, policies and laws. Without addressing these fundamentals, the implementation of IRBM cannot succeed. Poor coordination among Ministries is a strong signal of this form of institutional failure. Allied to this are laws and policies that promote sector-based management.</p>	<p>IRBM is as much about social and economic policy reform as it is about moving to manage the environment for long-term sustainability. For this reason the implementation of IRBM must be mandated by the highest level of Government and be supported by appropriate legal and administrative coordination tools.</p>
<p><b>Inappropriate management scale</b> River basins provide a convenient and appropriate management scale; yet historically management has been allowed to operate at small scale without due consideration for downstream and broader impacts.</p>	<p>The paradigm shift to IRBM needs to draw into river basin level planning and management ALL government Ministries and stakeholders, at all levels; national, provincial and local. Decentralisation of management responsibility to river basin commissions, provincial and local governments is the key to successful IRBM.</p>

#### 5.1.1 Leadership from the top

IRBM represents a shift from sector-based thinking and actions to collaboratively implementing an integrated planning framework designed to balance economic, social and environmental aspirations and needs. It is therefore essential that the Head of State and all Ministers understand and support this shift in approach.

It is also important to appreciate that national strategies and policies for economic development, human health and poverty reduction are totally compatible with IRBM and vice versa. IRBM is about sustainable development, and thus by inference is designed to provide long-term benefits for the

economy and society without damaging the natural assets that support these aspirations. Strong leadership is needed from national government to see this shift in management approach take place.

### **5.1.2 Harmonising and strengthening policy and legal frameworks**

Most countries have a complex array of policies and laws that reflect sector-based approaches to governing. IRBM usually necessitates a review of these so that they are harmonized, and where necessary, integrated or strengthened. Such reviews need to ensure that international obligations under environment and other treaties are taken into consideration. In this context, the Convention on Biological Diversity and the Ramsar Convention on Wetlands are key international instruments. Fortunately these two conventions have a Memorandum of Understanding and Joint Work Plan which sees them assisting signatories to address their respective obligations under the two conventions in a more integrated way. Both promote IRBM and provide various tools to assist with its application. They also jointly support the River Basin Initiative ([http://www.riverbasin.org/ev\\_cn.php](http://www.riverbasin.org/ev_cn.php)) as a tangible support mechanism.

One mechanism used by some countries is to form a high level advisory committee of experts to advise the government on how to go about amending their legal and policy framework to support IRBM. Such bodies can remain in place for the long-term to remain vigilant to and advise on any national level issues of problems that may arise.

### **5.1.3 River basins commissions - the backbone of IRBM**

River basin commissions are the vital core ingredient of successful IRBM. However, if they are established without the necessary mandate, resources and skills then they will not be able to fulfill the expectations placed upon them. Among the tools needed by river basin commission are unambiguous terms of reference that 'capture' all issues and sectors of relevance to IRBM. They must also have legal backing so that their planning, coordination and management roles can be defended and enforced if necessary. River basin commissions must also have adequate resourcing and be fully conversant with the IRBM model and how to go about its implementation.

### **5.1.4 Setting environmental targets**

Successful IRBM is usually based around an inclusive planning process (meaning to involve all key government and private sector stakeholders), which includes target setting for environmental management and condition. Typically this includes consideration of water quality (salinity, nutrients, chemical, thermal pollution etc), flows and allocations (environmental allocations, consumptive uses, modifications due to infrastructure etc), riverine ecosystems health (wetland condition and productivity, fishery production etc) and terrestrial ecosystem health (forests, reforestation, grasslands etc). A central goal of IRBM is attaining sustainable yields for the water and products derived from the river; environmental degradation indicates a failure to achieve sustainability.

### **5.1.5 Delegating responsibilities**

Large river basins cannot be managed effectively without delegation to more local managers, be they local communities and stakeholders or regional administrations. IRBM in many countries sees the river basin managed through smaller catchment plans united under a river basin master plan. In this way day-to-day decision making can operate at a more local level. However, where existing regional administrative boundaries don't align with catchments or drainage patterns this can be problematic. In the case of New Zealand local government boundaries were re-defined to match drainage systems, and allow for simplified management arrangements. Another important consideration is that standards and target

setting (see above). Under an IRBM system standards and target setting frameworks need to be developed at the river basin scale and then delegated down to regional or catchment level administrators.

#### **5.1.6 Building the capacity to implement IRBM**

Within government organizations, staff training and capacity building will be needed. IRBM requires decision makers to be more consultative and to seek compromise outcomes in many cases. Also, because IRBM seeks to find solutions that support economic development and society's needs, without degrading the natural 'capital' of the river, it requires a greater breadth of knowledge among senior managers in particular.

#### **5.1.7 Designing protected areas into IRBM**

In many countries where IRBM is now being practiced, the governments and local people are recognizing the value of integrating the development of systems of protected areas (across all of the categories described by the IUCN – The World Conservation Union) into river basin planning. The Convention on Biological Diversity at its Conference of the Parties in Malaysia in February 2004 adopted a revised programme of work on inland water biological diversity. It included as one of the stated goals for signatories to pursue the development of “*..comprehensive, adequate and representative systems of protected inland water ecosystems .....*” The Ramsar Convention on Wetlands also encourages its signatories to develop “comprehensive and coherent’ national networks of Wetlands of International Importance. The integration of these activities into IRBM is an important tool for retaining the overall ecological integrity of river systems. It has the added benefits of generating eco-tourism and supporting fisheries.

#### **5.1.8 Importance of high quality management information**

Part of building capacity for implementing IRBM is to develop and make available high quality data to guide decision-making and monitoring. Geographic Information Systems (GIS) that show bio-geographical and socio-economic information is a minimum requirement for meaningful planning. Data management is ideally coordinated through the river basin commission, integrating existing information held by the range of sector-based government agencies. Providing a mechanism for public examination of this resource information is part of bringing stakeholders into the river basin planning environment (see section 5.2). In the same way, encouraging local stakeholders to regularly collect certain types of data (water quality for example) and contribute it into publicly accessible data holding and management systems, is another mechanism to raise awareness and build support for IRBM.

