Stakeholder involvement in the drinking water supply system: a case study of stakeholder analysis in China

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ABSTRACT

Stakeholder involvement in drinking water supply systems is crucial for the successful management and improvement of drinking water supply systems. However, there is no agreement on stakeholders, their interests, and levels of importance, especially in drinking water supply systems. To achieve efficient stakeholder management, the first step is to understand who the major stakeholders are and what their interests, influence, and relationships are. This paper discusses the role of stakeholders in drinking water supply systems through the consideration of the results of a stakeholder analysis. The primary data were collected from interviews and questionnaires with representatives of stakeholders in Shenzhen, China. The findings indicate that water companies, governments, consumers, and polluting companies are the most important and definitive stakeholders in drinking water supply systems in China. However, their interests, attitudes, and influence on drinking water supply systems are quite different.

Key words | China, drinking water, stakeholder analysis, water supply system

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INTRODUCTION

In recent years, China has suffered frequent drinking water supply accidents. According to the Ministry of Environmental Protection Administration, there were 6,928 drinking water pollution accidents from 2000 to 2010 (China Statistic Yearbook 2010). Especially, the nitrobenzene spill in the Songhua River in 2005 and the 'Wuxi Water Crisis' in 2007 were particularly serious, and resulted in severe consequences to the drinking water demands of millions of residents (Zhang *et al.* 2011). For this reason, it is a matter of urgency to strengthen the protection of water sources and improve water supply systems to ensure the safety of drinking water. Moreover, the new Standards for Drinking Water Quality (GB5749-2006), which make more stringent requirements for drinking water, were required to be made compulsory in China on 1 July 2012. However, empirically, the new standards cannot be met due to the failings of management and conflicts of stakeholders. Thus, effective stakeholder involvement in water management is essential to keep drinking water safe and reliable (Tillman *et al.* 2001; Moglia *et al.* 2011). The interests, characteristic behavior, and relationships of the stakeholders involved in water supply systems must be taken into account in water management.

Since the Water Framework Directive (Directive 2000/60/EC, WFD) embraced the new idea of stakeholder involvement, the European Commission (2003) asserted that the involvement of stakeholders is a key element for successful implementation of the regulation for sustainable water management (Lucia 2010). In addition, Water Safety Plans promoted by the World Health Organization as the most effective method for ensuring safe drinking water, emphasize that a number of stakeholders play an important role in the provision of safe drinking water (Gunnarsdottir *et al.* 2012). However, there are still no clear laws and regulations supporting stakeholder participation in water management in China. To investigate stakeholders of drinking water supply systems can fill the gap in this field in China.

Stakeholder analysis is an approach for generating knowledge about actors as to understand their behavior,

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intentions, interrelations; and for assessing the influence and resources they bring to bear on decision-making or implementation processes (Varvasovszky & Brugha 2000). The information from the analysis can be used to help understand how policies have developed and to assess the feasibility of future policy directions; to facilitate the implementation of projects or organizational objectives; and to develop strategies for managing important stakeholders (Brugha & Varvasovszky 2000). Despite a general interest in stakeholder analysis (Freeman 1984; Donaldson & Preston 1995; Mitchell *et al*. 1997; Jansson 2005), there is still no consensus in opinions about how to identify, classify, and manage stakeholders. A broad range of methods for stakeholder analysis have been applied in nature resource management (Prell *et al*. 2009; Reed *et al*. 2009), environmental management (Heidrich *et al*. 2009; Maguire *et al*. 2012), and water resource management (Carter & Howe 2006; Stanghellini 2010; Romanelli *et al*. 2011), but there is little information regarding stakeholder participation in drinking water supply systems. This paper therefore aims to contribute to this discussion through presenting the stakeholder analysis for the drinking water supply system in Shenzhen, China.

