< Session 1> Improvement of water environment

Joint Water Quality Study to Determine the Cause of Pollution on the Upstream Portion of China's Liaohe River

Northwest Pacific Region Environmental Cooperation Center
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The Liaohe River is one of China's three most polluted rivers, and a great amount of money is being spent on its remediation. Our study involved four years of grassroots technical cooperation between two local governments: Toyama Prefecture in Japan, and Liaoning Province in China. We found that the main cause of pollution is soil runoff along the West Liaohe River, which is the upstream portion, and we proposed six ways to clean up the river, including afforestation projects, and improvement of revetments that prevent soil runoff and are sensitive to riparian vegetation and natural scenery. We believe that these proposals are important for the restoration of not only the Liaohe River, but also other rivers.

1. Project Description: Participants, Achievement, and Effects

The purpose of our project, which ran about for four years from July 1998 to March 2002, was to scientifically determine the cause of pollution in the upstream portion of the Liaohe River, have our findings incorporated into Liaoning Province's environmental administration, and offer some concrete proposals to remediate the river. Over this period both sides worked steadily and in good faith using three main elements: (1) Sending experts from Toyama Prefecture to Liaoning Province, (2) attendance by representatives from Liaoning Province at meetings held in Toyama Prefecture to discuss the study results, and (3) acceptance of technical trainees from Liaoning Province into the Toyama Prefectural Environmental Science Research Center.

(1) Number of participants: 47

- Toyama Prefecture: 21 participants (eight from the Northwest Pacific Region Environmental Cooperation Center, six from the Toyama Prefectural Environmental Science Research Center, six from the Toyama Prefecture Civic Affairs and Environment Department, and one from Toyama University)
- Liaoning Province: 19 participants (11 from the Liaoning Provincial Environmental Monitoring Center, five from the Liaoning Provinceial Environmental Protection Bureau, three from the Tieling City Environmental Monitoring Center and other agencies)
- Others: seven participants (two from the Japan International Cooperation Agency (JICA), five interpreters)

(2) Achievement

(a) Researchers built close friendship and a relationship of firm trust through their many frank and sincere discussions.
(b) Personnel from both countries cooperated in preparing a report ("Report on the Results of a Joint Study on the Investigation of Water Quality on the Upstream Portion of the Liaohe River," in Japanese and Chinese versions) describing the results of the four years of research.
(c) We proposed six specific ways to clean up the river to have our findings incorporated into Liaoning Province's Environmental Bureau .

(d) We made a major contribution to the development of personnel skill by accepting six technical trainees over three years.
(e) Fifteen experts were sent to China to provide suitable technical guidance, and we provided the needed equipment.

(3) Effects

(a) It was seen that our proposed clean up solutions could also be used to clean up other polluted rivers in China.
(b) Thanks to the achievements of our four years of activity, it was also possible to begin a new study at the mouth of the Liaohe River in 2002.
(c) Our study induced authorities to enhance the facilities of the Liaoning Provincial Environmental Monitoring Center. This included major restoration work on buildings, equipping of laboratories, and the improvement of analytical instruments.
(d) Researchers gained substantial motivation for work and research.
(e) The study results were released mainly in Liaoning Province, where they significantly benefited the provincial citizens' environmental education concerning the Liaohe River.

2. The Start, Unfolding, and Future Direction of Our Activities

(1) Start of Activities

Mitigating pollution and conserving the environment are urgent tasks in China, whose Liaohe River is one of the country's three worst polluted (the other two are the Haihe and Huaihe). Liaoning Province was faced with the task of determining the characteristics of the river's water quality, which worsens year by year, and the reasons for that decline. Geographically, Toyama Prefecture has a long history of trade and interchange with the Russian coastal area, the Korean Peninsula, and China. Even in modern times there has been a variety of interchange and cooperation, with cooperation in the environmental issues considered especially important. Because Liaoning Province has a friendship arrangement with Toyama Prefecture, since 1985 the prefecture has pursued its own program of cooperation by accepting and training technical trainees in this field. Since 1998, the Northwest Pacific Region Environmental Cooperation Center has performed such studies and research under a commission from the prefectural government.

(2) How Our Activities Proceeded

Toyama Prefecture and Liaoning Province, which had announced they would cooperate in solving the problem of Liaohe River pollution, proceeded with a joint Japan–China project for environmental protection that involved working together to study water pollution on the upper reaches of the river and to determine its causes. Consultations were held while working. The Toyama Prefectural Environmental Science Research Center and the Liaoning Provincial Environmental Monitoring Center assumed responsibility for conducting the research. During the four-year period we studied the basic state of the natural and social environments in the upstream area of the Liaohe River; regularly sampled the river's bottom sediments and water, the bottom sediments and water of urban effluent channels in the river's upstream area, and soil along the river's upstream portion; and performed analyses that included COD, BOD, TOC, TN, TP, heavy metals, organic matter, and ignition loss. Results yielded by scientifically analyzing the many valuable data obtained allowed us to determine the characteristics

of water pollution on the upper portion of the Liaohe River. Through this study and research, the many researchers from both countries who were involved in the project carried on vigorous and candid discussions in the "study result discussion meetings." Thanks to these discussions, participants from both countries were able to arrive at the same basic perception of the results gained from research on water pollution on the upstream portion of the Liaohe River.

(3) Future Direction

The Northwest Pacific Region Environmental Cooperation Center is working on preparations to implement UNEP's North-West Pacific Action Plan. Its main purpose is to develop new monitoring technologies (remote sensing and biological effect) for marine conservation in areas such as the Sea of Japan and the Yellow Sea. To accomplish this, in 2002 we started Phase II, which involves testing water quality at the mouths of the Liaohe River and other rivers for the purpose of ascertaining the pollution load from land, and estimating the impact on Liaodong Bay, the Bohai Sea, and other marine areas. This will determine the state of pollution at river mouths, and also provide a foothold for the next step, which is studying marine pollution in Liaodong Bay, the Bohai Sea, and other areas.

3. Other Matters (Funding Amount, Procurement Methods, and Television Appearance)

(1) Funding Amount and Procurement Methods

Funds for our activities were obtained from Toyama Prefecture and JICA. Thirty percent of our approximately ¥10 million annual funding is project commissioning fees from Toyama Prefecture, and 70% comes from JICA (Project Funding for Citizen-participatory Technical Trainee Acceptance, and Project Funding for Short-term Dispatching of Experts).

(2) Television Appearance

On Saturday, September 28, 2002 from 7:30 to 9:50 pm, the Japan Broadcasting System (NHK) broadcast a News Special on the NHK Sogo Television Channel called "China Changes in the 21st Century: How Should We Get Along with China? —Three Decades Since Japan's Normalization of Relations with China." The program's second part, "From Friendship to True Partnership," described our study and research as an example of environmental cooperation between local governments. The program observed that Japan and China have arrived at a new stage, moving from "government-level exchanges" to "broad-based, pluralistic exchanges at the grassroots level," and also said that our efforts suggested a concrete way to address this problem.

中国遼河上流部の汚濁原因解明に関する水質共同調査研究

財団法人　環日本海環境協力センター
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遼河は中国における三大汚濁河川の一つであり、現在その浄化対策に巨額が投じられている。本調査研究は、両国の自治体である富山県と遼寧省との間の４年間にわたる草の根技術協力である。研究の結果、汚濁の主要因を上流部の西遼河からの土砂流出であることを解明し、浄化対策として、「植林事業の推進」、「川辺の植生・自然景観に配慮した土砂流出防止のための護岸工事の推進」等六つを提案した。この提案は、遼河のみならず他の河川の修復に対しても重要であると認識している。

１．具体的な活動状況 (参加者数、成果と影響)

このプロジェクトは、遼河上流部の汚濁原因を科学的に解明し、遼寧省の環境行政に反映させ、具体的な汚濁浄化対策を提言することを目的に1998年7月から2002年3月までの約４年間実施された。この期間に、①富山県から遼寧省への専門家派遣、②遼寧省から富山県で開催する調査結果検討会への出席、③富山県環境科学センターにおける技術研修員の受入れを三本柱として、相互に誠実に、そして地道に実行してきた。

(1). 参加者数：47 名

・富山県；21 名（(財)環日本海環境協力センター:8 名、富山県環境科学センター:6 名、富山県生活環境部:6 名、富山大学:1 名）、

・遼寧省；19 名（遼寧省環境監測センター:11 名、遼寧省環境保護局:5 名、鉄嶺市環境監測センター等:3 名）

・その他；7 名 (国際協力事業団 2 名、通訳 5 名)

(2). 成果

(a) 研究者間の率直で誠実な討議の積み重ねを通して、日中両国の親愛な友情を形成し、強固な信頼関係を構築した。

(b) 4 年間の研究結果を報告書(遼河上流域の水質調査に関する共同調査研究結果報告書)として日中協力(日本語版、中国語版)して作成した。

(c) 遼寧省の環境行政に反映させるため、6 つの具体的な河川浄化対策を提言した。

(d) 3 年間にわたり、6 人の技術研修員を受入れ、人材育成に大いに寄与した。

(e) 15 人の専門家を派遣し、適切な技術指導を実施するとともに、必要な機材を提供した。

(3). 影響

(a) 浄化対策提言は、他の中国の汚濁河川の浄化に対しても有効であることが認識された。

(b) 4 年間の活動の成果を受けて、2002 年度から新たに遼河河口調査として開始できた。

(c) この調査研究が引き金となり、遼寧省環境監測センターの施設の機能が強化された。具体的には、建物の大幅な修復、実験室の整備、各種分析機器の強化等である。

(d) 研究者の勤労・研究意欲が大幅に向上した。

(e) この調査研究が省内を中心に紹介され、省民の遼河に関する環境教育に大きく寄与した。

２．活動の発端、経過、今後の展開

(1) 活動の発端

公害防止・環境保全が急務となっている中国で、遼河は三大汚濁河川（他に海河、淮河）の１つであり、年々悪化する水質の特性とその原因解明が懸案となっていた。富山県は地理的にロシア沿岸地区、朝鮮半島、中国と長い交易・交流の歴史を持っている。現代においても多様な交流・協力を進めており、特に環境分野の協力を重視してきた。遼寧省は県の友好提携先であることから、1985 年から県独自にこの分野で技術研修員を受入れて人材育成に協力してきた。1998 年からは、(財)環日本海環境協力センターが県の委託を受けてこの調査・研究に取り組んだ。

