

Analysis of water privatization scenarios in Korea with multi-criteria decision-making techniques

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ABSTRACT

This study introduces three scenarios for water privatization in Korea and analyses them with multi-criteria decision-making techniques. The three scenarios are developed to provide the general directions in which the current Korean water industry is to be privatized. They are thus formulated on the basis of the current situation of the Korean water industry and foreign examples of privatization. The scenarios are called the British model, the French model and a mixed model since the first and second models are similar to the privatization processes that took place in the United Kingdom and France. In applying multi-criteria decision-making techniques for comparison of the three scenarios, this study classifies decision makers into four groups: the central government, local governments, consumers and employees of the water industry. Each group evaluates the scenarios with 25 criteria and the evaluation results of each group are compared. The analysis results indicate that the mixed model is the most favoured by all the groups. And it is also indicated that the most important factors for the success of privatization include strong commitment of and implementation by the central government and development of more programmes to induce more active participation of local governments and employees. Among the four groups, central government is found to favour privatization the most while the employees favour it least. In addition, this study proves that the multi-criteria decision-making techniques can be useful tools for analysing water management issues that are highly debated among various social groups and for providing a sound basis for compromise.

Key words | multi-criteria decision making, MCDM, privatization, water industry, water management

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INTRODUCTION

Water management and multi-criteria decision making

Water management generally involves many factors, qualitative and quantitative, tangible and intangible. Many interest groups are also involved in the water policy-making processes, especially those that deal with water resources development and conservation. As a consequence, it is not easy, and in many cases it can be complicated to resolve water problems, satisfying all groups involved. Among many analytical techniques recently introduced to mitigate such a difficulty in the field of water management, multi-criteria decision-making (MCDM) techniques are those which utilize many criteria, even

contrasting with each other, to find the best decision. The techniques have successfully been applied for the development of water management plans in a number of river basins (Gershon and Duckstein 1983; Ko *et al.* 1994; Raju and Pillai 1999a). To develop a strategic water management plan, Stewart and Scott (1995) also proposed a group decision-making method which is based on the principle of MCDM. They applied an MCDM technique to evaluate a number of scenarios to be included in a regional water management plan in South Africa. Netto *et al.* (1996) applied an MCDM technique to develop a long-term water supply plan which involves many interest groups. It is a regional development plan in the south-western part of

France to develop more water resources. They set a model that consists of four actor groups, 13 criteria and 38 alternatives, to determine the location of a large reservoir in the plan. They reduced the number of alternatives to eight by using the ELECTRE III technique and then expanded the ELECTRE III to simulate the multi-actor multi-criterion decision process.

Özelkan and Duckstein (1996) compared five MCDM techniques with an example water management project in the Austrian part of the Danube River Basin. Five MCDM techniques were used with 12 alternatives and 33 criteria:

1. Preference ranking organization method for enrichment evaluations (PROMETHEE-I, II)
2. Geometrical analysis for interactive assistance (GAIA)
3. Multi-criterion Q-analysis (MCQA-I, II, III)
4. Compromise programming (CP)
5. Cooperative game theory (CGT)

The criteria were rooted mainly in economic, ecological and sociological aspects. The alternatives included construction of a hydroelectric power plant as well as development of a national park. Raju and Pillai (1999a) used and compared five MCDM techniques to determine the optimum location of a reservoir for the development of the Chaliyer River Basin in India. The MCDM techniques were: ELECTRE-2 (ELimination and (Et) Choice Translating Reality), PROMETHEE-2, Analytic Hierachy Process (AHP), Compromise Programming (CP) and EXPROM-2 (Extension of PROMETHEE-2 in distance-based environment). Compromise Programming was found to be the best in this case. In another report, they used the Multi Attribute Utility Theory (MAUT) and a stochastic extension of PROMETHEE-2 (STORM-2) to find an optimum alternative in the performance evaluation of an irrigation system (Raju and Pillai 1999b).

Generally speaking, even if the MCDM techniques are successfully applied in the above examples, some difficulties in their application for water management are known to include: formulation of practicable scenarios, selection of criteria to evaluate the scenarios, and determination of preference levels of various interest groups involved. In

addition, as the proper reflection of the conflicts among many interest groups in the analysis of water management problems becomes more important, the application of MCDM techniques has gained more attention in the field of water management in recent years.

As in many other developing countries, the central government has led the development of water management policies in Korea. This, however, is rapidly changing due to the introduction of the local autonomy systems and other liberalization policies, which have resulted in many interest groups actively participating in various water management issues and policies. A typical example is the disagreement among many interest groups, including the residents upstream and downstream of the Han River, over a proposal for conserving the only water supply source in the Han river to the Seoul-Kyunggi Megalopolis area. During the public hearing process, the original proposal prepared by experts has been significantly changed by the interest groups, although the environmental validity of the proposal was widely approved by the public and most experts. As many people worry over this kind of occurrence in the field of water management, there arises an acute need to develop methodology to evaluate water management issues with socio-economical, technological and environmental soundness.

Water privatization in Korea has become a 'hot' issue about which many interest groups have started to show their opinions. Severe conflict has already developed among them. Indeed, confusion over the issue is rampant. There is a need to look closely at the issue using more scientific and quantitative methods and then to give interest groups and others a more defined understanding of water privatization. In response to the need, this study is designed to review and analyse some topics in water privatization in Korea as follows. Firstly, the current status of privatization is introduced. Secondly, three water privatization scenarios are developed which are being considered at this time in Korea. At the same time, some relevant issues are discussed in depth. Thirdly, the three scenarios are analysed with MCDM techniques. This is to evaluate the scenarios on the basis of selected criteria reflecting the opinions of various interest groups and to recommend the best scenario for water privatization in Korea.