The paper initially outlines the theory underpinning stakeholder analysis and then details the mechanism and method used to collect the primary data required to complete the stakeholder analysis. Next, the results of the stakeholder analysis for outlining the identification, classification, and relationship of relevant stakeholders are presented and discussed. Finally, the discussion and suggestions for managing stakeholder involvement in the drinking water supply system is presented.

METHODOLOGY

The stakeholder analysis is conducted to obtain a clear and detailed identification and classification of the urban water supply stakeholders and an indication of the most appropriate level of involvement. It can be defined as a process that: (1) identifies stakeholders; (2) differentiates and categorizes stakeholders; and (3) investigates relationships between stakeholders (Prell *et al*. 2009). This study was developed within a research project concerning the mechanism of drinking water security supported by Housing and Urban–Rural Development of the People's Republic of China.

Identification of stakeholders

The widespread use of the term 'stakeholder' was defined by Freeman (1984) as 'any group or individual who can effect or is affected by the achievement of the firm's objective'. Stakeholders in drinking water supply systems can be regarded as actors who have an interest in drinking water supply systems, who are affected by drinking water supply safety, or who have or could have an active or passive influence on decision-making and implementation processes.

Identifying stakeholders is usually an iterative process, using focus groups, expert opinion, semi-structured interviews, snowball sampling, or a combination of these (Reed *et al*. 2009). Based on an initial review of secondary sources (e.g., published and unpublished documents, policy statements, internal regulations of organization, etc.), potential stakeholders in this study were identified mainly through: (1) participant observations in several government workshops and public meetings; (2) semi-structured interviews with the involved actors; and (3) the recommendation of interviewees, i.e., 'snowballing'. Interviews were 20–30 min in length, with 39 interviewees from Shenzhen Municipal Water Affairs Bureau, Shenzhen Water Affairs Group Limited, China Urban Water Association, local residents, and professional institutes. Interview guides included issues related to stakeholders' perceptions and interests in the water supply system, and attitude towards behavioral changes in some common practices within the water supply system. After the interviews 20 groups of stakeholders were noted. The potential stakeholders include water companies, municipal water affairs, municipal environmental protection bureau, consumers (e.g., commercial navigation, power generation, agricultural and industrial water users), communities, polluting companies, associations, media, experts and so on. Then, a group of 25 experts was asked to reconfirm the stakeholders of the urban water supply system. Within these experts with more than 10 years of experience working in the water industry, 10 experts came from government, eight from water supply companies, two from associations, and five from professional institutions. After asking them for their

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opinion and allowing them to add or delete one or more stakeholders, the final list of stakeholders was identified.

Classification of stakeholders

Many past studies have attempted to classify stakeholders using various criteria (Winn 2001): primary versus secondary, direct or indirect, generic versus specific, legitimate versus derivative, etc. However, there is no overall consensus about the 'affect criterion' (Heidrich *et al.* 2009). The binary classifications usually create confusion about who falls into which class and single examples can easily push stakeholders into different categories.

Mitchell *et al.* (1997) offered a theory of stakeholder identification and salience based on the attributes of power, legitimacy, and urgency. Their article has been recognized as a significant development of stakeholder theory (Winn 2001), expanding the definition by stating that a stakeholder possessed at least one of three distinct qualities – power, legitimacy, and urgency – and the combination of these attributes determined the stakeholder's relative importance. Power is a stakeholder's ability or potential ability to impose their will on others. Legitimacy is the 'generalized perception that the actions of an entity are desirable, proper or appropriate within some socially constructed system of norm values, beliefs and definitions'. Urgency exists when the stakeholder's claim is time sensitive and important to other stakeholders. Following identification of the attributes possessed by the stakeholders, relative importance can be assessed through the combination of those attributes. Mitchell proposed that definitive stakeholders who possess all three attributes should be the most active and able to pursue their own interests. Expectant stakeholders who possess two attributes have strong interests in the outcome of a given issue but lack an important attribute that demands priority response by management. Latent stakeholders have only one attribute and non-stakeholders possess no attributes. This is the most widely used approach in stakeholder analysis.