(2) 経過

遼河の水質汚染問題の解決に協力を表明した富山県と遼寧省は、協議しながら共同で遼河上流水質汚染の調査と原因の解明を行うことにより、両国の環境保護に関する共同プロジェクトを推進した。実施する研究実施機関として、富山県環境科学センター及び遼寧省環境監測センターが担当した。この 4 年間に、遼河上流地域の自然環境や社会環境の基本的な状況を調査し、定期的に遼河の水質と底質、遼河上流地域の都市排水路の水質と底質、及び遼河上流地域周辺の土壌を採取し、ＣＯＤ、ＢＯＤ、ＴＯＣ、ＴＮ、ＴＰ及び重金属、有機質、強熱減量などを分析した。得られた貴重な多くの測定データを科学的に解析した結果、遼河上流域の水質汚染の特徴を明らかにすることができた。また、この調査・研究を通して、毎年実施した「調査結果に関する技術検討会」において、両国で係わった多くの研究者が活発で率直な議論を交換した。その結果、遼河上流域の水質汚染に関する研究結果について、両国は基本的な認識を一致させることができた。

(3) 今後の展開

(財)環日本海環境協力センターは、国連環境計画の北西太平洋地域海行動計画を実施するための準備作業を進めている。主目的は、日本海や黄海等の海洋保全のための新しいモニタリング技術（リモートセンシングを利用した赤潮や海洋生物によるモニタリング）を開発することである。こうした課題を実現するため、陸域からの汚濁負荷量を把握し遼東湾・渤海等への海域影響を推測することを目標に、遼河及びその他河川河口の水質調査を 2002 年度から PhaseⅡとして開始した。これは、河口での水質汚濁の実態を明らかにするとともに、次のステップである遼東湾・渤海といった海洋汚染調査への足がかりとする。

３．その他 (活動資金の規模と調達方法等)

(1) 活動資金の規模と調達方法

富山県と国際協力事業団（JICA）から活動資金を調達した。年間の活動資金約 1,000 万円のうち、3 割が富山県からの事業委託費、7 割が JICA（国民参加型技術研修員受入れ事業費及び短期専門家派遣事業費）からである。

(2) その他

2002 年 9 月 28 日(土) 19:30～21:50 まで、NHK の総合テレビで NHK 報道スペシャル「21 世紀・変貌する中国－中国とどう向き合うか～日中国交正常化 30 年」の第 2 部「友好から真のパートナーへ」で自治体間の環境協力事例に、本調査・研究が紹介された。その中で、これまでの「国どうしの交流」から「草の根レベルの巾広い多元的な交流」へと新たな段階に入っていることが指摘された。そして、この課題の具体的な進め方（日中間の新しい交流）のヒントになる事例として紹介された。

Joint Water Quality Study to Determine the Cause of Pollution on the Upstream Portion of China's Liaohe River

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NPEC

(Northwest Pacific Region Environmental Cooperation Center)

The Objective of Establishment

NPEC was established to promote the preservation of marine environment of the Sea of Japan and the Yellow Sea through regional cooperation (Japan, People's Republic of China, Republic of Korea and Russian Federation) as a non-profit organization on April 30, 1997.

Projects

(a) NOWPAP activities

NPEC was designated in 1999 as the Special Monitoring and Coastal Environmental Assessment Regional Activity Center (CEA／RAC) of the Northwest Pacific Action Plan (NOWPAP).

NPEC as CEA/RAC is responsible for the development of new monitoring techniques such as remote sensing and bioassay.

Organization of NOWPAP

- UNEP (United Nations Environment Program) Nairobi, (Kenya)
  - NOWPAP/RCU (Regional Coordinating Unit) Toyama (Japan) and Pusan (Korea)
    - CEA/RAC Special Monitoring and Coastal Environmental Assessment Toyama (Japan)
    - DIN/RAC Data Information Network Beijing (China)
    - MER/RAC Marine Environmental Emergency Preparedness and Response Taejon (Korea)
    - POM/RAC Pollution Monitoring Vladivostok (Russia)

(b) Other activities

- Projects to promote Researches relevant to Environmental Protection
- Projects to promote Environmental Interaction
- Projects to support measures for Environmental Preservation

Introduction

The Liaohe River is one of China's three most polluted rivers, and a great amount of money is being spent on its remediation. Our study involved four years of grassroots technical cooperation between two local governments: Toyama Prefecture in Japan, and Liaoning Province in China. We found that the main cause of pollution is soil runoff along the West Liaohe River, which is the upstream portion, and we proposed six ways to clean up the river. We believe that these proposals are important for the restoration of not only the Liaohe River, but also other rivers.

Over this period both sides worked steadily and in good faith using three main elements: (1) Sending experts from Toyama Prefecture to Liaoning Province, (2) attendance by representatives from Liaoning Province at meetings held in Toyama Prefecture to discuss the study results, and (3) acceptance of technical trainees from Liaoning Province into the Toyama Prefectural Environmental Science Research Center.

2. The Start, Unfolding, and Future Direction of Our Activities

(1) Start of Activities

Liaohe River is one of the country's three worst polluted (the other two are the Haihe and Huaihe). Liaoning Province was faced with the task of determining the characteristics of the river's water quality, which worsens year by year, and the reasons for that decline. Geographically, Toyama Prefecture has a long history of trade and interchange with the Russian coastal area, the Korean Peninsula, and China.

Even in modern times there has been a variety of interchange and cooperation, with cooperation in the environmental issues considered especially important. Because Liaoning Province has a friendship arrangement with Toyama Prefecture, since 1985 the prefecture has pursued its own program of cooperation by accepting and training technical trainees in this field. Since 1998, the Northwest Pacific Region Environmental Cooperation Center has performed such studies and research under a commission from the prefectural government.

(2) How Our Activities Proceeded

Toyama Prefecture and Liaoning Province, which had announced they would cooperate in solving the problem of Liaohe River pollution, proceeded with a joint Japan–China project for environmental protection that involved working together to study water pollution on the upper reaches of the river and to determine its causes. The Toyama Prefectural Environmental Science Research Center and the Liaoning Provincial Environmental Monitoring Center assumed responsibility for conducting the research.

During the four-year period we studied the basic state of the natural and social environments in the upstream area of the Liaohe River; regularly sampled the river's bottom sediments and water, the bottom sediments and water of urban effluent channels in the river's upstream area, and soil along the river's upstream portion; and performed analyses that included COD, BOD, TOC, TN, TP, heavy metals, organic matter, and ignition loss. Results yielded by scientifically analyzing the many valuable data obtained allowed us to determine the characteristics of water pollution on the upper portion of the Liaohe River.

Through this study and research, the many researchers from both countries who were involved in the project carried on vigorous and candid discussions in the "study result discussion meetings." Thanks to these discussions, participants from both countries were able to arrive at the same basic perception of the results gained from research on water pollution on the upstream portion of the Liaohe River.

Proposal for river purifying measure

1 Prevention measure toward soil outflow

A mass soil outflows from the river upstream due to flood cause the rise of a riverbed and exert a big influence on SS and COD which are water pollution items. Especially, at the result of this survey, an outflow quantity from West Liaohe river showed a high value of it, nearly 80 percents

(1) Promotion of an afforestation project

The afforestation to prevent from soil outflow has already been carried out in Liaohe river basin. However, it should be carried out immediately with a more effective planning.

(2) Bank protection works

Because now it is pointed out as a reconsideration subject that it has not paid any attention to environmental view and ecological system around rivers, the bank protection work should be implemented to maintain the beauty of Chinese view and care creatures/vegetations which lives on natural stones or rocks, without using concrete.

2 Household wastewater

At present, urban sewage water treatment facilities are being built in the cities like Shenyang. But it is still not enough. A financing for construction and running costs is important and it is also important to take beneficiary-payment principle into a policy in order to maintain/manage the facilities. Besides, it is necessary to plan from both sides of a technical subject and cost to make treatment technologies be high level (denitrification/dephosphorization). Also, it is an urgent work to train many engineers who are able to do routine managements of facilities properly.

3 Factory effluent

It is an urgent task to find and carry out the business which suits in Chinese system. For example, a quantitative and qualitative grasp of factory effluent arising from the differences of each industrial structure, a selection/size of appropriate treatment methods, a technology for maintaining/managing the facilities, a permanent stationing of person who collects and analyzes effluent daily, an establishment of the environmental management division that organizes them entirely.

4 Survey on wastewater of agriculture/stock farming

This time, it was not able to carry out the survey on agriculture/stock farming due to its size and costs.

In order to grasp the water quality environment in Liaohe river comprehensively, it is necessary to research wastewater from agricultural and stock farming industry that use water a lot.

5 Strengthening of surveillance

(1) Reinforcement of Environmental Monitoring Survey

The data by the monitoring is collected and analyzed, and then it is ideal to use it effectively and inductively for reflecting to the Administration.

(2) Reinforcement of Factory on-the-spot inspection

In Japan, the state examination system of a "prevention-of-pollution administrator" was provided in 1973. And it is obligated that each factory must have person who has passed the exam based on the law. Moreover, it is recommended that each local government's staff that actually perform a factory inspection have this qualification and they can offer an appropriate technical guidance to factories.

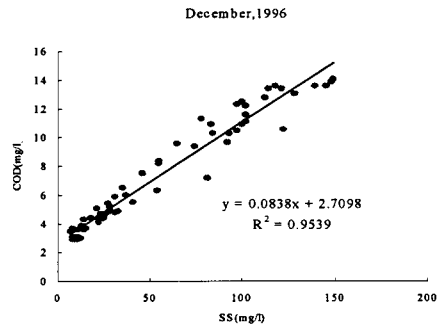
6 Spread of environmental education

The environmental education including "Volunteer works" has already been implemented through elementary school to University in China. As for Liaohe river, in accordance with World Environment Day, one million signature activity of "Save Liaohe river by our love" was carried out in 8 cities and 3 prefectures along the river.

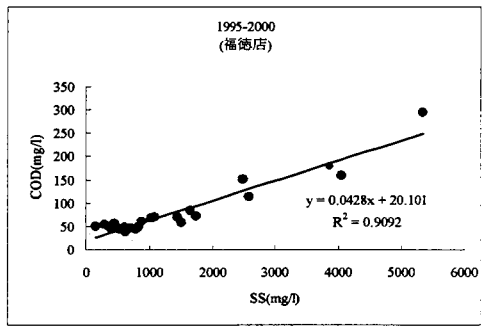
It is expected for the people living there to perform activities for preventing from throwing garbage into the river.