#### **5.1.9 Licencing of dams and similar infrastructure**

The lesson has been learned the hard way in a number of countries that some form of licencing arrangement, with regular built-in review of performance and impacts, is an important element of IRBM. In this way technological advancements can be considered at regular intervals, while the issues of public health and safety, and the impacts on the downstream and upstream environments can be revisited at the time of considering licence renewal.

### **5.2 Stakeholder and public participation**

Public participation in integrated river basin management is a critical tool for better governance. Public participation in this context is the process of involving individuals and groups of people in society in improving river basin management. The depth of this participation may vary from environmental

education that changes an individual's behavior through to participating in advisory or decision making bodies representing a particular expertise or group.

In section 4.2 a summary overview of the lessons learned from IRBM experiences in other countries was presented and the subject of stakeholder and public participation was considered. Reproduced in the table below (reproduced from Part 1 of this report) are the summarized findings that relate to these issues.

**Table 1 (reproduced from Part 1 of this report):  
Summary of international experiences in relation to river basin management and how IRBM offers solutions to these problems**

The problems	The solutions IRBM offers
<b>Stakeholder and public participation</b>	
<p><b>Unsustainable land and water uses fostered by ignorance</b> Unless the principles of IRBM and sustainability are understood by both the government sector and civil society, and then applied at the local, provincial and river basin levels, the capacity of ecosystems to support livelihoods will continue to decline.</p>	<p>Stakeholder and public participation can enhance the quality of IRBM decisions and help implementation by reducing costs and delays. In order to empower local stakeholders it is necessary to invest in education and public awareness programs and activities that target all sectors of society.</p>
<p><b>Lack of transparency and consultation in decision making</b> The failure of governments to inform and consult local people about development and river/water resource management proposals that may impact on them is strongly counter-productive to the ethos of IRBM, breeding conflict and resentment among stakeholders.</p>	<p>Opportunities to participate in decision-making and providing access to management-related data are key aspects of gaining the support, involvement and commitment of stakeholders for implementing IRBM.</p>

**Considering this issue in more detail there are several key aspects. The question of “why”, “how” and “who” to involve in IRBM processes are key issues, which are examined below.**

#### 5.2.1 Why devote resources to stakeholder and public participation ?

There are several reasons why public participation contributes towards good management of rivers:

- ❖ **Obtain additional information about the needs and interests of various stakeholders, thereby improving decision making**

Any river management action may impact upon a variety of different environmental values (such as fish populations) and users (such as the transport, fisheries and water use sectors). Often the people who work in these stakeholder groups on a day-to-day basis have more detailed information on environmental conditions, changes caused by different impacts, and economic values than those held by governments. Collecting and incorporating this information in decision-making can create win-win solutions that maximize socio-economic and environmental benefits.

In many countries around the world, school children and other citizens play a central role in the collection and analysis of data on rivers, especially on water quality and pollution. Not only does this greatly increase the capacity of the state to monitor and thus better manage rivers, it also greatly increases public awareness of river management issues and support for necessary reforms.

A key element of these programs is public access to data, often via the Internet, and the sharing of river management data (such as water quality information) between downstream and upstream communities. In countries like Australia where this is commonplace (through the program called Waterwatch

Australia), it builds an empathy for IRBM and established important communication links between these stakeholder groups.

Citizens and landowners are more motivated to contribute to IRBM efforts when they can see the data they help collect being made available to the society. When they can see the overall trends in river condition they are more active in supporting action by their workplaces and by local and provincial governments to better manage rivers.

#### ❖ **Prevent inappropriate management decisions**

In most countries there are competing pressures on rivers for their use for such purposes as fisheries, transport, water supply and hydroelectricity production and conservation of wildlife. Often, particular development proposals come from one sector, industry or government agency and only reflect the interests and expertise of that user group or its associated government agency. Clearly the best government decisions on developments occur when all the different user groups are able to add their expertise and perspectives to enable governments to take decisions that offer the best combination of benefits for society, the economy and the environment.

This sort of decision-making requires:

- a. Public access to data and information on proposed developments to allow other community, industry and government groups to contribute informed comments;
- b. A process by which community and other groups can contribute additional data and opinions;
- c. Decision making by the most objective government agency available, rather than a government agency with a sectoral interest.

For example, in many countries, hydroelectricity projects are proposed by the energy sector and assessed and approved by a government department for energy. If these dams are poorly designed and operated, they can destroy downstream fisheries. Involvement of the fishing and environmental organizations and departments in decision-making can contribute information and ideas to mitigate these impacts. Dams can be built that have fish ways that allow migratory fish species to pass to breed and with water off-take towers that ensure released water has oxygen and is the right temperature for fish. Dams can also be operated to release some water at the right time of year to promote fish breeding. This sort of information on better dam design for fish is rarely available within energy companies or governments departments, yet by incorporating additional stakeholder expertise in such a development decision the benefits for society from a dam development can be greatly improved.

#### ❖ **Gain public support, understanding**

Everyone lives in and relies on a river basin in a variety of ways. Water supply and food production are but two of the services provided by rivers. It is vital that civil society understands their reliance on healthy and productive rivers, so that they support and can contribute to IRBM efforts.

The extensive areas of land covered by rivers mean that the enthusiastic cooperation of as many citizens as possible is needed to better manage rivers. Further, there are particular groups of people who use rivers and impact on them in particular ways. They may include anglers, river transport workers, irrigated agriculturalists, and river side residents. For example, river pollution caused by transport workers dumping rubbish in the river, or farmers enabling water contaminated with farm chemicals to run off fields, cannot be easily solved without the understanding and cooperation and a cultural change by these groups.