In this paper, the dimensions chosen for ratings have already been identified as power, legitimacy, urgency (Mitchell *et al.* 1997; Jansson 2005), impact of drinking water supply system (Varvasovszky & Brugha 2000) and importance (Heidrich *et al.* 2009). A questionnaire was used to collect the required data. Representatives of all kinds of stakeholders in Shenzhen were asked to rank the stakeholder on a scale of 1 (lowest) to 5 (highest) with respect to the five attributes. During December 2012, data were collected and 300 questionnaires were gathered. Thirty-one questionnaires with multiple missing values were removed and a total of 269 effective surveys were used for the remaining analysis.

Interest–influence matrix

The interest–influence matrix is an approach for conducting a stakeholder analysis which is usually adopted as a management tool in project design (Romanelli *et al.* 2011). This approach focuses on the social aspect of stakeholder analysis for the purpose of avoidance and management of conflict. Stakeholders are classified according to their relative importance and interest in the project, which can then be used to determine how stakeholders might be engaged (Grimble & Wellard 1997). Our discussion on 'interest' focused on defining what constitutes a legitimate 'stake' in the affairs of other individuals or groups. 'Influence' was defined as 'power', which means the stakeholder's ability or potential ability to impose its will on others. We used the method of interest and influence to classify stakeholders into 'Key player' (high interest and influence over urban water supply), 'Context setters' (high influence, little interest), 'Subjects' (high interest, low influence), and 'Crowd' (little interest in or influence over water supply system).

RESULTS

Identify stakeholders and their stake

After the collection of all the data, the final list of the stakeholders for the drinking water supply system was identified. They are water companies, governments (containing local government and municipal water affairs bureau), consumers, polluting companies, communities, experts and professional institutions, media and non-government organizations (NGOs). It should be noted that although some stakeholder groups are composites (e.g., government can

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be municipal water affairs bureau, bureau of public health, etc., or NGOs could be China Urban Water Association, Guangdong Water Supply Association, etc.), it was decided to retain them as whole units for this analysis, because they share the common desire and interest. However, subdividing would be precluded if an organization needed this amount of detail.

Table 1 provides a summary description of each of the stakeholders, including their roles in the water supply system, their effect on water supply system, and how water supply system affects them. Water companies are the most vital part of the drinking water supply system and responsible for producing and delivering safe and sufficient drinking water. Water companies affect the drinking water supply system directly through the production process or service networks. Governments are also key stakeholders in drinking water supply systems and affect the system via legislation, regulation, and compliance. Especially in water-scarce areas, governments are responsible for enacting water supply planning that includes water requirement prediction, water source planning, developing planning and economic evaluation to ensure access to safe and adequate water supplies. Since drinking water is a necessity, consumers are greatly affected by drinking water supply safety and consumer demand determines water supply quantity. Polluting companies near to water sources are likely impacting water sources by discharging waste. In China, communities are important stakeholders for daily maintenance on the secondary water supply. Experts and professional institutions will provide necessary technical help or guidance. With the growing influence of mass media, media may highlight water issues. NGOs pursue wider social aims that have an indirect effect on other stakeholders via lobbying on security or planning issues.

Table 1 | Stakeholders for drinking water supply system

Stakeholders	Role	SH effect on WSS	WSS affects SH
1. Water companies	Produce and deliver safe and sufficient water	Direct effect as the specification of raw material, production process or services might determine water supply security	May be affected directly by government putting pressure on them
2. Governments	Legislation and strategy development. Planning processes and control. Administration and surveillance	Can affect the process directly via legislation, regulation, and compliance. Local authority affects the process directly via planning, monitoring and provide subsidies	Affected directly by production process and social stability objectives
3. Consumers	Purchases and uses of products or services	Can affect the water supply process and water demand directly; low participation in China	Affect human life and property security
4. Polluting companies	Generate some level of water pollution	Direct effect on water sources by discharging waste water nearby	Impact to production. Affected by regulation authority
5. Communities	Be responsible for maintenance of 'secondary water supply' (e.g., water tower, etc.)	Direct effect by cleaning or not cleaning secondary water supply facilities	Direct effect, e.g., if an security claim by consumers is made
6. Experts and professional institutions	Share best practice in water supply system	Affect the system indirectly through provision of guidance and suggestions	No major influence unless advice is needed
7. Media	May highlight water issues	Potentially higher if urgent claims or effects were ever to become present; low involvement currently	No influence
8. NGOs	Non-elected representation of sectors of the public	Possible indirect effects via lobbying on security or planning issues. Become more important if any urgent claim or effect became present	No influence other than as an example of good practice