(3) Future Direction

The Northwest Pacific Region Environmental Cooperation Center is working on preparations to implement UNEP's North-West Pacific Action Plan. Its main purpose is to develop new monitoring technologies (remote sensing and biological effect) for marine conservation in areas such as the Sea of Japan and the Yellow Sea. To accomplish this, in 2002 we started Phase II, which involves testing water quality at the mouths of the Liaohe River and other rivers for the purpose of ascertaining the pollution load from land, and estimating the impact on Liaodong Bay, the Bohai Sea, and other marine areas. This will determine the state of pollution at river mouths, and also provide a foothold for the next step, which is studying marine pollution in Liaodong Bay, the Bohai Sea, and other areas.



Correlation between SS and COD (Oyabe River in Toyama)



Correlation between SS and COD (Liaohe River in China)

WATER QUALITY MANAGEMENT AND WATER SUPPLY POLICY IN KOREA

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Part I. Water Management Policy in Korea Based on Watershed Management

Introduction

For the past three decades, Korea government has focused on increasing the capacity of water resources in order to keep up with the household, industrial, and agricultural water demand. However, the consumption level has overwhelmed the expansion of public water supply, mainly achieved by constructing dams and reservoirs. Moreover, the expansion has almost reached the limit due to the difficulties of finding dam sites and the concerns over the negative effects of ecosystem.

Korea sustained the development priority policy rather than preservation from 60s to 80s. For the several decades, lots of regions have urbanized and industrialized rapidly, while investment for water preservation has not sufficient. As a result, water quality has been deteriorated in many areas. In Korea, two thirds of annual precipitation occurs during summer, and spring has usually severe draught. As flow is small during dry season, rivers and reservoirs are easily affected by pollution.

In the 1990s, several water pollution accidents happened, for example, the phenol spill from an electronic plant in the Nakdong River basin. Under the situation, an effective strategy has been needed for the preservation of water quality. Unfortunately, the federal government and local governments do not always agree on the goals; local government is generally focused on the community's economic development rather

than the preservation and sound management of the water environment. Hence, it is difficult to propose an integrated approach to water management. Particularly, the disputes on the cause and responsibility of the water pollution between the upstream and downstream residents have made the situation more complicated.

The Current Water Management Status

For the convenient management of all the water bodies, 4 major watersheds and subsequent 11 small catchments has been set up since 1991, as shown in Table 1 and Figure 1. The 4 major watersheds are as follows: the Han River watershed, the Nakdong River watershed, the Geum River watershed, and the Youngsan River watershed.

General Status

The Han River watershed includes the Han River, the South Han River, the North Han River, the Kongan River, and other streams. Total basin area is 26,018km^2, and the annual precipitation is 1,286mm. Total amount of the river's water resource is about 33.5 billion tons per year. Two large dams, Soyang and Chungjoo Multi-purpose Dams, are located at the upper stream of Han River for the purpose of proper control of water flow. The population of the Han River watershed is estimated 23.5 million, which is about 50% of the total population in Korea.

Table 1 General status of 4 major watersheds in Korea

Category	Han river	Nakdong river	Geum river	Youngsan river
Main stream length(km)	481.7	521.5	395.9	136.0
Basin area(km^2)	26,018	23,817	9,810	3,371
Annual precipitation(mm)	1,286	1,137	1,268	1,400
Population (x10,000)	2,349	1,316	579	426
Live stock(x10,000)	197	360	427	282
Emission site	17,999	12,058	6,089	3,793

Sewage treatment ratio(%)	87.5	60.6	62.1	75.2
Major water supply source	Paldang reservoir, Chamsil water Supply system	Mulgum, Maeri intake	Daechung reservoir	Juam reservoir

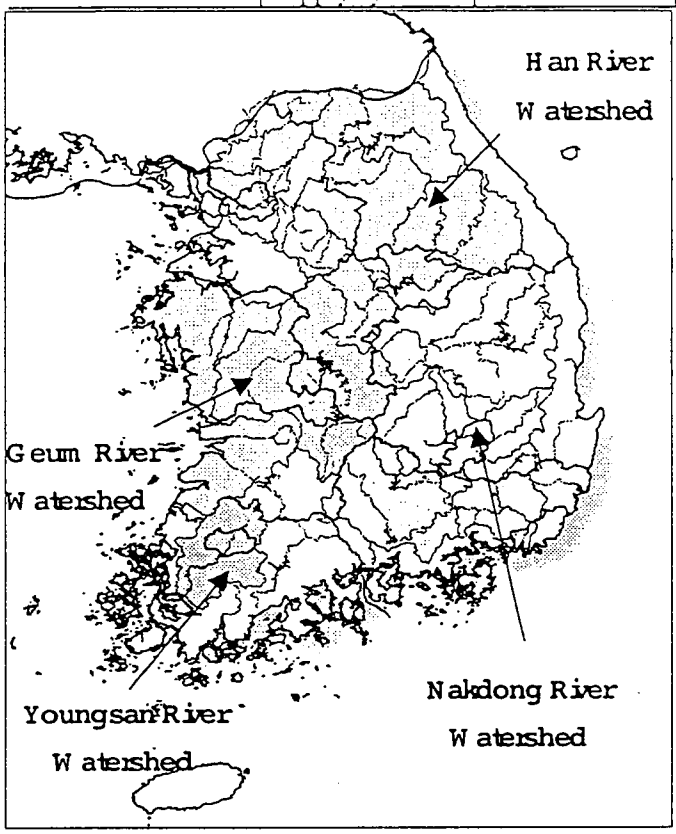


Figure 1- Location of 4 major watersheds in Korea

The majority of people lives in Seoul and Kyunggi province, the lower stream of Paldang Dam, and only 9.1% of people in the Han River watershed live at the upper stream which are mainly used as source waters for water supply. At the upper stream of Han River, 1.5 million tons of wastewater are generated daily as of 1997. The percentage of households, industrial and livestock wastewater is 81.3, 17.1, and 1.6%, respectively.

Two main sources of water supply for the region are Paldang Reservoir and Chamsil Underwater Dam. The capacities of water supply for these two sources have 7.7 and 6.3 million tons per day, respectively. 31% of the water supply is used for households, 12% for industries, 26% for agriculture, and the remaining is used for maintaining water quality preservation and other uses.

The Nakdong River originates from the Taeback mountains. The Geumho River joins at midstream, and Hwang River and Nam River at the lower stream. The total river

basin area is 23,817km^2, and the population in this watershed is estimated 13.2 million. Since lots of people live in the midstream of the Nakdong River, the water quality at mid- and lower stream had not been properly controlled. Even though wastewater generation, 3,364 thousand tons per day in the Nakdong River wastewater, is less than the half in the Han River watershed, the degree of pollution in this watershed is relatively high due to the pollution concentrated at the midstream. The wastewater is comprised of 80%, 19%, and 1% for households, industrial and livestock wastewater, respectively. There are five multi-purpose dams in the Nakdong River watershed, including Andong Dam and Ymha Dam, the total capacity is less than that of Soyang Dam in the Han River. In addition, due to less precipitation at the upper stream than the lower stream region of the river, it is often not sufficient to meet the water supply demand, especially during a dry season.

The Geum River originates from Jangsu County in Cholla-buk-do, runs through Taejeon, Gongju, and Buyeo, and finally flows into the Yellow Sea. The total river basin area is 9,810Km^2. The population in this watershed is about 5.8 million, one fourth of the population in the Han River watershed. Daechung dam is the major source of drinking water source for Daejon and Chungchung province, supplying 0.98 million tons per day. Water quality of this watershed is considered to be adequate for drinking water. The wastewater is generated 1,345 thousand tons per day as of 1998, which is only 18% of the wastewater of Han River watershed. However, due to the distributive characteristics of polluting sources, water quality at the mid stream gets deteriorated. 88% of wastewater is from households, 10.5% from industries, and 1.5% from livestocks. The water supply system in this watershed provides enough amount of water (6.4 billion tons per year) for the use (5.8 billion tons per year) - 10.3% is utilized for households, 8.8% for industries, 52.1% for agriculture, and 17.9% for maintaining the water quality and other uses.

The Youngsan River originates from Damyang County in Cholla-nam-do, and runs

through Gwangju and Naju. The total basin area covers 3,371km^2. The population in this watershed is estimated 4.3 million, and most of them live in upper and mid stream region. Thus, the water quality for the lower stream has been adversely affected. 86% of the wastewater in this watershed (764 thousand tons per day) is generated from households, 12.7% from industry, and 1.3% from livestock. This watershed is characterized to be agricultural regions, thus, there are a number of agricultural dams instead of water supply or multipurpose dams. The total water demand is 4.8 billion tons per year; 8.3% is for the use of households, 5.2% for industries, 76% for agriculture, and 10.5% for irrigation or the river maintenance.

Status of Water Source and Water Pollution

Even though the mean annual precipitation in Korea (1,274mm) is 1.3 times higher than that of the world, our mean annual precipitation per capita is only 2,900 tons due to the higher population density, compared with 26,800 tons for the world. From one year to another the annual rainfall fluctuates from 770 mm to 1,640 mm. Moreover, two thirds of annual precipitation intensively occurs intensively in a runoff season (from June to September), thus flood frequently bring on lots of damages. On the other hand, insufficient amount of precipitation during a dry season has resulted in a rapid decrease in the water level of river and lack of water supply. In addition, the coefficients of river regime, which represents the ratio of the maximum flow to the minimum flow, varies from 300 to 700, while it ranges normally from 10 to 30 in Europe.

Total amount of annual water consumption is estimated 30.1 billion tons which accounts for 24 % of Korea's total rainfall. Agricultural use represents 49.5% of the total, households 20.6 %, river maintenance 21.3%, and industries 8.6 %. Surface water from river, reservoir and dam are main sources of water supplies, accounts for 91% of all water sources.

In the case of groundwater, which is estimated 1.54 trillion tons, the maximum available groundwater is about 13.5 billion tons, but only 2.6 billion tons(20% of available amounts) have been developed and utilized.