At one level this public support for better river management can be engendered by environmental education and public awareness campaigns. Increasing levels of public participation include providing access to government managed data, allowing the public to contribute additional data (see above), and consulting the public over proposed decisions.

At the other end of the spectrum of public participation, in many countries representatives of civil society organizations are appointed by governments to be board members of river management commissions, for example, representatives of industry groups like fishers or environmental organizations or academics with particular expertise. This is considered beneficial for adding expertise and a broader range of perspectives to the decision making process and for generating additional awareness and support for reforms by the key groups who are affected.

❖ **Reduce costs/increase benefits of implementation/enforcement**

Better management of rivers usually requires the imposition of rules and regulations, yet the sorts of activities they control, like diffuse sources of pollution or water withdrawals for agriculture, can be difficult for the state alone to effectively enforce. When a significant portion of society are aware of the collective benefits from well-managed rivers, and help enforce the rules and regulations, the task of the state is made easier and its actions are more effective in improving rivers.

It is also true that those using, relying on and living beside rivers are the local custodians of the resources and ‘managers’ of the IRBM process at that micro-scale. Investing in their support and understanding of sustainable use and downstream impacts of their actions, can not only reduce government costs in dealing with these issues, but also generate significant ‘in kind’ contributions towards the overall management of the river.

5.2.2 How to go about engaging stakeholders and the public in IRBM

❖ **Raising public awareness**

Engaging the public through schools, advertising and information campaigns in different media, and by personal involvement in key activities is important to raise awareness, change individual behaviours and generate support for better river management.

❖ **Sharing information**

The community can contribute greatly by providing key data to government and academic institutions, and also to river basin planning. Further, by making this data publicly available (such as on the internet), the public can be informed and motivated to support better river management. Information sharing also develops a informal system of monitoring, so that early warning is given of problems that arise.

❖ **Consulting on proposed actions**

Asking the community for data and opinions on proposed actions and developments can increase knowledge needed for better decisions and generate public support for proposed changes.

❖ **Participation in governance structures (eg. river commissions)**

Including representatives of key stakeholder groups (community, industry, academic) can bring additional expertise to inform decision making and also lead to more effective support from key stakeholders in the community.

5.2.3 Who should be consulted ?

❖ **All relevant government agencies**

A key challenge for better river basin management is bringing together different government agencies with different expertise and sectoral interests to make more balanced decisions that promote sustainable development. River basin commissions are key institutions for leading such collaboration.

❖ **Governments at all levels (national, provincial and local) and other administrative bodies**

A further key challenge is for better river basin management is bringing together different levels of government (local, provincial and national) and adjoining governments with different expertise and perspectives to make more beneficial decisions. River basin commissions are key institutions for leading such collaboration.

❖ **Individuals**

Enthusiastic and knowledgeable individuals can make an enormous difference in improving their community's awareness and participation.

❖ **Professional / technical bodies (such as Academy of Sciences)**

Much knowledge resides with academic institutions that can be harnessed for better river management.

❖ **Industry and union bodies (such as fisheries association, forestry workers, eco-tourism operators etc)**

The people who work daily with river environments and issues often have a wealth of knowledge that can be used to enhance river management, and can support state institutions to improve practices and apply new regulations.

❖ **Community, non-governmental organisations (such birdwatchers)**

Non-government community organizations often have expertise and can bring additional resources to key river management problems.

### 5.3 Economic measures and financial incentives

In section 4.2 a summary overview of the lessons learned from IRBM experiences in other countries was presented and the subject of economic measures and financial incentives was considered. Reproduced in the table below (reproduced from Part 1 of this report) are the summarized findings that relate to these issues. Part 3 of this report looks at these issues in detail.

**Table 1 (reproduced from Part 1 of this report):  
Summary of international experiences in relation to river basin management and how IRBM offers solutions to these problems**

The problems	The solutions IRBM offers
<b>Economic measures and financial incentives</b>	
<p><b>Failure to consider all costs (economic, environmental and social) of development activities</b></p> <p>Where economic cost and benefits are the primary consideration of impact assessment processes, then</p>	<p>The global trend in impact assessment is to consider the full range of environmental, social and economic cost and benefits, and this is now supported by robust methods for valuing the services provided by ecosystems within these assessment processes.</p>

<p>unsustainable land and water use practices are promoted when external costs – both environmental and social – are excluded from resource allocation decisions.</p>	
<p><b>Failure to provide economic incentives and remove disincentives to sustainability</b>          Not valuing the full range of services provided by ecosystems has contributed strongly to their widespread degradation. Unsustainable land and water management practices have unwittingly been encouraged and even subsidized by governments, both through their ignorance of the broader social and environmental costs , and through the promotion of an economic development agenda as a priority.</p>	<p>There is now a vast array of economic measures and financial incentive options being applied in China and internationally that are proving highly successful in transforming land and water management into sustainable development enterprises. Two of several keys to their successful application in a Chinese context are to tailor the measures to fit local situations and to combine measures together in creative ways.</p>

## 5.4 Innovative IRBM-related technologies

In section 4.2 a summary overview of the lessons learned from IRBM experiences in other countries was presented and the subject of innovative IRBM-related technologies was considered. Reproduced in the table below (reproduced from Part 1 of this report) are the summarized findings that relate to these issues.