Table 1 | Typical features of water supply (Ministry of Environment 1998)

Water tariff (won* ton ⁻¹)	Water production cost (won ton ⁻¹)	Cost recovery (%)	Water supply (l per capita day ⁻¹)	Water supply coverage (%)	Lost and unaccounted- for water (%)
316	434	72.8	409	84.5	28.2

*1300 won=US\$1.00.

Table 2 | Financial status of the entire water supply authorities (Ministry of Environment 1999)

Revenue and debts (1997)	Billion won	%	Annual expenditure (1997)	Billion won	%
Water tariff	1,365.6	32.5	Construction	3,775.7	36.2
Capitals etc.	1,709.4	40.6	Maintenance	2,733.3	25.9
Revenue Subsidiary	430.9	10.2	Repayment	396.2	9.2
Bond government	600.6	16.6	Others	28.7	699.6
Total	4,205.6	100	Total	4,205.6	100
Amount of debt	3,762.8	89.5			

Current status of water privatization in Korea

Two main needs are driving water privatization in Korea. One is from outside the water industry, the other is from inside. Due to the recent financial crisis, the national economy is going through strong reformation. Privatization is a means of such reformation and many industries are undergoing privatization. The water industry is one of them. The central government has developed plans to privatize two national water companies, KOWACO (Korea Water Resources Corporation) which is in charge of regional water supply and EMC (Environmental Management Corporation) in charge of wastewater management. And local governments are also trying to privatize their own water works according to the recommendations and plans of the central government.

The inside need includes many factors, including the chronic financial deficit. Table 1 shows some features of water supply in Korea. The national average water tariff was 316 won t⁻¹ at the end of 1997 while the national

average production cost was 434 won t⁻¹. This indicates that the cost recovery through the water tariff was only 72.8%. This low tariff set by the government is the most important reason for the deficit. In addition, the high percentage of lost and unaccounted for water of 28.2% is another reason.

As shown in Table 2, the total deficit of all the national and local water enterprises, having increased every year, amounted to 3.762 trillion won (= US\$34.2 billion) at the end of 1997. During one period of 1997, it reportedly went up 502 billion won. The water tariff income in 1997 was only 32.5% of the total annual income. This did not compensate even for the costs of operation and maintenance and the payments of principal and interest, which were 35.1% of the total annual expenditure. As such, the insufficient water tariff is the main cause of such a huge deficit. In addition, this deficit prohibits the water systems from being properly renewed and expanded at the right time and makes the water industry dependent on governmental support.

Table 3 | MOE's privatization plan for the water industry

Stage 1 (1998–1999)	Stage 2 (2000)	Stage 3 (2002)
Provide basis for allowing private participation: modify the water act	Implement case projects of privatization	Open water market to foreign investors

Other inside problems noted include the ineffectiveness of management, lack of employees' expertise and aged equipment. Apart from the national water corporations, KOWACO and EMC, most of the water works, especially those owned and operated by small local governments, suffer from such problems.

One way to mitigate these problems is the privatization of the water industry. An example of water privatization can be found in the comprehensive 10-year plan of the Ministry of Environment (MOE) for the national water treatment facilities, which was announced in June 1998. In the case of the wastewater management field, many local governments have already entered into contracts with private companies for construction and operation of their wastewater treatment plants. Restructuring of KOWACO and other water-related public enterprises, as part of privatization of public enterprises by the government, can also be identified as an example of privatization of the water industry in a broad context. KOWACO, which owns and manages 10.2% of the water treatment works in Korea and 47% of the regional water supply systems from multi-purpose dams, has already put privatization of its water treatment facilities on the list of its restructuring schedule, independent of the MOE's privatization policy.

Since 1997, MOE has prepared a plan, shown in Table 3, for raising private interest and investment for the basic environmental facilities including water and wastewater treatment facilities. According to the plan, MOE has already changed the Water Act to allow participation of the private sector in the water business in 1999 and started to lease some water-related facilities in 2000. Furthermore, MOE wants to open the water market to

foreign investors by 2002. From the implementation of the plan MOE expects:

1. Reduction of the financial burden on the central government.
2. Elimination of the need for recruiting new local governmental officials.
3. Improvement in environmental pollution prevention.
4. Improved technological and management efficiency of the existing facilities.
5. Increased competitiveness in the water industry leading to technological and management innovation.

Aware that private participants have not yet received enough encouragement, MOE prepared some rules, as shown in Table 4, to stimulate them. Major rules are as follows. The central government announced plans to maintain the current level of subsidy, which is provided to local governments for water facilities, to private participants. To secure the profit of private investors, auxiliary business is allowed. Local governments continue to collect water tariffs after privatization for the private investor.

Now, many local governments are evaluating the possibility of privatization of their own water and wastewater systems, and some of them have already started to lease part of their systems to private companies. In addition, KOWACO prepared its own privatization plan and began to carry it out. International water companies, including the Vivendi group from France, are also trying to enter the Korean market by forming a joint venture with Korean private companies (Park 1999). Generally speaking, however, many local governments are still seeking for

Table 4 | MOE's basic rules for supporting private investors

Items	Rules for supporting private participants
Subvention from the Central Government	Give the current level of the central government's subsidy to private participant instead of local governments For the mid and long term, adjust the amount of subsidy according to the results of cost reduction effort
Auxiliary business	Accept suggestions regarding auxiliary business from private investor as much as possible
Rental fee of government facilities	Set fee through negotiation between local government and private investor on the basis of the current level of fee
Collection of water tariff	Local governments continue to collect water tariff after privatization for private investor
Provision of land	MOE or local governments provide lands for the necessary facilities, if possible, or intermediate purchase of them

and weighting ways of privatization and have not moved as fast as the central government expects. As a result, Kim and Yoo (1998) came to suggest that the central government must deliver more financial support, and technical re-education of the employees of the local water works to accelerate privatization in the local water services.