At present, no area is encountered with lack of water supply except for the driest season. However, considering the current trend of water use, it is obvious that all demands will not be met after 2006 for the present facilities. In order to meet the increasing water demand, Korea government plans to develop new water resources along with constructing seven new dams until 2011.

As shown in Table 2, the reserved ratio of water use for four large watersheds in 2011 is expected to be 14.3% for the Han River, 3.6% for the Nakdong River, 5.9% for the Geum River, and 7.8% for the Youngsan River.

Table 2 Status of water demand / supply in 4 major watersheds

(unit: million ton/yr)

Category		Goal year			
		1994	2001	2006	2011
Nation	-Water demand	30,144	33,662	35,014	36,673
	-Water supply	32,463	34,364	34,607	34,662
	(Dam under construction)[1]	(-)	(1,891)	(2,131)	(2,131)
	-Δ Deficit	2,319	702	Δ 407	Δ 2,011
	-Plan of dam construction[2]		700	4,140	5,140
Han River	-Water demand	10,889	12,266	12,574	13,177
	-Water supply	11,815	12,009	12,053	12,057
	(Dam under construction)	(-)	(112)	(112)	(112)
	-Δ Deficit	926	Δ 257	Δ 521	Δ 1,120
	-Plan of dam construction		430	2,620	3,000
Nakdong River	-Water demand	8,569	9,496	9,974	10,562
	-Water supply	8,969	9,500	9,520	9,535
	(Dam under construction)	(-)	(575)	(575)	(575)
	-Δ Deficit	400	4	Δ 454	Δ 1,027
	-Plan of dam construction			810	1,410
Geum River	-Water demand	5,831	6,552	6,988	7,361
	-Water supply	6,448	7,162	7,328	7,355
	(Dam under construction)	(-)	(757)	(997)	(997)
	-Δ Deficit	617	610	340	Δ 6
	-Plan of dam construction			440	440

Youngsan River	-Water demand	4,855	5,348	5,478	5,573
	-Water supply	5,231	5,693	5,706	5,715
	(Dam under construction)	(-)	(447)	(447)	(447)
	-Δ Deficit	376	345	228	142
	-Plan of dam construction		270	270	290

Note) [1] Water provided by dam under construction

[2] Water supply from plan for dam construction in the future

Figure 2 illustrates the amount of wastewater generated from households, industries, livestocks, and non-point sources, and the biochemical oxygen demand (BOD) loads ratios in the four watersheds as of 1997. The total amount of wastewater is estimated 12,826 thousand tons per day, equivalent to 3,563 tons per day of BOD loads, and 83% is from households. Households and industries represent 52% and 35% of the total BOD loads, respectively. It is noted that more than half of the total wastewater is generated in the Han River watershed. The Nakdong River watershed represents 26% of total wastewater generated and 30% of the total BOD loading rate. The major pollutant source is found to be wastewater from households in the former watershed, and from industries in the latter [Fig. 2 (b) and (c)]. In case of the Youngsan River watershed, the percentage of livestock wastewater in terms of BOD loading rate (22%) is relatively high, compared to other watersheds [Fig. 2 (e)].

The quality of surface waters is periodicaly monitored at more than 1800 stations. Mean annual levels of BOD in the four major rivers suggest reasonably good water quality, but there are significant seasonal fluctuations. In upper stream, mean BOD levels are generally less than 1.5 mg/L. In lower stream, mean BOD levels range 2.0 to 4.0mg/L, but it reaches more than 6.0 mg/L in a dry season. However, toxic substances and heavy metals are not detected yet in most of water quality monitoring stations.

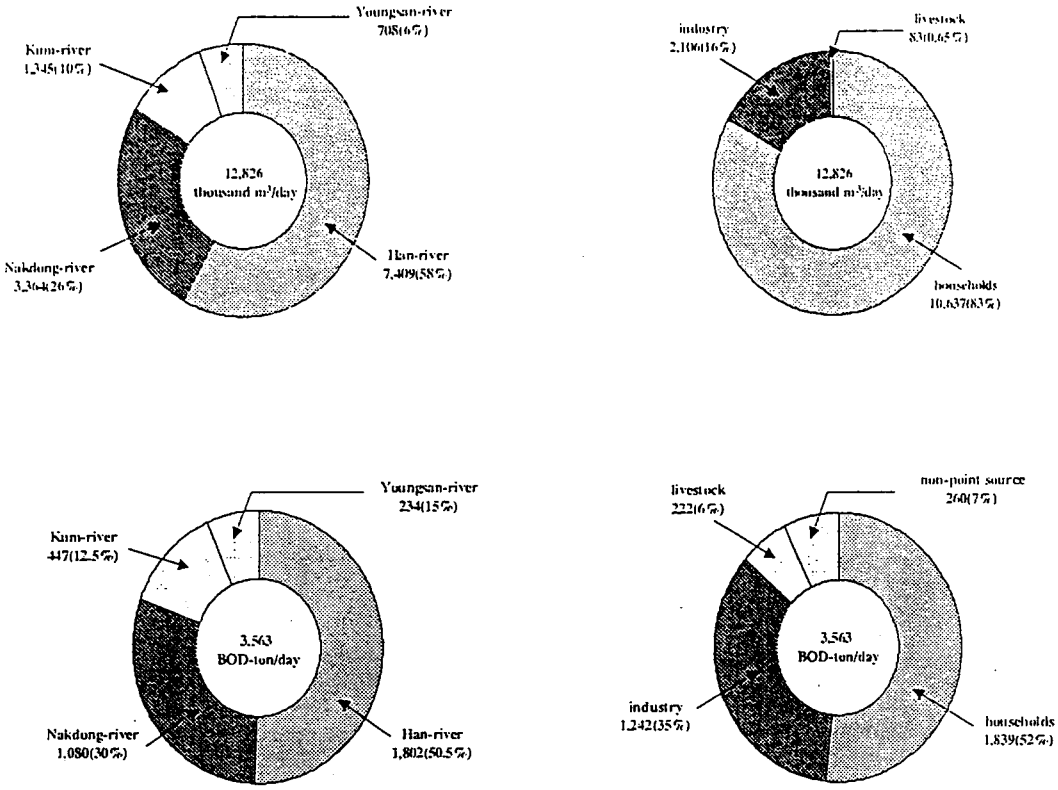
Figure 3 shows the change of mean annual BOD concentrations in four rivers. Since 1990, the water quality in the Paldang Reservoir, supplying drinking water to 20 million people, has been grade II or better. In recent years, the BOD concentration

has increased to 1.5 mg/L, which demonstrates that the old strategy for water management is less effective than it was expected.

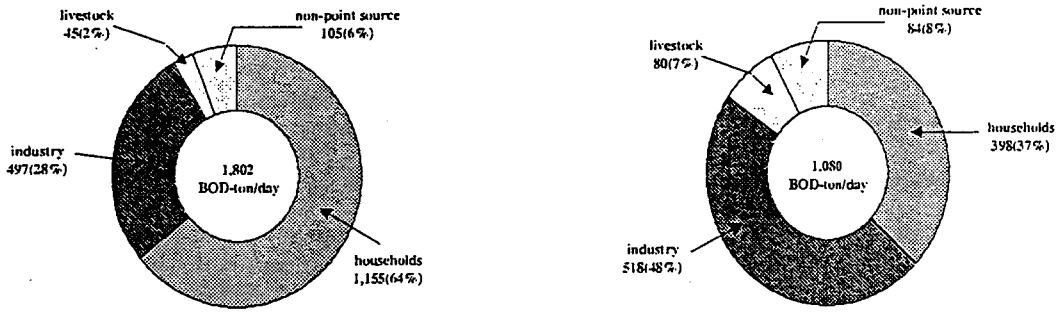
On the other hand, the water quality of the Nakdong River has apparently been improved. The reason is that all the wastewater from Daegu city are adequately treated by the four wastewater treatment facilities. However, for all these efforts, the Nakdong River has shown the worst water quality among drinking water resources.

The water quality in the Geum River is better than that of the Nakdong River. Since 1998, the water quality of Daechung Reservoir has been in Grade I level because water pollution sources such as households and industries have not been placed nearby. Furthermore, it is expected that the total pollution loads to the Daechung Reservoir will not excessively increase in the future.

The Youngsan River is no longer used as the drinking water source of Mokpo city. The pollution level is the highest among the four rivers. It has the shortest length by 136km and the smallest watershed area by 3,371 . In addition, the lack of wastewater treatment facilities and the abundance of pollutant sources such as livestock's excretions and chemicals from agricultural lands exacerbate water quality in this watershed.

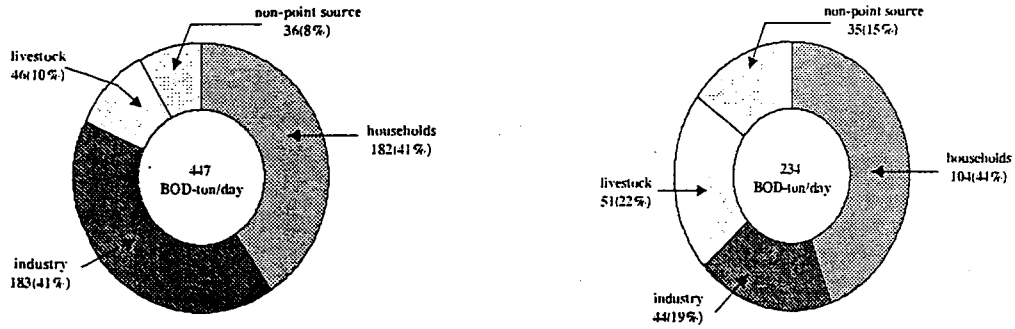


(a) Wastewater generation and BOD loads in 4 major watersheds



(b) Han river BOD loads

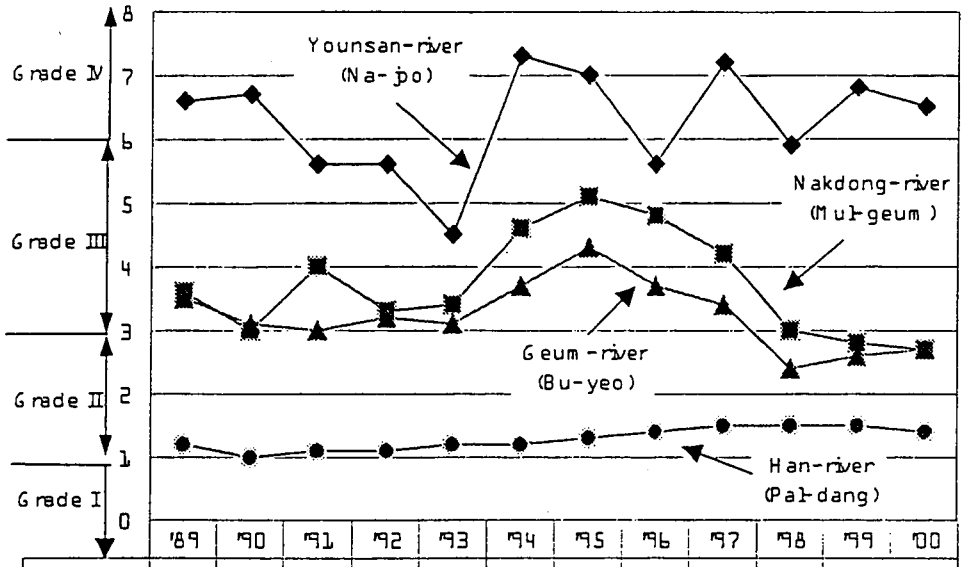
(c) Nakdong river BOD loads



(d) Geum river BOD loads

(e) Youngsan river BOD loads

Figure 2- Wastewater generation and BOD loads in 4 major watersheds in Korea ('97)