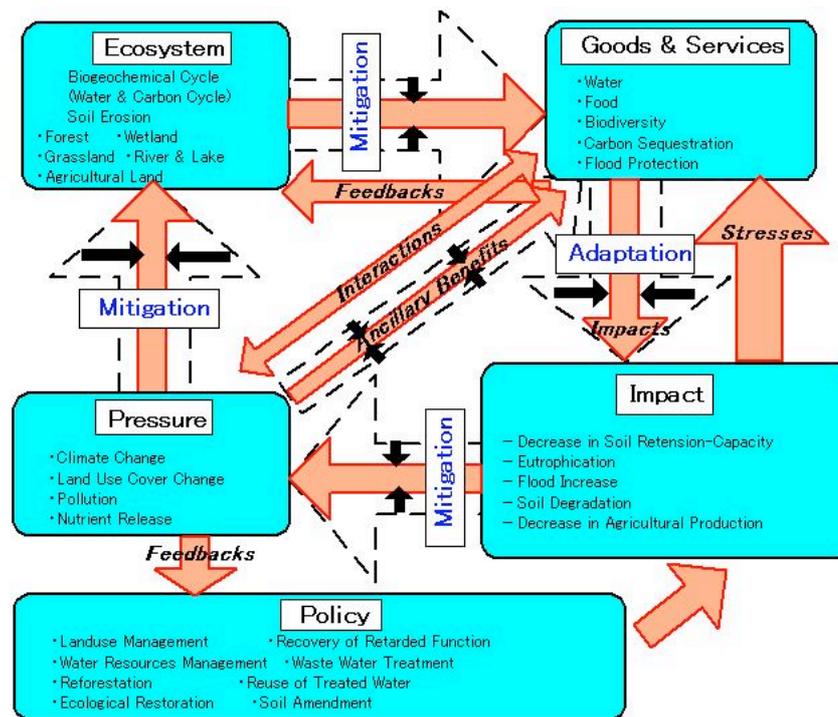
**Table 1 (reproduced from Part 1 of this report):  
Summary of international experiences in relation to river basin management and how IRBM offers solutions to these problems**

The problems	The solutions IRBM offers
<b>Applying IRBM-related technologies:</b>	
<p><b>River management problems not being addressed through available technologies</b>            Typical river management problems are flooding, pollution, water scarcity and loss of biodiversity. Associated with these are escalating human health costs, damage to urban, rural and industrial infrastructure, food and water shortages, and lost opportunities for economic development and poverty reduction.</p>	<p>An IRBM approach helps to mobilize these technologies in a strategic and carefully planned way. This leads to a reduction in these impacts, while not compromising development and social betterment aspirations.</p>

### 5.4.1 Decision support systems

Decision support systems are gaining popularity and being used increasingly to guide what can be complex considerations of management issues. The objectives of decision support system mainly focus on answering the following questions as shown in figure below

- ❖ What are the major threats to the ecosystem?
- ❖ What are the major impacts on the ecosystem services such as water and food supplying capacities, biodiversity, carbon sequestration capacity, flood control capacity, etc?
- ❖ What kind of policy and technological options can be implemented in order to achieve sustainability in the catchment ecosystem?



**A framework of Ecosystem Assessment**

#### 5.4.2 GIS based planning and evaluation systems

Closely allied to decision support systems (see above) are GIS based planning and evaluation systems for catchment regions. This technology is currently being developed by the National Institute for Environmental Studies, Japan. The system is designed to provide policy alternatives for catchment ecosystem management through various technology options such as for water treatment, run-off water management and solid waste management as well as land use control and industrial developments. Each policy option is defined based on the future vision for the region such as ‘Business As Usual (BAU)’, ‘Best Available Environmental Technologies for the existing societal and spatial systems (BAT)’, and ‘Societal and spatial restructuring coordinated with environmentally efficient technologies (Sustainable Restructuring; SR)’. The policy options contemplate catchment-wide management from upstream rural areas to downstream urban areas.

The BAU scenario considers the future region as an extension of current socio-economic structures and spatial distribution patterns. The BAT scenario is designed to identify the environmental improvement effects possible through the adoption of the most innovative technologies currently available.

The SR scenario considers the future region to be managed to bring sustainable regional metabolism. Unlike other scenarios, land use patterns and urban development plans as well as other societal policies are incorporated to obtain environmentally sound regional frames under the SR scenario. Each scenario is constituted by a range of regional policies, namely organic solid waste control, wastewater and rainwater runoff control, strategic urban development plans and regional biotope management. A GIS-based decision support system provides the alternative regional policy packages as combinations of innovative environmental technologies varying from concentrative treatment systems to district-scale small treatment systems and correspondent urban development options.

The system consists of the following two categories;

- 1) regional frames of land use, population, and industrial systems, and,
- 2) policy programs to combine planned unit urban developments and sustainable technologies.

The technology system is based on a wide range of technology inventories such as traditional incineration plants without resource recycling, gasification plants, and methane fermentation for wet organic matters. Other policy options are also considered such as mixed development among urban buildings facilities and environmental facilities or compost recyclers between rural and urban sectors. Regional future frames for population, industries and land uses are exogenously provided while policy options are obtained by finding optimal alternatives for environmental indicators such as emissions levels and environmental states. A comprehensive estimation system is also to be provided as hierarchical indicators of physical indicators for direct environmental impacts and more diverse physical indicators such as life cycle emission and total material flow, which are correlated with socio-economic indicators for total environmental values and quality of life (see figure below).