MULTI-CRITERIA DECISION-MAKING TECHNIQUES

Multi-criteria decision making (MCDM)

In general, MCDM is divided into two categories, multi-objective decision making (MODM) and multi-attribute decision making (MADM). MODM is a method to select an alternative that satisfies given objectives from a set of finite alternatives defined by constraints. There are two approaches in MODM, linear programming and goal programming. MADM, which is adopted in this study, is a method to select an alternative best fit to the given conditions or to determine ranks among a number of

alternatives. Basic terminology used in MADM is listed in Table 5.

Generally, MADM can be represented as follows:

$$\max \{u_1(a), \dots, u_n(a) \mid a \in A\} \quad (1)$$

where A is action space and $u = A \rightarrow R^N$ is the criterion function differentiating the possible actions.

If there are m alternatives and n criteria, each element of evaluation matrix E (n, m) can be represented as $u_n(a_m)$. Each element must be specified in verbal or ordinal or cardinal value. The evaluation matrix has to be converted to payoff matrix to be objectively and quantitatively compared. The best alternative is chosen from this result.

There are many MADM techniques, including weighted sum method (WSM), weighted product method (WPM) and analytic hierarchy method (AHP). Among them, the weighted sum method, used in this study, is the most widely used, in which the decision maker must assign a weight to each element. The rated values for individual elements must be converted, by element transformation and normalization, to be compared with each other. If the

Table 5 | Basic terminology in MADM

Criterion	Criterion is an index of effectiveness and becomes a base of evaluation. In practice, criterion is expressed in the form of an attribute or an objective
Goal	Goal is an a priori value or a level which the decision maker wants to reach
Attribute	A characteristic or quality of an alternative, which is used to evaluate the extent of the closeness to the objective
Objective	The ultimate goal or level of satisfaction that the decision maker pursues. In general, an objective is composed of several attributes
Decision matrix (Pay-off matrix)	A MADM problem can be expressed in the form of a matrix. In $m \times n$ decision matrix, D_{ij} represents the evaluation result of i th alternative, A_i , with respect to j th attribute, X_j

weights are given as $W = \{w_i\}$, $i = 1, \dots, N$, the most preferred alternative, a^* , is given as follows:

$$a^* = \left\{ a_i \left| \max \frac{\sum_{j=1}^N w_j u_{ij}(a_i)}{\sum_{j=1}^N w_j} \right. \right\}. \quad (2)$$

Here, $u_{ij}(a_i)$ is the rated value of alternative a_i evaluated by the j th criterion. The weights are normalized such that $\sum_{j=1}^N w_j = 1$.

Comparison procedure of alternatives with MADM

In this study, the 5-step method is used for comparing alternatives, which combines the advantages of the simple weighted sum and linear allotment method. The procedure of the 5-step method is as follows:

1 Definition of policy elements

Policy alternatives or policy scenarios are composed of policy elements. That is, each scenario is a combination of the policy elements. Generally speaking, policy elements are composed of arguable issues, which are in dispute

across various interest groups, and possible options chosen from the existing cases. For example, important policy elements in water privatization include determination of the regulation system and selection of privatization option.

2 Establishment of policy alternatives

Policy scenarios are composed of policy elements. If there are five policy elements and each policy element has three options, the theoretical number of alternatives is 3^5 . But this is too big to consider. Therefore, a few more realistic alternatives have to be chosen. These alternatives must go through further screening, which, for example, includes constraining by the preference levels of different interest groups. For example, this study analyses foreign examples of privatization to draw out three privatization scenarios, as discussed later.

3 Grouping of participants

Participants are divided into groups that exert influence on or share interest in the policy. If there is only one group, it is the decision maker group. For example, this study takes four groups into consideration: the central government, local governments, customers and employees of water works.

4 Establishment of evaluation criteria and weighting factors

Evaluation criteria are for comparison of the alternatives which have survived the screening. This study divides the attributes into five major parts: technology, environmental effect, public benefit, economic aspects and operational efficiency. The criteria are scaled using numbers or verbal expressions such as 'excellent', 'good' and 'average'.

There are many methods for weighting factors, including the ratio method, the swing method, the pricing out method, the unit weighting method, the point allocation method, the multiple regression method, the eigenvector method, the trade-off method and the centroid method. For illustration, the procedure of the ratio method is as follows (Edwards 1977):

- Rank the criteria in the order of importance.
- Allot 10 for the least important criterion.
- Allot multiples of 10 for other criteria as raw weights according to the relative importance.
- Normalize these raw weights such that the sum of them is 1. That is, divide each raw weight by the sum of all the raw weights.

$$w_j = \frac{r_j}{\sum_{j=1}^N r_j} \quad (3)$$

where $j = 1, \dots, N$.

5 Scoring of individual interest groups for evaluation

Different methods such as the direct allocation and value function methods can be used to allot an evaluation score for each attribute which is expressed with criteria. In order to compare evaluation results, normalization of score is often required. When it is difficult to objectively quantify the evaluation score for each attribute, the allocation score tends to depend on the preference of a researcher, that is, an assumed decision maker. To avoid a biased decision, this study differentiates the various decision groups which allot evaluation scores according to their interest. The preference for an attribute within an interest group is assumed to be the same and clear, whereas that of

each interest group may be different from the other. In this study the preference degree for each attribute is divided into five scales from -2 (very negative) to 2 (very positive). Then, the final decision making such as selection of the best alternative or ranking the alternatives depends on the integration of evaluation results by individual groups.

DEVELOPMENT OF WATER PRIVATIZATION SCENARIOS

As done in the previous studies (Park *et al.* 1998; Park and Choi 1999), we have derived three privatization scenarios in Korea as privatization alternatives, considering opinions of different interest groups and the mid and long-term water management plans of water authorities. As discussed in Table 6, the privatization scenarios comprehensively deal with nation-wide strategies that include innovative and massive restructuring of the current water management system itself, whereas many water privatization plans of individual water authorities have focused on enhancing the efficiency of individual utility organizations. Park *et al.* (1998) pointed out why reformation of the water management system and establishment of an efficient regulation system are most critical to the successful implementation of water privatization in Korea.