	'89	'90	'91	'92	'93	'94	'95	'96	'97	'98	'99	'00
Youngsan	6.6	6.7	5.6	5.6	4.5	7.3	7	5.6	7.2	5.9	6.8	6.5
Nakdong	3.6	3	4	3.3	3.4	4.6	5.1	4.8	4.2	3	2.8	2.7
Keum	3.5	3.1	3	3.2	3.1	3.7	4.3	3.7	3.4	2.4	2.6	2.7
Han	1.2	1	1.1	1.1	1.2	1.2	1.3	1.4	1.5	1.5	1.5	1.4

Note) Grade I : drinking water source I, Grade II : drinking water source II

Grade III : drinking water source III, Grade IV : agricultural water use

Figure 3- Changes in water quality in 4 major rivers

The Korea Ministry of Environment has arranged all the streams into 194 small regions depending on the purpose of water use, and has established the stream standards since 1991. As shown in Table 3, however, only 30% of the overall goals were achieved as of 1998.

Table 3 Achievement status toward the river standard goals in Korea ('98)

Category	Total	I	II	III	IV	V	Percent goal(%)
Total	194(58)	120(32)	49(14)	9(3)	8(6)	8(3)	30
Han-river	52(20)	30(12)	11(4)	3(2)	2(1)	6(1)	38
Nakdong-river	40(12)	32(9)	6(1)	1(1)	-	-	30
Geum-river	38(14)	20(3)	12(6)	1(0)	5(5)	-	37
Youngsan-river	12(1)	5(0)	5(1)	1(0)	1(0)	-	8
Seomjin-river	6(0)	6(0)	-	-	-	-	0
Other	46(11)	27(8)	15(2)	3(0)	-	1(1)	24

Note) ( ): Number of achievement

Since 1990s, Government has invested in environmental facilities intensively. However, it would be impossible to provide a complete solution to the environmental problems in a short period until a great number of treatment facilities are provided so that waste discharges can be treated to the extent necessary to prevent the stream from being contaminated above the established level. As of 1999, 150 sewage treatment plants were in operation. Total capacity amounted to almost 18 million cubic meters per day and a sewage service supply rate was approximately 70%. 128 thousand tons of livestock wastewater were produced daily. About 87%of that were recycled to compost. For the last 4-5 years, lots of restaurants and motels have been built in the upper stream areas, especially around Paldang reservoir, and this has been accelerating water pollution. Additionally, thousands of livestocks broadly distributed in all rural areas have become one of major pollutant sources for the public water supply. Eutrophication is more serious problem in many artificial reservoirs, which requires the reduction of nutrients.

There are two types of regulation tools for emission control; standards for effluents apply to the discharge point at final wastewater treatment plants treating sewage, industrial wastewater, and night soil. Standards for effluent wastewater are set for biochemical oxygen demand (BOD), chemical oxygen demand (COD), suspended solid (SS), total nitrogen (T-N), and total phosphorous (T-P). T-N and T-P were newly applied from 1996. Different levels of standards are applied according to the regional classification such as Clean Region, A Region, B Region, and Special Region. Table 4 shows standards for wastewater of T-N, T-P, BOD, COD and SS. Standards have been stringent and extended continually to keep up with people's elevated expectation for the environment quality.

Table 4 Allowable Standards for Wastewater

Classification of Region		T-N	T-P	Daily Waste Water Discharge					
				(more than 2,000□)			(less than 2,000□)		
				BOD	COD	SS	BOD	COD	SS
		(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)
Clean Region	Maintains water quality standard I designated by the Minister	□ 30	□ 4	□ 30	□ 40	□ 30	□ 40	□ 40	□ 40
Region A	Maintains water quality standard II designated by the Minister	□ 60	□ 8	□ 60	□ 70	□ 60	□ 80	□ 80	□ 80
Region B	Maintains water quality standard □□or□ designated by the Minister	□ 60	□ 8	□ 80	□ 90	□ 80	□ 120	□ 130	□ 120
Special Region	High concentration of industrial complexes, designated by the Minister or Mayor. Alternately, agro-industrial development is planned, designated by the Regional Head.	□ 60	□ 8	□ 30	□ 40	□ 30	□ 30	□ 40	□ 30

Comprehensive Measures for Water Quality Management

The Comprehensive Measures for Water Quality Management of 4 major watersheds comprise subsequent categories of policy measures; pollution prevention measures, pollution reduction measures, water-use charge system, financial subsidies, watershed management system, development of water resources, and water demand control.

A.Pollution Prevention Measures

- The Han River Watershed

In 1990, Korea government fixed the boundaries of the special zone for water quality preservation in 7 cities and counties in Kyunggi Province near Paldang Reservoir, the zones are called "the Paldang Special Measures Zone". In 1999, the area within 1km from the boundaries of the Han River and Kyungan stream within 'Paldang Special Measures Zone' are set the limits for 'Riparian Buffer Zone'. In this area, any new livestock sheds, restaurants, motels, public bath, and factories are prohibited. In addition, the current effluent levels for wastewater (e.g., 20 mg/L for BOD) from the existing restaurants and motels are strengthened (e.g., 10mg/L for BOD). Beyond the Paldang Special Measures Zone, Riparian Buffer Zone is set for the area within 500m from the Han River boundaries, extending to Euiam Dam in the North Han River and

Chungju Dam in the South Han River. In this area, only the facilities satisfying the stringent regulation (e.g., BOD 10mg/L) are allowed for the new building permit. All national and public forest within 5km from the Han River, the Kyungan stream and the origin of stream are designated as 'Reserved Forest'. 'Reserved Forest' can strengthen the function of green dams to retain clean and sufficient water resources.

Korea government has decided to introduce the Total Maximum Daily Loads (TMDL) control system, which controls the total amount of pollution load discharge into the river. Since the water quality of Paldang Reservoir is concerned about deterioration under the current regulations, the allocation of the waste discharge load within the capacity of nature is needed to control overall pollution. In the future, only environmentally sound developments would be allowed under the total load allocation policy.

- The Nakdong River Watershed

The characteristics of the Nakdong River watershed are highly concentrated population and industrial complexes centered at the mid- and upper stream, and lower river flow compared to the other watersheds. Korea government intends to apply the regulation system based on TMDL, gradually from 2003.

Several attempts will be tried for the control of non-point source pollution. Only environment friendly farming, which restricts the use of pesticide and chemical fertilizer, will be allowed in riverside. Installing storage tanks will be installed for the control of run-off pollution from initial rainfalls, which settle down suspended pollutants from non-point sources.

- The Geum and Youngsan River Watersheds

In the Geum River watershed, Riparian Buffer Zone will be specified in the area of 1km from the river boundary in the Daechung Special Measures Zone and 500m in the upper regions. In the Youngsan River watershed, area within 500m from the

boundaries of Juam Reservoir, Dongbok Reservoir, Sangsa Reservoir, Sueo Reservoir, the Bosung, Dongbok, and Yisa streams will be specified as Riparian Buffer Zone. In these areas, standards for effluent wastewater will be strengthened from 20mg/L to 10mg/L for BOD and suspended solids (SS). The TMDL regulation will be applied gradually from city areas to rural areas.

B. Pollution Reduction Measures

- The Han River Watershed

By 2005, a total of 2,639 billion won (2 billion U.S. dollar : the exchange rate is about 1300won per 1 U.S. dollar) will be invested to construct 188 municipal wastewater treatment plants (WWTPs), 12 industrial and livestock WWTPs, and 3,341km sewer pipes. It is expected that wastewater treatment can serve 81.6% of population in this area by 2005. Not only construction of new wastewater facilities but the rehabilitation of current sewer systems will be focused, since the water quality is not improved when the improper sewer system exists.

Composting of livestock waste will be strengthened for the prevention of water pollution from livestock waste, comprising 24% of the total pollution load in this watershed. Small-scale livestock farms will be obligated for installing pollution control facilities such as a separation and storage tank, and Korea government will partially support the expenses for the facilities in order to encourage the participation.

- The Nakdong River Watershed

Korea government plans to invest 4,247 billion won (3.3 billion U.S. dollars) for the construction of 266 municipal WWTPs, 6 industrial WWTPs, and 16 livestock WWTPs by 2005. The wastewater treatment ratio, indicating the percentage of population served by wastewater treatment facilities, will increase from 49.8% in 1997 to 84.4% in 2005. The advanced wastewater treatment technologies capable of

removing nutrients (nitrogen and phosphorus) will be applied to the several WWTPs, which contribute to the prevention of eutrophication of reservoirs and rivers. The standards for the effluent wastewater will be stringent from 20 mg/L for BOD and SS to 10 mg/L. During this period, 4,388km of sewer pipes will also be rehabilitated.

Livestock waste and wastewater accounts for 17% of the total pollution load generated in this watershed. To maximize the waste composting and to minimize its inflow into the river, livestock farms will be obligated to install screens over the waste as well as separation and storage tanks, and government will partially support the expenses.