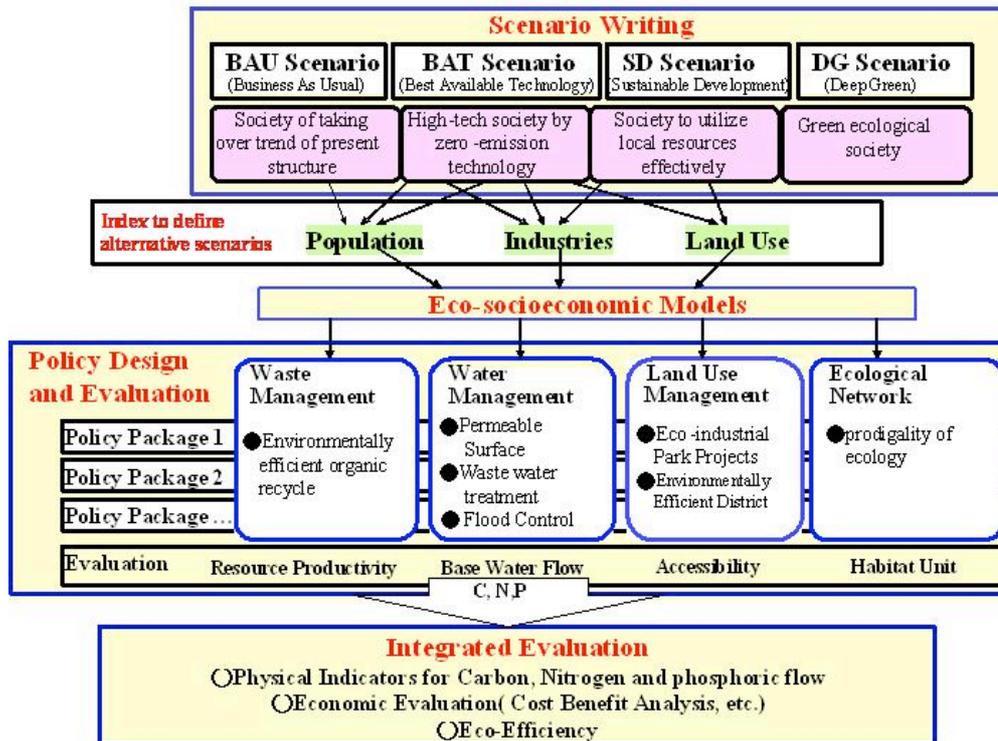
Evaluation systems for integrated catchment management are developed to present the scientific basis for approaches to sustainability management from a viewpoint of reforming environmental infrastructure and technological practices by showing the following procedures;

- 1) Specify framework of designing policy scenarios and planning options for integrated catchment-wide management,
- 2) Prepare data-base in the manner of GIS for calculation, accounting, and summing up of catchment-wide material flow and direct/indirect environmental burdens.
- 3) Model simultaneously discharging or loading of both of waste water and organic solid waste, and
- 4) Evaluate performance of expected innovative technological practices such as methane fermentation and energy recovery.

Comprehensive system approach to combine technological sub-model, socio-economic sub-model and ecosystem sub-model are found to be effective to design and evaluate policy recommendations for sustainable catchment management.

In particular, the ecosystem sub-model consists of an integrated catchment model to estimate the spatial and temporal distributions of the water cycle, heat cycle, carbon cycle, nutrients cycles, sediment transport as well as agricultural productivities in order to evaluate the condition of ecosystem services.

One of the biggest environmental loads, such as nutrient supply exists in Chongqing in the upper reaches of the Changjiang river catchment, and this causes enormous environmental problems in the middle and lower reaches of the river. The most important strategy for sustainability of catchment ecosystem is to adopt the concept of zero-emission in urban areas and sound recycling in agricultural and natural forestry/grassland areas. Recycling of nutrients from urban areas to rural area should be also included.



A Framework for Integrated Policy Planning and Evaluation System

### 5.4.3 Waste water treatment technologies

A summary of waste water treatment technologies is described in the table below. This qualitatively evaluates the typical technologies from the perspective of (a) removal of water pollutants, (b) treatment time, (c) excess sludge production and (d) cost and energy consumption. Most treatment processes have the effect of removing carbon, but nutrient removal is low. Most of technology which has high performance for nutrient removal takes a long treatment time and the costs are very high. As a whole, “Advanced Biofilm Process” is conceived as one of the best available technologies.

#### *Biofilm Process; water treatment for community scale*

“Biofilm” is one of the purification technologies for which operates through microorganisms adhered on the surface of a substrate. It generates little waste sludge, because of no or little aeration. It’s easier to operate this process in a small area. Additionally it’s possible to hold down the expenses in construction and operation. Hence it’s expected to be one of the innovative water treatment technologies for community scale.

Type of process	Removal					Treatment time Land occupation	Excess sludge production	Cost&Energy consumption
	Carbon	Nitrogen		Phosphorus	Pathogen			
		Ammonium	Total Nitrogen					
Lagoon (Oxidation pond)	Moderate	Low	Moderate	Low	Moderate	Long (Large)	Moderate	Low-moderate
Aerobic filter (Trickling filter, Percolating filter)	High	Moderate	Moderate	Low	High	Moderate	Moderate	Moderate
Oxidation ditch	High	Moderate	Moderate	Low	High	Moderate-long	High	Moderate
Septic tank	High	Moderate	Moderate	Low	High	Moderate	High	Moderate-high
RBC (Rotating Disk Contactor)	High	Moderate	Moderate	Low	High	Moderate-long	Moderate-high	Moderate-high
Activated sludge	High	Moderate	Moderate	Low	High	Moderate	High	High
Biological nitrification and denitrification (AO process: Anoxic-Oxic)	High	High	High	Low	High	Moderate	High	Very high
Biological phosphorus removal (A2O process: Anaerobic, Anoxic, Oxic)	High	High	High	High*	High	Moderate	High*	Very high
Anaerobic process anaerobic sludge blanket etc.)	Moderate	Low	Low	Low	Moderate	Moderate	Low	Low**
Advanced biofilm process (Combination of anaerobic&aerobic biofilm process)	High	High	High	Moderate	High	Short-moderate	Low	Very low**

\*Require physical chemistry post treatment \*\*It is possible to recover the methane energy

### Summary of waste water treatment technologies

#### *Activated Sludge Method; water treatment for city scale*

“Activated Sludge Method” is one of the most common waste water treatment technologies. It keeps waste water and activated sludge in the aeration tank for a set period of time so that aerobes, acclimatized and proliferated in advance, can decompose the organic substances by oxidation. Next, the mixture of the activated sludge and waste water is fed to the settling tank where kept for 2 to 3 hours. In the meantime, the sludge and supernatant separate, the sludge precipitating to the bottom under gravity.