Scenario I is to integrate all water and wastewater authorities to a few regional water authorities and then privatize them. That is, regionalization precedes privatization in this scenario. As shown in Figure 1, the four regional authorities can be formulated on the basis of river basins: the Han river, Nak-dong river, Keum river and Yeongsan river water authorities. In this whole procedure of privatization, the central government takes the initiative. Since it is similar to what happened in the United Kingdom (UK), Scenario I is thus called the British model. In the UK, reformation preceded water privatization. In 1974, the over 1,400 water-related bodies previously separated and dealing with water supply, river management and wastewater treatment were combined into the 10 large Regional Water Authorities, which were then privatized in 1989. We think that the merits and demerits of this model are largely related to the concentration of

Table 6 | Three scenarios for water privatization in Korea

Policy element	Scenario I British model	Scenario II French model	Scenario III Mixed model
Water management	Strong integrated management by river basin with establishment of independent management institution	Weak integrated management by river basin with establishment of an association with member authorities	Integrated management by river basin with establishment of independent management institution
Ownership of water facilities	Private investors	Both the central and local governments	Local governments and private investors
Main features	Integrate all water and wastewater works into a public water authority by river basin and then privatize the authorities	Maintain the existing water and wastewater works and allow them to privatize by their own needs	Two national water companies, KOWACO and EMC, are divided by river basin and then privatized Local governments decide which way to go by their own initiatives and decisions
A prime mover with the initiative	The central government	Local governments	The central government and local governments
Private investment	Relatively easy to induce large-scale investments	Depending on the ability of individual local governments or the scale of facilities	Relatively easy for the privatized national companies to induce large-scale investments For the cases of local governments, same with scenario II
Domestic water company and competition	A number of large domestic water companies can be formulated, which will be able to compete with the multinationals Limited competition between regions	Many small domestic water companies may be created which are no match for the multinationals Various types of competition are possible	A number of large domestic water companies can be formulated, which will be able to compete with the multinationals Various types of competition are possible
Technological and management innovation	Highly possible with speed Highly likely to be bureaucratic	Possible but limited, due to no restructuring	Highly possible with speed
Regulation	Need to establish very tight regulation system which can control the regional monopoly and uneven distribution of information	Major regulating method will be the contents of contract	Need to establish tight regulation system over time Various types of regulation formats may be necessary because of various types of business

systems and the economies of scale. Details are given in Table 7.

As is well known, Korea has had a civilian president in true sense for only eight years. Since then, the Korean

government has tried to decentralize its system by transferring powers from the central government to local governments and to liberate by removing many rigid rules and regulations. And, meeting its expectations, local

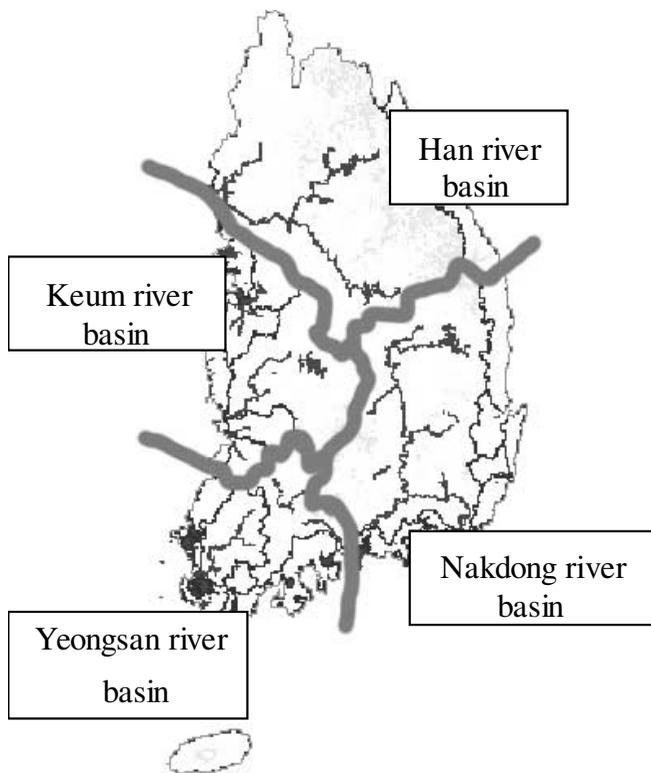


Figure 1 | Scenario I: Four regions for regionalization and privatization.

governments and civilian activities including labour movements have become more active and responsible. Since it needs to centralize water systems under such political and economic circumstances, the implementation of Scenario I is expected to face many obstacles that will be difficult to overcome. If this scenario is introduced, however, Korea will also see the contradiction that the regionalized water companies work as regulating bodies as well as polluters, during the course of privatization. This is actually what the UK experienced with their Water Authorities. It is therefore desirable to separate the regulating organization from water business at the time of regionalization.