-The Geum and Youngsan Watersheds

4,226 billion won (3.3 billion U.S. dollar) will be invested for these two watersheds to construct 300 municipal WWTPs, 6 industrial WWTPs, and 8 livestock WWTPs. As a result, it is expected that the treatment ratio will be increased from 62.5% as of 1998 to 74.5%. The existing WWTPs located at the upper stream will be supplemented with the advanced wastewater treatment technologies with the stringent effluent discharge limits (the same as for the Nakdong River). Plans for swage pipe rehabilitation and livestock wastes will be carried out like the other watersheds.

C. Water-Use Charge System

Water-use Charge System is based on a WIN-WIN strategy, which brings mutual benefits to the upper and lower reaches of the river. Applying the "User Pays Principle" instead of the "Beneficiary Pays Principle", all users are charged for their use of water in proportion to the amount used. Citizens of the lower streams will be advantaged from pollution prevention measures, such as strict land use regulations and the TMDL regulation, while residents and local governments of the upper streams will be supported by the fund raised by water-use charge.

- The Han River Watershed

Residents of the metropolitan area receiving water from the water supply sources in the Han River pay water-use charge in addition to the regular charges for tap water. The fund is used in supporting projects for the residents who are disadvantaged by the land use restrictions in the water protection area and around the dams, such as income augmentation, living improvement, education, etc. It also supports the construction and operation of wastewater treatment facilities, and is used to purchase the land within the Riparian Buffer Zone. When first introduced at August 9, 1999, the charge rate was determined to 80 won (6.2 cents) per ton and it has been raised to 110 won (8.5 cents) since January 1, 2001.

- The Nakdong River Watershed

All the residents living in the Nakdong River watershed are to pay for the charge. However, those who are subject to regulations for water resources development and those who damaged by weather changes from dam constructions will be exempted. Considering the water consumption in 1998, if the charge rate is set to 100 won per ton, approximately 100 billion won (77 million dollars) will be funded every year. The Nakdong River Watershed Management Committee, composed of the Minister of Environment, the Vice-minister of Construction and Transportation, three metropolitan city mayors, three provincial governors, and the President of the Korea Water Resources Corporation, will decide on the executive rate later.

D. Financial Subsidies and Watershed Management System

- The Han River Watershed

A total of 2,639 billion won (2 billion dollars) will be invested in the wastewater management of this watershed. Both the federal and local governments will support financially. The Han River Watershed Management Committee was organized and

have all the authorities and responsibilities for the water management. The committee is composed of the Minister of Environment, the Vice-minister of Construction and Transportation, two metropolitan city mayors, three provincial governors, the president of Korea Water Resources Corporation, and the president of Korea Electric Power Corporation. It decides the rate of the water-use charge, and sets up water quality improvement project.

- The Nakdong River Watershed

Approximately 8,457 billion won (6.5 billion dollars) will be invested in the water management of this watershed. In the investment, 4,247 billion won (3.3 billion dollars) will be used for the water pollution reduction and prevention project, and the rest (3.2 billion dollars) for developing water resources. The former project is scheduled to be completed by 2005, and the latter project by 2008. Federal government, local governments and private sectors will finance 77% (6,507.4 billion won), 19% (1,569.4 billion won), and 4% (380.5 billion won) of the total budget, respectively. Some portion on the local governments will be supported by the water-use charge. The Nakdong River Watershed Management Committee will have the authority of consulting and managing.

-The Geum and Youngsan River Watersheds

By 2005, 2,724 billion won (2.1 billion dollars) and 1,502 billion won (1.2 billion dollars) are to be invested in the water quality improvements of the Geum River watershed and the Youngsan River watershed respectively. The Geum River Watershed Management Committee and the Youngsan River Watershed Management Committee will be organized like the Han and Nakdong River watersheds.

E. Development of Water Resources and Control of Water Demand

, The water flow in the Nakdong River is as low as one fourth of the Han River during a dry season despite of the similar basin area for these two watersheds. It indicates that water quality in the Nakdong River is easily affected than in the Han River. In order to enlarge the flow capacity in a dry season, a task force team worked on the measures for enlarging water inflows into the river. These measures include optimization of water resource management of existing dams, control of water demand, development of groundwater, etc.

Many cities near the lower stream of the Nakdong River depend on the surface water for their drinking water resources. Thus, if water pollution accidents occur and water quality is worse during a dry season, this area could have difficulties in supplying safe drinking water. A group of local experts has been organized to develop alternative drinking water resources such as developing bank filtration process, and improve the water treatment facilities applying advanced treatment technologies such as biological pretreatment system.

Federal and local governments is reinforcing the progressive water rate system and stimulate installation of water saving devices, thereby reducing wasteful water use. New large buildings is obligated to install water recycling facilities, and industries is forced to increase the reuse of wastewater. Also, federal government evaluates the administration of water management of local governments annually, and provides incentives to induce better water management and safer drinking water supply.

F. Miscellaneous Strategies

Environmental monitoring systems will be extended, especially for the Han River and the Nakdong River basins. Field education programs will provide valuable opportunities for elementary, junior and senior school students to realize the importance of the environment, and educational institutions for the environmental

protection will be supported.

CONCLUSIONS

The need for innovative approaches to the conservation and proper management of the water environment has been widely recognized. Higher quality water definitely improves the quality of our lives. Therefore, with the blueprint of improving water quality by the year 2005, Korea government has established and propelled the Comprehensive Measures for Water Management. Our final goal of this project is to make 62% of the total streams have Grade I level and 25% Grade II level, and the rest suitable for agricultural use at least.

In the past, the strategy for the water management focused on the sufficient supply of inexpensive water resource. At present, however, we start a new strategy aiming at supplying high quality water at a price including the full production cost. For this goal, we will drive a strong and stringent Water Demand Management Policy.

One of the most important keys to our final goal is the participation and cooperation of the public for the new strategy. It is evident that the discharge of wastewater from one community has an adverse impact upon the degree of water treatment required at lower stream communities. The solution is to compromise with each other, especially relating to the vital issue, 'Clean Water'.

PART II. Water Supply Management Policy in Korea

Background

The average annual precipitation in Korea (1,274mm) is 1.3 times that of the world (974mm). Because of high population density, however, average precipitation per capita of 2,755m3 is only 12.5% of the world average of 22,096m^3. Thus, Korea has not abundant water resources; per capita usable water in Korea is merely 1,470m^3. In 1993, the Population Action Institute (PAI) of the United Nations classified Korea as a water-stressed nation along with South Africa and Libya. The Ministry of Construction and Transportation also expects that Korea will face annual water shortage of 400 million tons starting from 2006 and 2 billion tons from 2011 when no counter-plan is applied.

The amount of water supply per person in Korea reaches 395 liters per day (as of 1998), which is much greater than that of advanced nations. Dam constructions are experiencing difficulties because of increased cost, insufficient number of sites for dam development, and strong opposition from local residents, all of which would result in more serious water shortage.

Under the situation, Korea government decided to change its water resource management policy from the previous supply-oriented approach into demand-management. Comprehensive water saving plan including the installation of water-saving devices and water reuse system, application of a water-saving pricing system, replacement of old pipes, and other water conservation tools are being promoted. It is expected that 2006 can save 790 million tons, which are 13.5% of the total water production (5.8 billion tons in 1998). When these water-saving goals are met, it is estimated that a roughly 400 billion won (308 million dollars) in water production cost and 80 billion won (62 million dollars) reduction in sewage treatment costs can be saved.

Basic Objectives for National Water Conservation

The government will drive 15 policy tasks as part of the comprehensive water conservation measures. When the objectives are met, it will bring greater benefits than building dams, which is equivalent to supply 350 million tons of water annually. The goals and scope of the project are listed in the Table 5.

In order to achieve these goals, Korea government will compare and evaluate monthly the results of water-saving efforts, such as water production of each water supplier, water usage by industry, and per capita water usage. Government also strengthen the monitoring of the progress and providing with consulting services.

Table 5 Water Conservation Goals by Policy Task

Category		Scale of Projects	Conservation Goals (1,000tons/year)
Total		-	790,000
Installation of Water-saving Devices	Subtotal	-	290,000
	Residences	11,63 million households	250,000
	Businesses and Others	11,500 businesses	40,000
Improvement of Water Pricing System		Due for improvement by 2001	200,000
Replacement of Old Water Pipes		27,000 km	240,000
Installation of Water Reuse System		300 units	30,000
Reuse of Water by Industries		Conserving 10% of industrial water	30,000

Introduction of Demand Management Goal System by Water Suppliers and Public Institutions

The government forces public water works to lead the water-conservation efforts so that all residents can become more aware of the need to save water. The Water Service Law was amended this year to allow mayors and governors to set up five-year comprehensive plans on demand management; these will include water demand management, reduction of yearly leakage, and water-saving device distribution. These plans will be carried out with approval from the Minister of Environment.

Mayors and county headman is in charge of detailed action plans. In addition, central administrative offices, autonomous local government offices, local public institutions,

educational organizations, and other public organizations will participate in the project to cut 15% in water usage by following Water Conservation Guidelines for Public Organizations.

Installation of Water-Saving Devices in Houses and Buildings

To save water demand, new buildings have been required to install water-saving toilets since March 1998, and water-saving faucets and showers from January 2000. While existing buildings are exempt from this requirement, water-saving devices are provided free of charge. Up until 2004, 76.7 billion won (59 million dollars) will be invested in the installation of water-saving devices in 11.63 million Korean households. Businesses with high water use, such as hotels, public baths, and golf courses, are required to install water-saving toilets, faucets, and shower heads in compliance with the Water Service Law. Certification is given to high-performance water-saving devices to encourage their adoption.

Table 6 Yearly Investment Plan

(in ten thousand households, hundred million won)

Category		Total	1999	2000	2001	2002-2004
Total	Number of Households	1,163	55	242	223	643
	Budget	767	25	153	148	441
Water-Saving Devices for Toilets	Number of Households	470	39	128	85	218
	Budget	282	17	74	51	140
Water-Saving Devices for Water Foucets	Number of Households	693	16	114	138	425
	Budget	485	8	79	97	301

A New Water Pricing System

Water charges in Korea are set at a very low level, representing only 70% of the production cost. Such a lower water charge rate induces waste of water, hinders the spread of water-saving devices, and exacerbates the financial difficulties of local governments.