#### *Organic Waste Management Technologies*

A lot of technologies for organic waste management have been developed along the way, and this paper compiles those processes on Removal of Environmental load, Treatment scale, Residuals and Dioxin production and Cost and Energy Consumption in Table2 Most technology takes effect for carbon removal and needs large space. By-products with treatment in wide area is lower than ones in local area, though the characteristic features on residuals/dioxin production and cost/energy consumption vary according to every technology, and conversely the expense is higher. First and last “methane fermentation” is thought of as one of most useful organic wastes management technologies.

#### *Gasifying and Melting Process*

The gasifying and melting process is the technology of burning and gasifying garbage under reduction atmosphere, carrying out high temperature combustion of the part for the separated gas and solid further without supplying energy from the exterior, and melting the remained ash. It is the greatest merit that generating of dioxin can fall sharply since it is made to burn at 1,300 - 1,500 hot degrees from the conventional incinerator. Moreover, the melting slag turned streamlining and harmless can be reused as roadbed material and so on, the generating gas and waste heat can be used for efficient power generation etc. There are various systems, such as a flow floor type, combination-type with various kiln furnaces and direct melting type.

Type of process	Removal				Treatment Scale	Residuals/Dioxin production	Cost&Energy consumption
	Carbon	Nitrogen	Phosphorus	Pathogen			
Dumping into rivers and wetlands	Low	Low	Low	Low	Very large	(High)	Very Low
Small scale incineration	High	Moderate	Low	High	Small	High	Low
City scale domestic wastes incineration plant	High	Moderate	Low	High	Large	Moderate	High
RDF	High	Moderate	Low	High	Moderate	Low	High
High-Grade carbonization	High	Low	Low	High	Moderate	Low	Moderate-Low
Gasifying and Melting	High	Moderate	Moderate	High	Large	Moderate	High
<b>Methane Fermentation</b>	<b>High</b>	<b>High</b>	<b>High</b>	<b>High</b>	<b>Small</b>	<b>Low</b>	<b>Low</b>

**Summary of Organic Wastes Management Technologies**

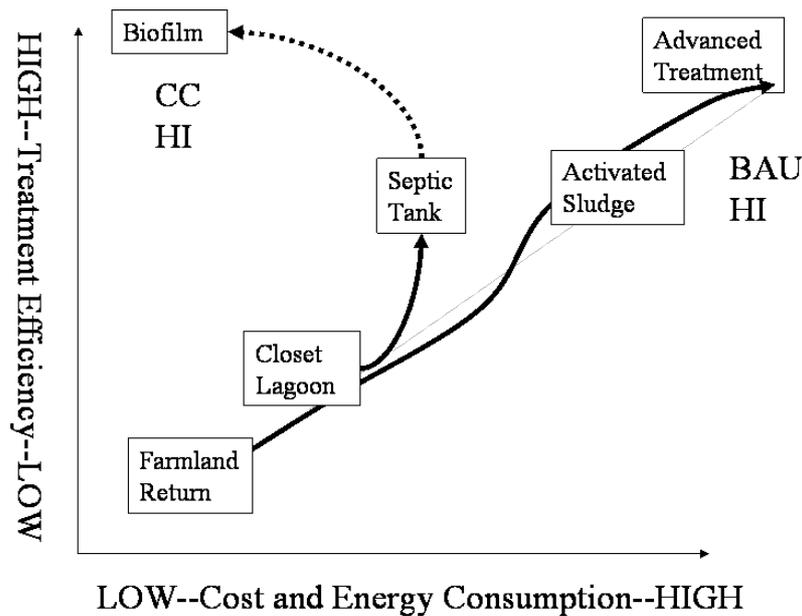
### *Methane Fermentation*

Methane fermentation can recover energy by fermenting organic waste with methane bacterium and generating methane gas. It is most feasible technology, for it can be operated in local scale and bring expenses under control. It's can produce 176 kWh electric energy and 321 MJ thermal energy per waste by combining fuel cell.

#### **5.4.4 Zero-emission technologies**

Another innovative approach are the new sustainable-technologies based on the zero-emission concept. Nutrients-load from farmland and urban areas in the upper reaches may cause serious eutrophication in lakes and reservoirs downstream. Land-use management of forestry, agriculture and animal husbandry in the upper reaches of Yangtze River for example, is strongly recommended for the control of soil erosion and non-point nutrients load. Sewage water and biological waste from urban areas should be recycled to energy (such as methane and hydrogen) and compost for afforestation.

The figure below shows the development of waste water treatment technologies from the perspectives of cost / energy consumption and treatment efficiency. As the country precedes into the higher industrialization stages, it is to invest more for the environmental improvement preferring larger scale treatment systems. On the other hand, innovation of technologies has come to provide different types of environmental technologies to attain higher improvement efficiency with smaller plants and smaller investments. A bio-film technology is one of representatives to attain cleaner region with smaller investment and locally segmented infrastructure systems.



Zero-emission technologies on treatment efficiency and cost and energy consumption