SH, stakeholders; WSS, water supply system.

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From the mean scores for the importance of stakeholders, the most important to the least important stakeholders in China's drinking water supply system are: water companies, governments, consumers, polluting companies, communities, experts and professional institutions, media and NGOs. The importance in this study is viewed as an independent rating scale to evaluate stakeholders on the whole (Heidrich *et al*. 2009). Then paired-sample *t*-tests were conducted to determine whether the cognition was significantly different from one another. Table 2 shows the *t*-test results for ranking drinking water system stakeholders. Most comparisons of importance showed significant differences, except for experts and media. This indicates that experts and media play the same important role in the water supply system. However, the implication that stakeholders may vary in their interests or influence leads to the obvious conclusion that the relevant dimensions must be identified.

Classification and involvement of stakeholders

Ratings of stakeholders for the drinking water supply system were compiled and allocated to the matrix model for all the stakeholders. The dimensions for all stakeholders are presented in Table 3. Guided by Stanghellini (2010), it is assumed that a score equal to or higher than 3.5 is considered as a high score, while a score lower than 3.5 is considered as a low score. According to this assumption, stakeholders who have all the attribute scores equal to or higher than 3.5 should be classified as definitive stakeholders. Stakeholders who have two or three attributes equal to or higher than 3.5 should be classified as expectant stakeholders. The remaining stakeholders, who have only one or no attribute should be classified as latent stakeholders.

This is an adaptation of the classification system suggested by Stanghellini (2010). It identifies three different degrees of stakeholder involvement: co-working, co-thinking, and co-knowing. Co-working indicates stakeholders who actually participate in and contribute actively to the drinking water supply system. Co-thinking means stakeholders who have an input with respect to content and are sources of expert knowledge. Co-knowing means that stakeholders do not play an active role in the process but should be kept informed.

According to the stakeholder analysis method, the most appropriate degree of involvement for the definitive stakeholders is active involvement (co-working). They are water companies, governments, consumers, and polluting companies. These stakeholders should be included in the highest level of involvement in the policy-making process. The appropriate degree of involvement of expectant stakeholders is consultation (co-thinking). Experts and media are considered as expectant stakeholders and should be consulted in order to gain useful information and opinions. The appropriate level of involvement for the latent stakeholders is co-knowing; community and NGOs should be kept informed. As shown in Table 2, it can be seen that communities are more important than experts and media. However, communities are classified as latent stakeholders through the rating

Table 2 | Results of paired-sample *t*-test for importance of stakeholders

	1	2	3	4	5	6	7
1							
2	0.2342[b] (4.6330)						
3	0.4498[b] (6.8980)	0.2156[b] (3.0360)					
4	0.6320[b] (10.0240)	0.3978[b] (5.8400)	0.1822[a] (2.1120)				
5	1.1524[b] (19.0170)	0.9182[b] (14.0890)	0.7026[b] (10.1680)	0.5205[b] (7.6330)			
6	1.4052[b] (21.2640)	1.1710[b] (17.4100)	0.9554[b] (12.1270)	0.7732[b] (9.9750)	0.2528[b] (3.6550)		
7	1.2565[b] (19.2120)	1.0223[b] (16.0120)	0.8067[b] (9.7060)	0.6245[b] (8.3520)	0.1041[b] (1.4550)	0.1487 (2.570)	
8	1.6729[b] (24.5330)	1.4387[b] (19.2600)	1.2231[b] (15.1050)	1.0409[b] (12.5420)	0.5205[b] (7.3530)	0.2677[b] (4.0510)	0.4164[b] (6.9410)

[a]Indicates significant level at $p < 0.05$.
[b]Indicates significant level at $p < 0.01$ (*t*-value).