Scenario II is to follow the French type of privatization in which local governments and the existing water authorities choose their methods of privatization or remain as they are. In France, local governments are responsible for producing and distributing drinking water, and collecting and treating wastewater. They do not sell their facilities but usually contract out. Very different from the British model, which had concentrated and sold their entities to a number of private companies, the French model seems to adopt decentralization and allows for local governments to take the initiative. Both models contrast so much in many aspects that we think of them as

Table 7 | Merits and demerits of Scenario I

Merits	Demerits	Tasks
<p>Possibility of nation-wide and centralized planning and management of water resources by river basin.</p> <p>Possibility of efficient use and distribution of water.</p> <p>Enjoy the economies of scale in every aspect.</p> <p>The regional water authorities can grow up to be world competitive.</p> <p>Solve the conflicts regarding water between communities.</p> <p>Easy to introduce the large-scale investment and efficient O/M system.</p>	<p>Labour unions may go against this scenario.</p> <p>Local government does not want to give up its own rights for the facilities.</p> <p>It goes against the national mood of decentralization in which the central government shift powers to the local governments.</p> <p>Ill-effect due to monopolization of water business.</p> <p>Difficult to regulate efficiently under the current political economic conditions due to the possibly of bureaucratic and corrupt water companies.</p>	<p>It is necessary to set up carefully designed regulation system.</p> <p>It is necessary to draw a definite and detailed blue print of privatization prior to implementation.</p> <p>It is desirable for the regional water authorities, governing private water companies, to be independent government organizations rather than belonging to any current ministry.</p> <p>It is efficient to divide and privatize the national companies such as KOWACO*, EMC₅ by river basin.</p>

*KOWACO: Korea Water Resources Corporation is the only national company in charge of water supply.

†EMC: Environmental Management Corporation is the only national company in charge of wastewater management.

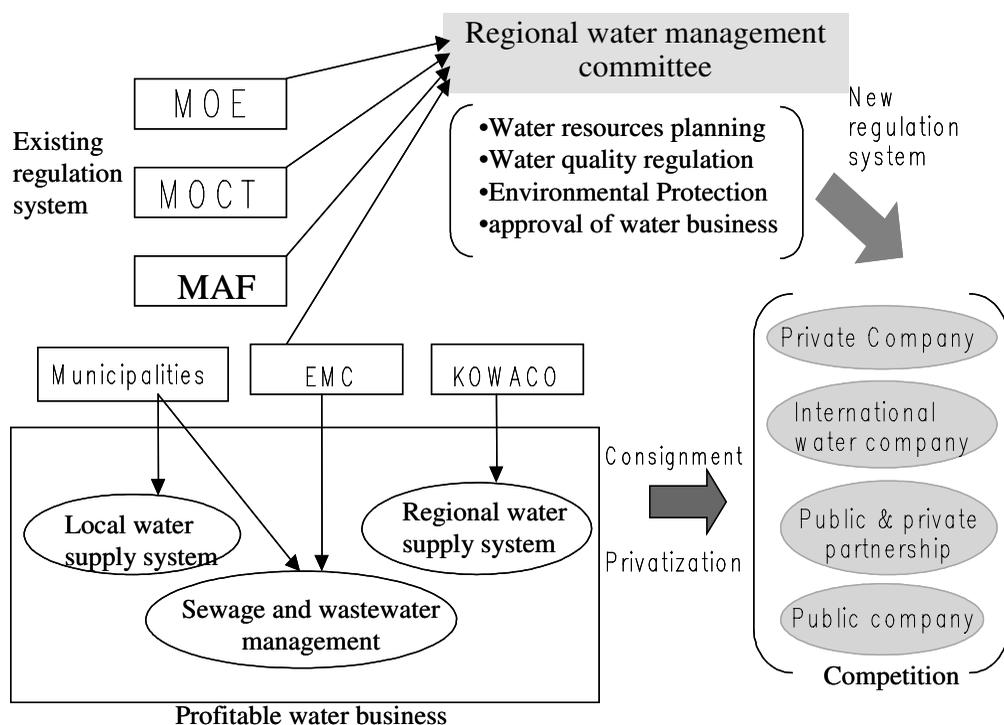


Figure 2 | Scenario II: French model.

two extremely opposed cases in a range of privatization alternatives. That is indeed why the two scenarios are set up.

In Scenario II, therefore, the existing water authorities (local governments, public water corporations under the central government) can take various ways of privatization, including no action, according to their own conditions and needs, on only one condition that they must be financially independent from the central government in the near future. What the central government will do is to establish regional water management committees, by river basin, in which local communities and other interest groups can discuss together; decisions made by these committees will not carry any binding power to their members. As shown in Figure 2, a water management committee can be established as a regulatory organization consisting of representatives from MOE, the Ministry of Construction and Transportation (MOCT), the Ministry of Agriculture and Fishery (MAF) and local governments. This scenario is very similar to the current situation in

Korea where many local governments look for, by themselves, a way of privatization which best fits their circumstances. It has already been reported that two local governments have contracted out their wastewater treatment facilities to local private companies recently established. Table 8 contains details of the merits and demerits of Scenario II, which are mainly related to its characteristic of decentralization.

In this scenario, the capability of local governments is of much concern. It is only a few years since they started to manage water-related facilities by themselves. Previously, almost everything was controlled and managed by the central government and the officials dispatched from it. They had been record-keepers only for a long time under such a centralized system. Compared with the local governments in France, they are so inferior in many technological and managerial aspects that they are not able to achieve such efficiency as shown in France, even if they take a similar approach to privatization. Many people are even afraid that the whole approach may fail due to the

Table 8 | Merits and demerits of Scenario II

Merits	Demerits	Tasks
<p>Fits the current Korean political economic circumstances.</p> <p>Ease and rapid implementation of privatization due to easy introduction.</p> <p>Possible to choose among the various means of privatization.</p> <p>Possible to bring in competition between private companies.</p>	<p>Limited opportunity for private sectors to participate in the market because of non-restructuring.</p> <p>Private investment will be sluggish.</p> <p>The separation of regulation and business is obscure.</p> <p>There remain the conflicts between regions or government departments.</p> <p>Politics has great influence on water business.</p> <p>Corruption may occur due to close adherence between local government and private company.</p> <p>Overall, the efficiency of privatization will be low.</p>	<p>Need to secure political independence of the committees and find ways to give them more binding power as regulatory authority.</p> <p>Clear separation of the regulation tasks and profitable business.</p> <p>Need to breed domestic private companies that can compete with the multinationals.</p> <p>Need to enhance technological and managerial capability of local governments.</p> <p>Need to develop various ways of inducing private participation.</p>

lack of ability of local governments. Overall, it is feared that this scenario is too weak to have the kind of efficiency we must expect.