Moreover, it delays improvements of pipes and treatment plants, which results in the inefficiencies of water supply and deterioration of water quality. Therefore, government considers the charge rate system so that people who use more water will have to pay more. In addition, a seasonal pricing system will be introduced which will impose additional charges during the summer months when water use is at its peak. A water rate calculation model will be developed which will include all costs related to water supply at the time of cost calculation for water production.

Water services will either be privatized or consigned to private businesses so that water works will voluntarily pursue water conservation, downsizing, and reasonable water charge rates.

Increased Installation of Water Reuse System

Since 1991, government recommended large buildings install water reuse system for water saving. However, higher cost of installation and operation inhibit full implementation of the policy. The government is thus planning to mandate all new buildings using large amount of water to install water reuse system.

In addition to the mandatory requirement of installing water reuse system for large new buildings, several economic incentives are being introduced, such as installation financing, tax benefits, and discount on water charge in order to encourage adoption of water reuse systems.

Table 7 Mandated Buildings for Installing Water Reuse System

Category	Scale Specification
Large hotels and department stores	Building area of more than 60,000 m^2 (400-500 rooms)
Factories	Waste water discharge rate of more than 1,500 tons a day (all type 1 Businesses, some type ^{2} businesses)
Other buildings	Buidling area of more than 60,000 m^2 to 70,000 m^2

Table 8 Incentives to Water Reuse System

Category	Current	Improved Plan
Tax Deduction on Installation Cost	5%	Maintain current rate
Installation financing	None	2 billion won per unit
Water Rate Discount	10-65%	50-70%
Discount on Sewage Producer Surcharge	None	50% of faculty capacity
Environment Improvement Discount	None	25% discount

Replacement of Deteriorated Water Pipes and Improving Water Provision

Due to inefficiencies in water pipe networks and management, the water leakage as of 1998 reached a national average of 18.1%, indicating around 20% of treated water is wasted. In 1998, about 1 billion tons of water was wasted, causing approximately 500 billion won (0.4 billion dollars) in financial losses. Insensitive water meters that fall short of measurement standards or that have an incorrect diameter have failed to detect 540 million tons of water in 1998, resulting in about 270 billion won (0.2 billion dollars) in losses for water suppliers.

Thus, government initiated the inspection of old pipes and has begun to replace those pipes. About 3.1 trillion won (2.4 billion dollars) will be invested in replacing 36,000 kilometers of old pipes from 2000 to 2011. It is expected that the project would improve the leakage rate from 18% (1998) to 12% (2011). Federal government is financing 50% of the total cost to local governments with lower interest.

For better prevention and detection of water leakage, the block system will be introduced. This system divides the drainage area into blocks, each of which includes a local meter system. The map of the distribution system will be updated, and geological information system (GIS) will be implemented for efficient management of distribution system. Pumps and valves will be installed to maintain proper water pressure and tonnage, taking a more scientific approach to installation and management of water pipes and steadily reducing leakage. Up until now, users paid for the leakage but from now on water works will pay a certain portion of the cost, which will encourage the water providers in leakage reduction.

All water meters in Korea are scheduled for inspection and inadequate meters will be either repaired or replaced gradually, and the percentage of inaccurate meters will be reduced gradually.

Table 9 Yearly Investment Plan

Category	Total	1997-1999	2000	2001-2011
Project Cost (in hundred million won)	38,319	6,866	2,374	29,079
Old pipes (km)	42,757	6,942	2,585	33,230
Number of Water Collection and Purification Facility	2,124	368	74	1,681

Sewage and Wastewater Reuse

Sewage and wastewater are reliable sources of water in times of shortage because it has steady effluent discharge even at a dry season. Government will intensify the obligation and incentives to reuse wastewater; inducing more widespread reuse of sewage and wastewater. If only 5% of the sewage treatment water can be used, about 320 million tons of water could be supplied to the entire nation, surpassing the comparable water supply of one large-scale dam.

According to the amendment of the Sewage Service Act, new wastewater treatment plants will be required to adopt proper tools for using wastewater effluents. If the plant fails to follow the requirements, forceful means such as the discontinuation of subsidy on local grants-in-aid will be imposed. Moreover, local grants-in-aid on sewage treatment water reuse plants, including highly-advanced treatment facilities, discharge pipes, and treated water pipes, and buffer tanks, will be subsidized to ease the burden to establish the reuse system for wastewater.

Utilization of Rainwater and Subway Pumping Wells

Korea government also plans to use rainwater and subway pumping wells in order to use water more efficiently. Stadiums with capacity over 5,000 seats, baseball parks,

and gymnasiums are appropriate for rainwater use because the facilities are not used very often and have large surface areas for collecting rainwater. The Water Service Law mandates these facilities to install rainwater use system. Rain water use systems are installing in six World Cup stadiums (Seoul, Incheon, Daejeon, Suwon, Jeonju, Seogwipo).

In addition, separate pipes for the use of subway pumping wells will be established with consultation of the subway management agencies in Seoul, Busan, Daegu, and Incheon. Water collected in the subway stations can be used for cleaning the stations, flushing the toilets, and maintaining the water level of small streams around subway stations.

Water Conservation and Supply Measures for Drought Areas

Even though cities are fully served by water supply, water supply are limited to the rural area and islands; only 25% and 15% of population for rural areas and islands are served. Government will invest 315 billion won (240 million dollars) through 2003 to complete the 24 projects providing alternative water supply system in the drought areas. Furthermore, drought areas has a priority in budget subsidies when implementing water demand management projects, such as installation of water-saving devices and replacement of old water pipes.

Table 10 Status of Water Supply Projects in Drought Areas

Category	Total	Completed in 2000	Completion in 2001	2002-2003
Total	24	9	9	6
Water Supply System in Rural and Fishing Villages	11	4	5	2
Water Supply System in Small and Medium Cities	6	1	2	3
Development of Drinking Water Sources on Islands	7	4	2	1

Promotion of Water-Saving Technology Development

Water saving technology is not yet highly developed since there is no incentive to save water due to lower water charge rate. More frequent meter checks, mandated installation of water-saving devices, and extension of water reuse systems are expected to increase the demand for water saving technology.

Development of a Water-Saving Education Program

Water saving is directly related to the concern and ethics of people across society. It is necessary for people to provide continuous educational programs. Water shortage, its causes, and water-saving activities need to be included in school curriculum. The development and widespread adoption of such programs will promote people to participate in the water-saving movement. Furthermore, with cooperation of local environment offices, the National Water Resources Corporation, and other related organizations, regional water tours can be developed. Regional celebrities, civil groups, teachers, and students can be invited to join the tour. Meanwhile, social education program is further expanded to encourage the participation of citizens in the on-site environmental education program.

At the same time, a public campaign is steadily held through the media (TV, newspaper), billboards and posters, and brochures. It is helpful that a variety of educational and publishing materials are offered to producers, writers of media programs.

Operation of a Water-Saving Campaign Web Site

Korea government opened a water conservation website (www.water21.me.go.kr) through internet. Many internet users have already visited the site and responded very positively.

Evaluation of Water Management and Provision of Incentives by Local Governments

Local communities tend to place priority on investing in visible projects, such as construction of roads, sports centers, or community centers. A number of local governments would not pay enough attention to environment improvement projects such as replacing old water and sewage pipes, or the operation of wastewater management systems. There was a gap between policies and actual implementation, increasing people's distrust of water management policy. Evaluation and announcement for local governments are one of the effective tools to encourage the participation of local governments to the environmental issues. Organizations with outstanding records will receive incentives and rewards, such as preferential support for water and sewage project costs. Evaluations are conducted on several items in four areas of water management, including management of water demand, management of water and sewage operation, water quality improvement, and regulation of businesses that discharge waste water. The evaluation committee is comprised of members from both private and public groups to secure fairness and objectivity.

Launching a Nationwide Water Conservation Campaign

Since water conservation is directly related to the changes in people's behavior, government efforts alone are limited. Private environmental and religious groups, professional organizations, schools, and both central and local governments need to be involved in establishing the nationwide water conservation campaign and educating the public. On February 16, 2000, fifty-two organizations, including private environmental and religious groups, professional organizations, and an association of businesses with high water use, formed the nationwide water conservation campaign headquarters, and started to produce and distribute publication booklets and posters on water conservation. In addition, the headquarters held a contest for children's cartoon

with a water conservation theme, and advertised water conservation campaign in newspapers. Other activities include operating of a water conservation web site, holding related seminars and conferences, and conferring environmental marks to outstanding water-saving devices.

МИНИСТЕРСТВО ПРИРОДНЫХ РЕСУРСОВ РОССИЙСКОЙ ФЕДЕРАЦИИ

Water Environment Management in Russian Federation

Sergey Bednaruk
Ministry of Natural Resources of Russian Federation

Water Quality Management

2

Water Quality Problem

- antropogeneous loading on many river basins in Russian Federation comes nearer to critical value
- rehabilitation and preservation of water quality in a condition adequate sanitary and ecological requirements, is one of the basic purposes of the water legislation of Russian Federation

3

Water Quality Standards: Maximum Allowable Harmful Impacts (MAHI)

established proceeding from:

- maximum allowable level of antropogeneous loading, longtime influence of which will not result in degradation of water ecosystems
- maximum allowable mass of harmful substances, which water body and its watershed can assimilate

4

Factors of the Maximum Allowable Antropogeneous Influences

- **sources of influence**
- **area of influence**
- **magnitude of influence**
- **duration and periodicity of influence**

5

Maximum Allowable Dumps (MAD) of harmful substances

established proceeding from Maximum Allowable Concentration (MAC) considering:

- **background concentration**
- **assimilating capacity of water body**
- **purposes of this water body usage**

on the basis of strict satisfaction to established MAHI standards for the water basin

6

Maximum Allowable Concentration of harmful substances

- national standards
- regional standards
- depends on target use of water body (for potable water, for fishery etc.)
- water quality standards, based on a "MAC-MAD principle", is not sufficiently effective

7

General Water Resources Management Problems

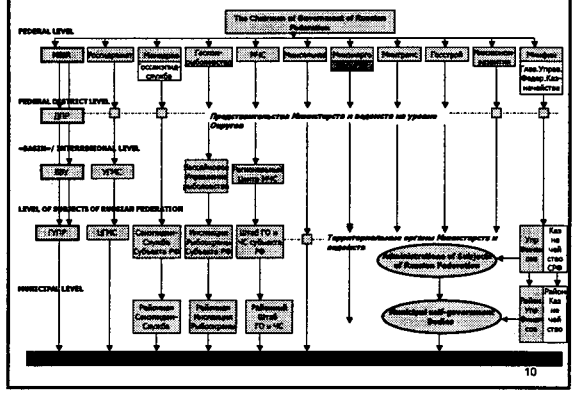
8

Problems of state water resources management

- Distribution of water resources management rights between economy sectors and government departments without consideration of the contradictions and interrelations between the public, economic purposes and tasks of protection of an environment;
- The issues of quantity and quality of waters, and of a condition of an environment are considered separately;
- The administrative regions have jurisdiction above water resources in their territories – the same water source is used without consideration of influence on other regions;
- The ongoing practice of water resources management does not take into account connections between quality of water and health of the population, environment and economic development;
- Water frequently is not considered as economic value.