#### 5.4.5 Eco-economy special zones

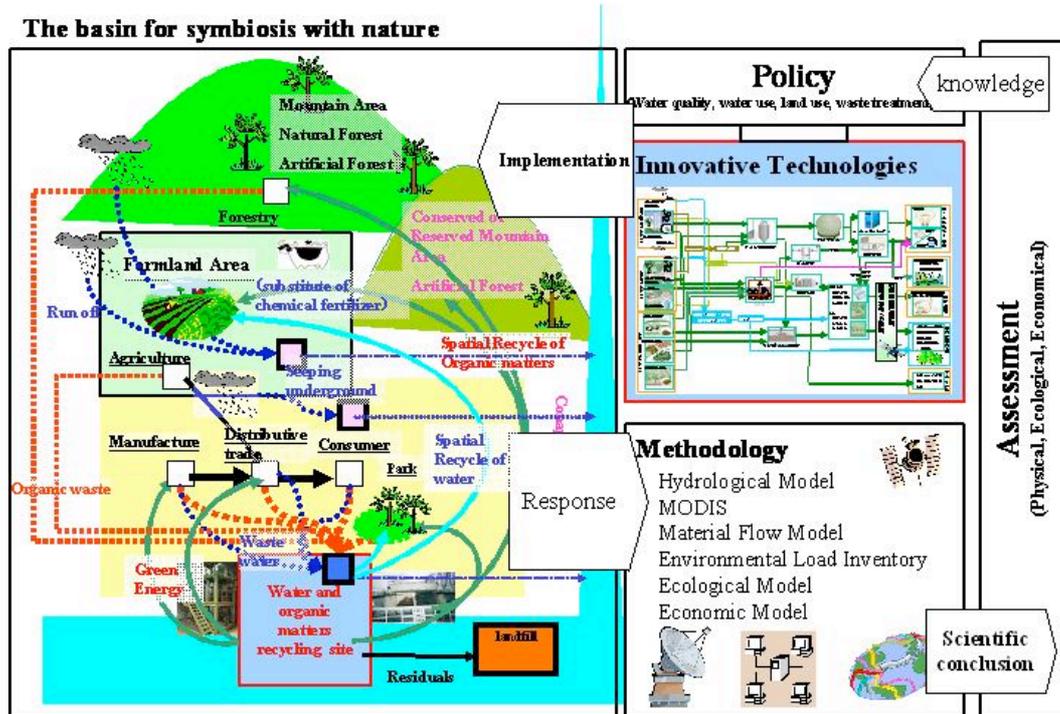
The construction of eco-economy special zones, which demonstrate a range of sustainable-technology and ecological models to accelerate sustainable development are also worth consideration. Eco-economy special zones are emerging as the primary arena for testing and implementing zero-emission ecology. Eco-economy special zones are designed to allow cities and firms to share infrastructure as a strategy for enhancing production and minimizing costs. The distinguishing feature of eco-economy special zones is their use of ecological design to foster collaboration among cities and firms in managing environmental and energy issues. In an eco-economy special zone setting, company production patterns, as well as overall zone maintenance, work together to follow the principles of natural systems through cycling of resources, working within the constraints of local and global ecosystems, and optimizing energy use. Eco-economy special zones offer firms the opportunity to cooperatively enhance both economic and environmental performance through increased efficiency, waste minimization, innovation and technology development, access to new markets, strategic planning, and attraction of financing and investment.

There are several innovative types of eco-economy special zone developments to cope with urban characteristics and urban regeneration demands such as urban development type, city-firm collaboration type, industrial-symbiosis-type (exchange by-products and emissions are located around industrial cores such as power plants or steel blast furnaces, Kalundborg, Denmark), product remanufacturing types which are planned to collect end-of-pipe plants for various industrial products (Kitakyushu city, Japanese Eco-towns).

The following perspectives are found critical to develop environmentally and economically sustainable eco-economy special zone as shown in the figure below.

- a. Demonstrative ecological technologies
- b. Institutionalized collaboration system among industrial sectors and other local stakeholders including farms and households to secure steadied provision and consumption of recycled resources.

- c. Integrated policy design for adopting environmentally efficient conversion technologies and their social and economical management systems considering spatial suitability of technologies.
- d. Economic incentive and freedom from legal constraint are essential for attracting industries.



### Material flow and metabolisms in Eco-Economy Special Zone

#### 5.4.6 Innovations for better management of dams

Dams have played an important role in development for centuries, if not millennia. The socio-economic benefits of dams typically include power, irrigation, municipal and industrial water supply, improved navigation, and flood control. In this sense, dams have facilitated economic development and job creation in many parts of the world. These benefits are the reasons why dams have been built. There are now around 40,000 large dams in China [check].

Dams are also among the most destructive developments that impact on rivers and ecosystems, with negative impacts for both wildlife and people. These impacts include: relocation of people, reduction in fisheries, downstream erosion, reduced water quality, and loss of delta lands. In recent years new methods and technologies have been identified to minimize impacts of dams and maximize benefits.

These impacts have meant that proposed dam projects are often controversial. Responding to this controversy, the World Bank and IUCN (The World Conservation Union) set up the World Commission on Dams (WCD) in May 1998. Following consultations with a wide range of stakeholders, this body carried out a comprehensive review of the world's large dams, looking at the performance and impacts of large dams, at alternatives and at a range of issues relating to all stages of dam projects.

The WCD's report *Dams and Development: A New Framework for Decision-Making* was launched in November 2000. It concluded the while dams have indeed contributed to human development and provided considerable benefits, this has been achieved at a high price, especially in terms of the social disruption of those displaced and the damage to the natural environment of downstream communities.

## *Key findings of the World Commission on Dams*

### **Technical, financial and economic performance.**

Many dams had failed to deliver the expected benefits. Dams designed for irrigation and multi-purpose dams seem to be particularly deficient in this respect. Delays and cost overruns during construction were common. There is an often unrecognised need for long-term monitoring of dams to ensure that the premises under which they were established (hydrological conditions, sediment load, suitability of land for irrigation, etc.) remain valid.

#### *Ecosystem and large dams*

The overall impact of large dams has been negative, including the loss of forests and species in flooded areas, biodiversity loss and the cumulative impacts of several dams in the same river basin. Measures to mitigate these effects such as fish passes have not always performed as well as intended.

#### *People and large dams*

Cumulatively, dams have displaced some 40 to 80 million people. The livelihoods of many others adversely affected by their construction have usually not been considered or compensated. Even where there was compensation, many resettled people suffered long-term losses that had not been taken into account. The benefits of large dams have not always been equitably distributed.

To improve this situation for future projects, the WCD proposed a decision-making framework based on five principles: equity, sustainability, efficiency, participatory decision-making and accountability.