In Scenario III, a mixed type of privatization model, the public water sectors under the central government are reformed to a few independent companies by river basin and then privatized, just as in Scenario I. And the local water services under local governments are privatized as suggested in Scenario II. That is, as shown in Figure 3, the central government creates, by river basin, regional water authorities for regulation and regional private companies for business. Firstly, the central government puts together or reorganizes the wastewater management business conducted by EMC and regional water supply businesses under KOWACO. Secondly, it divides the integrated water and wastewater business into several 'regional public water corporations' by river basin. And, lastly, the government privatizes the corporations. In this way, the competitiveness of a number of private water companies can be rapidly developed. In the meantime, the local governments will privatize according their own needs and schedules, choosing one of the options such as making contracts with the newly formed regional private companies, creating their own public or private company and so on.

This scenario is designed to be in the middle of Scenario I and II in nature. The central government takes

an initiative but not as strong as that in Scenario I. At the same time, the local governments will do what they can do, as in Scenario II. In such a set-up, both sides can take initiatives and also implement the plan of privatization, not as quickly and harshly as Scenario I and also not as slowly and inefficiently as Scenario II. Such characteristics summarize the merits and demerits of Scenario III as shown in Table 9.

INTERESTED PARTIES AND THE EVALUATION CRITERIA

In order to compare and evaluate the three scenarios, four interest groups of privatization are considered here. The first is the central government, which is currently the biggest investor in the water management field. The second is the local governments that own and operate their own facilities. The third is employees of the current central and local water and wastewater facilities. And the last is consumer groups who make use of water services.

For more accurate analysis, the groups of public officials such as those from central and local government can be split further for separate consideration, since public water service corporations such as KOWACO and

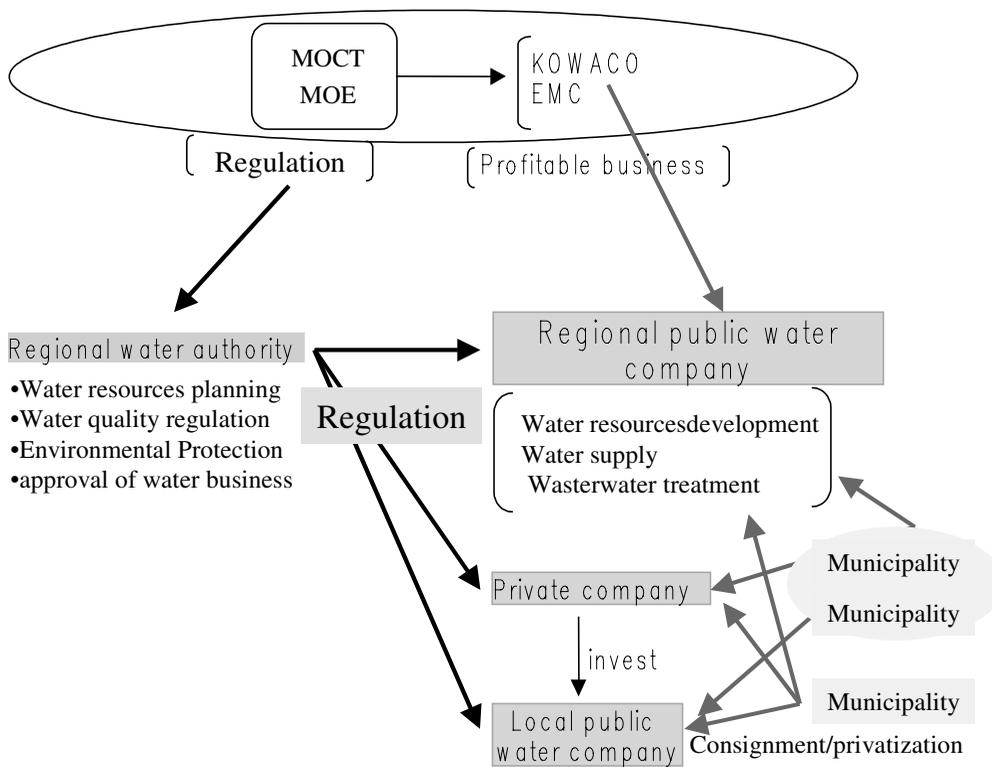


Figure 3 | Senario III: Mixed model.

EMC have played an important role in the Korean water industry. It is, however, assumed that the public service workers working with KOWACO and EMC have the same interests as other public service officials. And, the group from the central government should be divided into the MOE, MOCT and the offices relevant to the budgets, since they may have different interests. For simplicity, however, they are also treated as a group and thus this study takes just four groups as shown in Table 10.

The evaluation criteria are divided into five categories, namely technology, environmental effect, publicity, economical efficiency and administrative efficiency. The attributes in each category ($j_1 \sim j_{25}$) are shown in Table 11. The weight and range of each attribute is set corresponding to its relative importance and they indicate the relative preferences of decision-makers towards the criteria. In this study, to avoid the effect of subjectiveness of authors,

the differences among evaluation criteria are minimized except for two criteria, technology and public benefit. Evaluation criteria are ranked from 1 (Technology) to 3 (Public benefit) in the order of importance and weighted by the ratio method. The highest weight of 0.3 is assigned to a criteria group of public benefit, 0.1 to that of technology and 0.2 to the remaining groups. The weight of each evaluation criteria is equally distributed to each attribute within the category by dividing the number of attributes.

It is possible to express the evaluation scores as a figure, number or verbal expression such as ‘very good, good and normal’. However, in the end, the evaluation scores must be transformed into the same unit through normalization. This study divides the preference degree for each attribute into five scales from -2 to 2 , i.e. ‘very positive (2), positive (1), normal (0), negative (-1), very negative (-2)’.