9

Structure of water resources management in Russian Federation



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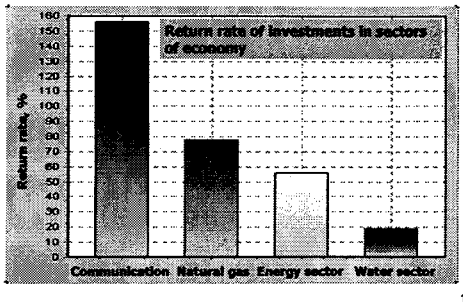
Problems of state water resources management



11

Legal bases of water resources management

12

According to clause 72 of the Constitution of Russian Federation, issues of possession, usage and management of water resources are in joint conducting of Russian Federation and subjects of Russian Federation.

The usage and protection of water resources are regulated by the:

- **Water code (1995)**
- **Other Federal laws**
- **Decisions of Government of Russian Federation**
- **Laws and decisions of bodies of state authority of the subjects of Russian Federation.**

13

The property on water bodies

State ownership on water bodies (item 34, Water Code)

Division of a state ownership into the federal property and property of the subjects of Russian Federation (items 33, 36, 37, Water Code)

DIRECTIVE 2000/60/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 23 October 2000 establishing a framework for Community action in the field of water policy: Water is not a commercial product like any other but, rather, a heritage which must be protected, defended and treated as such.

14

Payments for water use

- Payments for water use in Russian Federation is established by an item 122 of Water Code. In item 123 it is specified, that the system of payments connected to usage of water bodies includes:
  - Payment for usage by water bodies (water tax);
  - Payment allocated on restoration and protection of water bodies.
- Projects on water restoration and protection were financed in 1999-2001 less than on 15 % from a minimally required level.
- The tendency of complete refusal from a principle « water should pay water ».

15

Conclusions from the analysis water legislation and the practice of water resources management

16

Inexpediency of division of state property on water bodies on federal and subjects of Russian Federation.

Necessity of introduction of joint water resources management on the basis of the principles:

- **Satisfaction of the public requirements;**
- **The consent of the consumers;**
- **Solidarity of the partners.**

The distribution of powers, rights and duties between bodies of state authority, municipal self-government and consumers in the field of management, use and protection of water resources requires essential legislative and normative completion.

Establishing of a system of joint water resources management through a number of consecutive measures:
- **organizational;**
- **legislative;**
- **normative.**

The targets:

- **decentralization of management;**
- **formation of public institutes for water resources management on a basin level;**
- **involving in decision making on use and protection of water bodies municipal formations, water users and public.**

18

Principles of the state water resources management :

Consideration of the geographical characteristics of large river basins, as " water does not know administrative borders ";

System approaches meeting all requirements of water users and preserving water ecosystems;

Partnership and co-ordination of actions among state bodies and organizations and persons engaged in development of water projects. This role should be allocated to basin water councils;

Mobilization of financial resources received from a payment for use of water and its pollution to protection of water bodies according to a principle " water should pay water ";

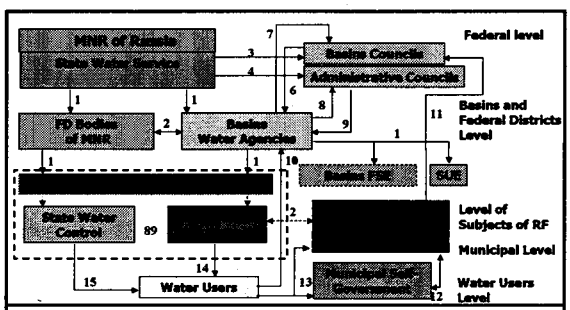
Long-term planning.

19

Directions of legislation development

- The amendments in WC – refusal of division of a state ownership into water bodies on federal property and property of the subjects of Federation (item 33, 36, 37); the appropriate updating of other clauses (item 87);
- The amendments to an item 120 WC - giving to Water Basins councils some functions of state management;
- Updating of unit 12 WC « Economic regulation of use, restoration and protection of water resources » (items 121-128);
- Development and adoption of Federal Laws « On Basin management of a water resources », « On Basin Water councils », « On financial bases of basin management of a water resources ».

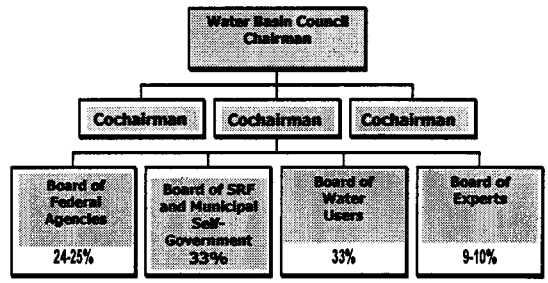
20



1. Submission
2. Information interaction
3. Formation of board of the state and participation in formation of board of the experts
4. Assignment of the Head of Administrative council
5. Formation of administrative council
6. Adoption of the plans, programs, of the tariffs on water
7. Proposals of plans, programs, water tariffs
8. Proposals on projects
9. Adoption of projects
10. Payments for water use and pollution
11. Formation of board of SRF and board of water users, participation in formation of board of experts
12. Participation in formation of board of SRF
13. Participation in formation of board of water users
14. The licenses (limits, target parameters)
15. State Water Control

21

Proposed structure of Water Basin Council



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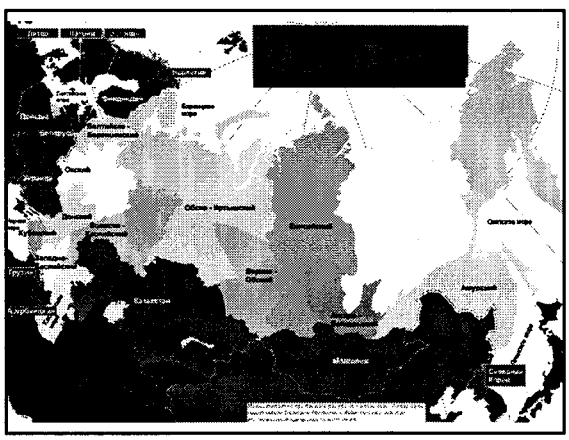

The first step is not made yet, and you already at the purpose.
The mouth is not open yet, and all is told.
And brighter then the lightning there should be a flare of mind,
That it would be possible to see, whence to leave for a way.

Eckay on a nickname Mumon.
« A Door without a door »
1228.

24

МИНИСТЕРСТВО ПРИРОДНЫХ РЕСУРСОВ РОССИЙСКОЙ ФЕДЕРАЦИИ

MAJOR ISSUES OF THE ENVIRONMENTAL POLICY IN THE RUSSIAN FEDERATION

The 11th Northeast Conference on Environmental Cooperation
December 5-6, 2002
Bo'ao City, Qionghai, Hainan Province
CHINA

Bednaruk Sergey
Head of Water Management Department
Ministry of Natural Resources of Russia

1

Environmental trends in Russia

- steady decline of pollutant emission and wastewater discharge in 1990's
- since 2000 as the economic growth has started the environmental impact has increased
- still natural resources and energy consuming economy type

2

Environmental legislation

- new Federal Law "On Environmental Protection" (January, 2002)
- legislative acts on environmental insurance, environmental certification, etc.
- drafts of new Federal Laws: Water Code, Forest Code and Mineral Resources Code

3

Environmental Doctrine of Russia

- Conservation and rehabilitation of natural ecosystems
- Sustainable use and an equal access to natural resources
- Provision of favourable environment for well-being and high standards of living for the Nation

4

State System of Environmental Management

United Ministry of Natural Resources:

- State Environmental Protection Service
- State Water Service
- State Forestry Service
- State Geological Service
- State Service of the Natural Resources Usage and Environment Protection Control

5

State System of Environmental Management

Regional Bodies of the Ministry of Natural Resources:

- District Departments of State Control of the Natural Resources Usage and Environment Protection (7)
- Water Basins Agencies (16)
- Departments of Natural Resources for Subjects of Russian Federation (89)

6

Recent Activities of MNR of Russia

- Concept of the National Plan of Actions "Water of Russia – XXI Centaury"
- National Strategy and National Plan of Actions on Biodiversity Conservation
- Environmental Program for the Baikal Lake Region
- System of specially protected natural areas

7

Specially Protected Natural Areas

- state natural reserves, national parks, state natural monuments, natural parks - total area 136,6 mln.ha - 8% of the national territory
- 1991-2002 - number of reserves increased from 75 to 100, their territory from 20 to 33 mln.ha (by 65%)
- 1991-2002 - number of national parks increased from 17 to 35, their territory – by 90%

8

Cooperation in North Eastern Asia

- Transboundary reserves: "Lake Xingkai-Khanka Lake"; "Daurskiy-Dalainuur-Daguur"
- Baikal Lake problem
- Amur River problem – International Conference on water protection in NEA (Khabarovsk, May 26-30, 2003)
- Kyoto Protocol – Russia reduced greenhouse gas emissions by 1/3

9

Commitment for Development of Cooperation in North Eastern Asia

- Bilateral cooperation
- International Conference on the Climate Change (autumn, 2003) – initiative of the President of Russian Federation
- 7th Intergovernmental Meeting on the NOWPAP program (Vladivostok, March 20-22, 2002)
- Conference of Senior Officials on Environmental Cooperation in NEA

10

THANK YOU!

11