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Table 3 | Rating of stakeholders for water supply system

Stakeholders	Legitimacy	Power	Urgency	Impact	Classification	Involvement
1	4.6059	4.6320	4.5539	4.4126	Definitive	*Co-working*
2	4.8030	4.7286	4.7100	3.9368	Definitive	*Co-working*
3	3.9814	3.5539	3.8848	4.6766	Definitive	*Co-working*
4	3.7398	3.8662	3.7361	3.6617	Definitive	*Co-working*
5	3.3941	3.3123	3.2045	3.5688	Latent	*Co-knowing*
6	3.1041	3.6011	3.5420	2.9294	Expectant	*Co-thinking*
7	3.0706	3.5725	3.8736	2.9368	Expectant	*Co-thinking*
8	2.8476	2.8513	3.0260	2.7658	Latent	*Co-knowing*

of four different dimensions. Experts and media are regarded as expectant stakeholders and should be consulted in drinking water supply systems.

Interest–influence matrix

Based on the results in the tables, the interest–influence matrix for the water supply system is illustrated in Figure 1. Stakeholders were classified according to their location within the interest–influence matrix. The key stakeholders in China are governments, water companies, and polluting companies, who take a central position in the water supply system and have a continued participation in the management of the drinking water supply. The acceptability of strategies to these key players should be an important consideration in the evaluation of new water policies. Consumers are 'Subjects' with a high interest in the water supply system but little power over the system. Experts and media are 'Context setters' that keep themselves informed but with low efforts. Regardless of their high influence they are generally not the main target for engagement, but cannot be ignored (Grimble & Wellard 1997). Communities and NGOs are classified as 'Crowd' since these stakeholder groups are able to participate with minimum cost and effort, and little interest in the process. With limited influence and little interest in the water supply system, there is little need to extensively engage with communities and NGOs.

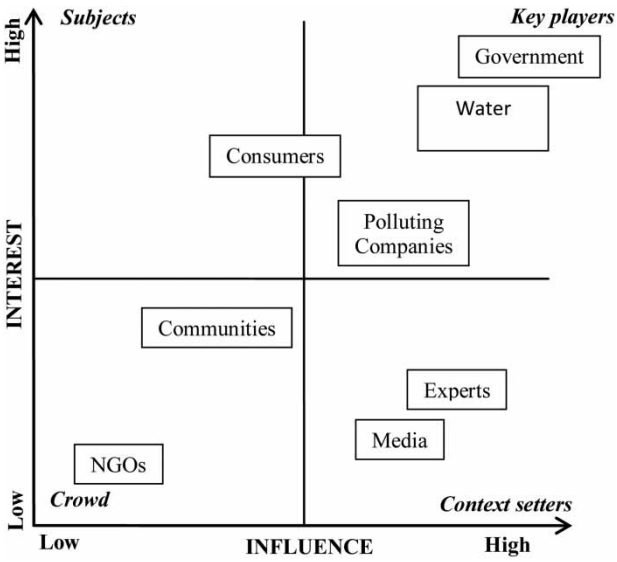

Figure 1 | Interest–influence matrix for the water supply system.

DISCUSSION AND CONCLUSION

According to the public nature of water supply and its multi-objective, stakeholder involvement is critical to water supply management and drinking water safety. In this study, a stakeholder analysis for the drinking water supply system in China is conducted to establish efficient and effective stakeholder involvement by determining who should be involved and how they should be involved. As a result, eight main groups of stakeholders were identified and ranked from the most important to least important as: water companies, governments, consumers, polluting companies, communities, experts, media, NGOs.