Table 9 | Merits and demerits of Scenario III

Merits	Demerits	Tasks
<p>Possibility of efficient regulation and management due to definite assignment between central government and local governments and private sector.</p> <p>Possible to breed the various domestic private water companies, some of which will survive international competition.</p> <p>Enjoy to some extent the economies of scale in securing private investment and bringing in technological and management innovation.</p> <p>Possibility of integrated management of water quality and quantity.</p> <p>Possibly speed up the privatization process.</p>	<p>Opposition from the existing public water companies is possible.</p> <p>Restructuring and privatization of local water works can be delayed.</p> <p>Inefficiency of public water system can remain due to incomplete restructuring.</p> <p>Difficult to expect active participation from private sector.</p>	<p>Establish strong and independent regulatory organization.</p> <p>Encourage local governments to actively participate.</p> <p>Strong restructuring of existing public water companies must precede reorganization and privatization.</p> <p>Set up incentive policy for inducing investment and participation from private sector.</p>

COMPARISON OF SCENARIOS

The preference of each group on each attribute, $u_{ij}(a_i)$ has been scored as shown in Table 12(a). The evaluation scores are determined by interview with selected members of each group except for the consumer group whose scores are estimated using the previous questionnaire survey results (Kim and Yoo 1998). For example, the central government is ‘very positive’ (2 points) on the reduction of the government subsidy, but the local government ‘very negative’ (−2 points). The total evaluation scores for each scenario a_i are calculated by Equation (4), resulting in the overall preferences as shown in Table 12(b).

$$\sum_{j=1}^{25} u_{ij}(a_i) \quad (4)$$

The preference of the groups for privatization.

From the evaluation results, it can be concluded that water privatization does not have a negative image at all to all groups since the average score is 0.41. It is also shown that the employee group is the least positive and the central government is the most positive, as they scored on average 0.21 and 0.68, respectively. These results reflect fairly well the concerns that the employee group has about privatization due to job security and the fact that central

government can mitigate its financial burden. Local governments are not as enthusiastic about privatization as the central government since the average score of the former is less than half that of the latter. This seems to be because they think that there is not much economic benefit to them after privatization. Anyway, they do not have much financial responsibility for their own water works right now. If they lose, the central government will pay back in the end. Rather, there may be concern over some negative effects of privatization. For example, local governments tend to think that privatization may weaken their control over water, which may deter any development projects in their district.

It has been shown that the evaluation results are analogous to what is currently happening in Korea. At present, water consumers pay little attention to water privatization. And, the central government has taken the initiative and is trying to prepare the basis for privatization by changing laws and developing guidelines and incentives. Most local governments, however, respond passively to the central government’s initiative. As a consequence, it is suggested that in order to drive water privatization further, it would be desirable for the central government to go further by privatizing the public water corporations first, instead of waiting for the local governments to move after it has changed laws and regulations and provided

Table 10 | Four interest groups in privatization

Interest groups	Important features	Reference
Employee (A)	This group is concerned about privatization due to job security after privatization. And, it is also interested in enhancing its own technical skills and increasing efficiency, and excluding the political intervention as far as it can.	Employee of the water and wastewater facilities owned and operated by local and central governments.
Consumers (B)	This group is generally discontented with water quality and water system management, and strongly demands the improvement of efficiency. In addition, it is concerned about the trade-off between public interest and monopoly due to privatization.	Water consumers.
Central government (C)	Taken as a group because it is in charge of supporting the local governments' water business and thus managing indirectly the water works of the whole nation. In addition, it has full responsibility for the privatization of the national water companies and partial responsibility for that of local water works. It also tries to reach a compromise between the interests of the government departments and those of local governments and takes responsibility for water consumers.	Even if there are possibly conflicts of interests between various departments (i.e. the departments concerning budget, the Office of the Prime Minister, MOE and MOCT), the conflicts are not taken into consideration.
Local government (D)	This group includes the large-scale local governments that can manage water business by themselves and small-scale local governments that serve rural communities and depend largely on the central government. This group is in a dilemma over the needs to privatize its water works to increase business efficiency and the needs to manage them directly for regional development.	Large and small local governments.

incentives. That is, the central government must take a stronger initiative to successfully carry out water privatization.

Evaluation of scenarios

With the evaluation results in Table 12 it can be concluded that Scenario II is the least favoured by all the groups; the employee group in particular had negative attitudes. This seems to reflect the fact that all the groups are concerned about the inefficiency of Scenario II. Local governments that supposedly take the initiative are not positive at all towards Scenario II. This seems largely due to the fact that

they do not expect much economic benefit and environmental improvement from privatization. The employees group is also negative to Scenario II, largely due to the insufficient guarantee of public benefits. It is shown that the consumers group is barely positive to Scenario I and II. This seems to be due to the group's lack of confidence in the private sector, as noted both in the scores of the criteria for operational efficiency, economic aspect and environmental effect in the case of Scenario I and in those of the criteria for economic aspect and public interest in the case of Scenario II. In the case of Scenario I, they seem to be concerned with the fact that this method of privatization leads to water supply monopoly and consequent bureaucratic management.