The WCD's main recommendations related to strategic priorities for decision-making include:

- The need for clear public acceptance, including the provision of reliable information to enable stakeholders to make informed decisions and participate effectively in decision-making. With regard to indigenous people, this must include prior informed consent.
- A comprehensive assessment of all the options ensuring in particular that social and environmental aspects are given equal weight alongside technical factors.
- A post-project review of existing dams, both from a technical and social point of view.
- The development of a basin-wide understanding of the aquatic ecosystem and of ways of maintaining it.
- The recognition that the benefits of dams should be widely shared.
- Checks and balances to ensure that at all stages and procedures comply with agreed standards.
- Special attention to trans-national impacts.

#### *Maintenance and decommissioning of dams*

All dams have a limited life span and become increasingly expensive to maintain as they grow older. Safety problems are likely to become greater as climate change is forecast to cause more extreme weather events, such as floods. At the end of its working life there may be a need to decommission the dam. This may involve breaching, or removing and disposing of the dam structure and associated equipment. The reasons for removal typically include: removal of a safety hazard; end of the economic life of the dam (for instance, of dams that are silted up), restoration of fish and wildlife habitat, and improvement of water quality.

In countries like the United States and France, dams are licensed for a set period and if this licence is not renewed, or required upgrading is too expensive, then the dam must be removed, which is costly. In France, more than 100 dams were assessed for concession renewal in 1994, and of these only three in the Loire River basin were rejected. The decommissioning and removal of these three dams, which ranged from 4-15 metres in height, each cost in the range of US\$1.0 – 2.3 million.

In China's case the suggested approach is for each existing dams to be assessed and progressively licensed for a period of 30 years. Each dam should be assessed every to assess:

1. Dam safety requirements;
2. Economic benefits and costs of the dam; and
3. Modifications to the structures and their operation that could maximise economic returns and minimize environmental and social costs, for example, replacing old hydropower generators with more efficient generators, releasing water for downstream fish breeding, or adding fish ladders.

This assessment would result in the issuing of a new 30 year license subject to implementation of recommended modifications. In a minority of cases this may result in the license being refused for unsafe or uneconomic dams, requiring the owners to breach or remove the structure.

### *Mitigating environmental impacts*

In recent years new methods and technologies for reducing impacts of dams have been identified.

#### **Water quality**

Riverine water quality may be affected, eliminating fish species downstream, due to the construction and operations of a dam or reservoir. These effects may include lowering of water temperatures, reduced oxygen levels and eutrophication. In Australia, water below large dams is 3-10 deg C lower than natural, eliminating native fish breeding for 300 km downstream. Released waters can be restored to more natural temperatures by building or retrofitting dams with multi-level outlets in the reservoir, or by adding mixing propellers or suspended curtains to mix in surface water. Similarly, the installation of air draughts in the water-release ports can boost oxygen levels by aerating released water. River basin management programmes focusing on maximising soil protection and minimising erosion (which have been extensively used in China) can further reduce potential eutrophication problems, while at the same time reducing siltation and boosting the useful life of the dam.

#### **Hydrology**

Dams and reservoirs, by their very nature, modify natural water flow patterns, changing the volume, season and timing of discharges, and altering the natural dynamics of a river. Many floodplain and river delta ecosystems do not require only steady flows, but are dependent on regular floods for their maintenance or survival. Regular high and low water flows are needed to maintain fish breeding. As China relies on its rivers for [X%] of its fish production, this is an important employment and food security issue. Many other foods and fibres from rivers and floodplains depend on the size and timing of water flows. Managed flood releases present an option. Flows maintained in regulated rivers for the sake of preserving semi- natural conditions, functions and ecosystems, called 'environmental flows', can partly compensate for impacts from dams.

#### **Sediments and morphology**

Sediments are normally trapped in dams and reservoirs, reducing the useful life of a dam, and multiple dams are known to remove 99% of sediment. Less sediment moving downstream inevitably leads to scouring and erosion of the river channel and banks, affecting river vegetation and damage riverbank structures such as roads, buildings and bridges.

Dams can be designed to allow periodic flushing of sediments, but the effectiveness of these mitigation measures is limited. Firstly, the process involves releasing water that could have been used for other purposes (e.g. generation of electricity or irrigation), and there is a general reluctance to 'waste' water for this purpose. Secondly, the process involves releasing sediment in a more controlled way than under more natural circumstances, and this is not distributed to the same extent as under peak flood conditions.

**Climatic effects & greenhouse gas emissions**

All reservoirs and dams emit greenhouse gases such as carbon dioxide and methane, which is somewhat contrary to the conventional wisdom that hydroelectric power is one of the renewable energy solutions to climate change. There is evidence that large, shallow hydropower dams located in the warm tropics have emissions comparable to thermal plants, while deep, small reservoirs usually have lower emission levels, especially in cooler climates. Removal of vegetation prior to flooding a newly constructed dam may reduce some of the initial impacts, but in the medium to long-term the positive effects of such measures are less noticeable.

**Fish migration, passes and habitat fragmentation**

Dam construction, especially multiple dams along a single river can form a barrier for fish migration, and lead to the demise of migratory species and a loss of fisheries and biodiversity. To overcome this problem and mitigate losses, the use of fish passes has been introduced in dam construction, especially during the past 50 years.

Fish passes are a technical means for allowing fish to migrate past a dam or reservoir by locally reducing the flow rate, and may consist of series of stepped ponds (so-called “fish ladders”), vertical slots, or even sophisticated “fish elevators”. Where effective, they can significantly reduce the impacts on the migration of species such as salmon and sturgeon moving upstream. However, where they have been fitted, their effectiveness is often low due to faulty design, as this must take into account - among other things - the size and nature of the migrating fish, the discharge of the river, and the size of the dam. In areas where they are effective, fish passes need to be managed so that they are not abused as elaborate fish trapping devices.

2. The Taskforce also recommends that the government apply the needs and options assessment methodology recommended by the World Commission on Dams (2000) to enhance planning for new dams, to maximize social and economic benefits and minimize environmental, social and economic costs.