Water companies play the most important role in water supply systems, since they are direct producers of drinking

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water and are key providers of water services. Water companies are regarded as definitive stakeholders and key players. They are primarily responsible for improving the capability to reduce the possibility of future water accidents and to implement the new Standards for Drinking Water Quality (GB5749-2006). In addition, water companies should ensure their production capacities can satisfy water demand. With high interests and high influence, water companies actually participate in and contribute actively to the drinking water supply system. However, their interest may not always be the same as other stakeholders' interests. Water companies tend to cut down the cost of production in order to maximize profit. It seems that water companies are reluctant to invest in updating their technical facilities and service networks due to the weak financing mechanisms and insufficient funding capacity for long-term sustainability. This suggests that effective regulation and incentive mechanisms are urgently needed to standardize the operation of water companies and promote water production technology.

Governments are also important stakeholders in water supply systems and are classified as definitive stakeholders and key players. They are responsible for ensuring and verifying that the drinking water supply systems they administer are capable of delivering safe and sufficient water routinely. However, governments usually affect the drinking water supply system indirectly by affecting water companies. In China, there is no clear and unified organization in charge of the whole drinking water supply system. For instance, water supply management involves soil and water conservation, water affairs, poverty reduction, forestry and agriculture sectors, etc. These increase the difficulties of establishing an effective management framework to improve the water supply system. It implies that local government should be responsible for ensuring access to safe and adequate water supplies and further indicates that performance evaluation for water supply systems is needed.

According to the analysis, consumers are definitive stakeholders with high interest but little power over the water supply system. It is mainly because there is little effective way for consumers to acquire information and to communicate with governments and water companies. Chinese consumers cannot get updated and reliable information on water quality and price. More participation should be supported and be encouraged, such as, public hearings, online public forums, etc. In particular, public participation is essential in water-scarce areas. Since consumer demand determines water supply quantity, the habits and behaviors of water users are an important part of drinking water supply safety.

Polluting companies are critical stakeholders in the water supply system. Water pollution, whether accidental or discharged, has a serious impact on water supply safety and influences public interests. Most water pollution incidents in China have been caused by accidents produced by polluting companies. The acceptability of strategies to polluting companies should be an important consideration in the evaluation of new water policies. The relocation of those polluting companies near to water sources and/or adopting stricter emission standards are the crucial first steps to compliance with the new standards.

Both experts and media are expectant stakeholders with a high influence on the drinking water supply system. However with low interests, they do not have enough incentive to be concerned about water supply security. Since both experts and media are categorized as expectant stakeholders and considered as 'Context setters', they play the same important role in the water supply system. If water supply management becomes a more topical issue, especially when people are concerned about what happens to the water supply in the case of an accident or water pollution, then the importance of the media may rise and even become a positive asset to drinking water supply systems.

In China, communities are important stakeholders for daily maintenance of secondary water supply. Because of the lack of legal regulation on secondary water supply, communities' influence and interest is relatively low. Similarly, NGOs can be viewed currently as of low importance stakeholders due to their limited interest and influence. There is little need to extensively engage with them.

In conclusion, this study attempts to show how the stakeholder analysis approach can be utilized to better understand the stakeholder involvement in drinking water supply systems. Given the necessary information, the main stakeholders involved in the areas, and their interests, influence, and potential conflicts are identified. The key unique finding in this research is that water companies, governments, consumers, and polluting companies are the most

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important and definitive stakeholders in drinking water supply systems in China; however, their interests, attitudes, and influence on the water supply system are different. The results suggest that the involvement of stakeholders in water supply management must be carefully managed to enable efficient and effective interaction among stakeholders according to the proportionate needs of water supply systems. This study is the first attempt to investigate stakeholders involved in drinking water supply systems using stakeholder analysis methods. The future challenge is how to successfully establish and implement a mechanism for effective and efficient involvement of stakeholders throughout the water supply system.

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