Table 11 | Attributes of evaluation criteria and weights

Evaluation criteria	Weight		Attribute ($J_1 \sim J_{25}$)	Range of evaluation score
Technology	0.1	0.025	Technological development	-2-2
		0.025	Expertise of employees	-2-2
		0.025	Introduction of foreign advanced technology	-2-2
		0.025	Long-time accumulation of technology	-2-2
Environmental effect	0.2	0.05	Applicability of strict water quality standards	-2-2
		0.05	Establishment of effective environmental regulation system	-2-2
		0.05	Regional management of water quality	-2-2
		0.05	Consumers' participation and surveillance	-2-2
Economic aspect	0.2	0.04	Securing investment resources	-2-2
		0.04	Reduction of subsidy from the central government	-2-2
		0.04	The monopolistic profit	-2-2
		0.04	Cost reduction through competition	-2-2
		0.04	Realizing the economies of scale	-2-2
Public benefit	0.3	0.05	Concerns for the poor	-2-2
		0.05	Increase of water service coverage	-2-2
		0.05	Excessive raising of water tariff	-2-2
		0.05	Reducing the inequality between regions	-2-2
		0.05	Consumers' participation and supervision	-2-2
		0.05	Integrated regional development	-2-2
Operational efficiency	0.2	0.033	Improve efficiency through competition	-2-2
		0.033	Prevention of bureaucratization	-2-2
		0.033	Exclusion of political intervention	-2-2
		0.033	Prevention of corruption	-2-2
		0.033	Welfare of employees	-2-2
		0.033	Job security	-2-2

Table 12 | Scoring of preferences and comparison of scenarios

(a) Evaluation criteria		Scenario I (a_1)				Scenario II (a_2)				Scenario III (a_3)			
		A	B	C	D	A	B	C	D	A	B	C	D
Technology	j_1	1	1	1	0	0	0	0	0	1	1	1	1
	j_2	1	1	1	0	0	0	0	0	1	1	1	1
	j_3	1	1	1	0	0	0	1	1	1	1	1	1
	j_4	0	1	1	1	0	0	0	1	1	1	1	1
Environmental effect	j_5	0	-1	1	0	0	0	1	1	1	2	2	1
	j_6	2	-1	0	-1	2	0	1	-1	2	2	2	1
	j_7	0	2	2	2	-1	0	-1	-2	1	2	2	1
	j_8	2	0	0	1	0	0	0	0	0	2	1	1
Economic aspect	j_9	2	0	-1	0	1	1	2	0	1	2	2	2
	j_{10}	-2	1	-2	0	-1	0	2	-2	-2	0	2	-2
	j_{11}	0	-2	1	-1	-1	-1	-1	0	-2	-2	-2	-2
	j_{12}	0	-1	0	-2	1	2	2	1	0	0	1	1
	j_{13}	2	2	2	2	-1	-1	-1	0	2	0	2	2
Public benefit	j_{14}	2	2	2	1	-2	-1	-2	-1	2	2	2	-1
	j_{15}	2	2	2	1	0	0	1	1	2	2	2	2
	j_{16}	1	0	1	0	-1	-2	-1	0	-1	-2	-1	2
	j_{17}	0	0	0	2	-1	0	-1	-1	2	2	2	2
	j_{18}	1	1	0	1	1	1	0	0	0	2	0	1
	j_{19}	0	0	0	1	-2	-2	-1	0	2	1	2	1
Operational efficiency	j_{20}	1	-2	2	-2	1	2	2	1	1	1	2	1
	j_{21}	-2	-1	-1	-1	-2	2	2	1	-2	2	1	0
	j_{22}	0	-1	-1	-1	0	0	1	1	0	0	0	-1
	j_{23}	0	-1	-1	0	0	2	1	1	0	2	2	-1
	j_{24}	-2	1	1	-1	-2	1	2	1	-2	1	2	-1
	j_{25}	-1	1	1	0	-1	0	0	2	-1	0	0	1

Table 12 | *Continued***(b)**

Groups	Scenario I	Scenario II	Scenario III	Average
Employee (A)	0.52	− 0.37	0.48	0.21
Consumers (B)	0.25	0.07	1.05	0.45
Central government (C)	0.53	0.30	1.23	0.68
Local government (D)	0.22	0.09	0.66	0.32
Average	0.38	0.024	0.85	0.41

The results also show that Scenario III is the most favoured by all the groups. This illustrates that all the groups favour water privatization in a moderate form in which both the central and local governments take the initiative at the same time and do what they can do. The employees and local government groups are still not that positive, compared with the other groups. This suggests that future development of privatization must include more programmes to draw more attention and interest from employees and local governments.

CONCLUSIONS

A mixed model of privatization is the most favoured in Korea, which is in the middle of the UK and French models in nature. This suggests that many people in Korea do not like the much centralized and progressive approach or the liberated approach, since they are concerned about bureaucratic management and incapability of the local governments, respectively. In addition, it is suggested that both the central and local governments take the initiative in the process of privatization. Therefore, it is recommended that since the local governments are well suited to take the initiative in the current privatization process, the central government must participate more actively by starting to privatize the national water corporations, KOWACO and EMC. That is, the

central government is advised not to simply wait for the local governments to play according to the plans and guidelines it has proposed, but to put itself into a position where they can work together.

The central government is found to be most in favour of water privatization while the employees of the water works are found to least favour privatization. This is mainly because the central government can be released from the current financial burden and the employees are very concerned about job security after privatization. Local governments are not found to be positive about water privatization, largely due to the fact that there are few economic benefits even after privatization and also that they do not want to lose control over water, especially for development of their own communities. From this it can be gathered that future development of privatization must include more programmes to draw more attention and interest from the employees and local governments. For example, provisions for job security will be good for the employees and provide more economic incentives to the local governments.

Water privatization is a complicated task to which many and various groups express different interests and different attributes of water management must be reflected. Therefore, it is a good subject to analyse with multi-criteria decision-making techniques. In addition, the techniques could be applied efficiently to the planning and implementation of other water management issues on which various groups have different opinions. In

particular, when severe conflicts exist among the groups, the techniques can be effective tools to develop grounds for compromise.

It is also noted that a comprehensive range of alternatives has not been evaluated in this study. Therefore, to gain a more fundamental understanding of water privatization in Korea, future studies should be done with more alternatives, more interest groups and more evaluation criteria. Importantly, various alternatives similar to Scenario III need to be evaluated. In addition, regulation systems need to be included in the analysis, too.

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