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A Water Sustainability Index for West Java – Part 2: Refining the Conceptual Framework Using Delphi Technique

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Abstract In the first paper of this two-part series on the development of a water sustainability index for West Java, a conceptual framework of West Java Water Sustainability Index (WJWSI) was developed. It consists of three main parts: components, indicators/sub-indicators and threshold values. This second paper of the series presents the application of the Delphi technique, followed by in-depth interviews with selected key experts, to refine the conceptual WJWSI framework. The Delphi application includes the design of the questionnaires, the selection of respondents, the distribution and collection of the completed questionnaires and the analysis of data. After round one of the Delphi application, the respondents reached consensus for all proposed components in the conceptual framework, with some modifications suggested. As for the indicators/sub-indicators, consensus for 9 of the proposed 12 indicators was reached, and 5 new indicators were suggested. For the threshold values, consensus was reached for threshold values of 5 indicators. In round two of the Delphi application, respondents were asked questions related to results from Round one, which include the modification on the components, indicators/sub-indicators which have not been agreed, and newly suggested indicators/sub-indicators and threshold values. In terms of its components and indicators, the framework was then finalised in the in-depth interview with four key experts, selected from different respondent categories. For the threshold values, further study will be carried out, as there was not much input from the respondents in the Delphi application and the in-depth interview.

Keywords sustainability index; water resources; Delphi technique; West Java; Indonesia.

INTRODUCTION

A critical stage of developing a water sustainability index is the identification of its components and indicators. As the issue of water sustainability is considerably complex, and is comprised of at least the environmental, social, and economic aspects, inputs from a wide range of experts are needed. One of the decision making techniques to identify the components and indicators is the Delphi technique.

The Delphi technique is a method to extract opinion from experts without having the experts congregate at agreed time and place (Delbecq, Ven & Gustafon, 1975; Dunham, 1998). This technique aims at reaching consensus among the selected experts through the distribution of a series of questionnaires (Delbecq, Ven & Gustafon, 1975; Toward & Ostwald, 2002). The questionnaire for the first round is developed through literature reviews, while for the following rounds questionnaires are constructed based on the responses to questionnaire from an earlier round.

In the past, the Delphi technique has been applied for indicator identification in various fields, such as health services (Toward & Ostwald, 2002), health industries (Hudak et al., 1993), marketing (Jolson & Rossow, 1971; Lunsford & Fussell, 1993), education (Olshfski & Joseph, 1993), information systems (Niederman, Brancheau & Wetherbe, 1991), transportation and engineering (Saito & Sinha, 1991), strategic planning (Javed, 1994), water quality (Cude, 2001; Dinius, 2007) and nursing and midwifery (Annells & Australian Institute of Nursing Research, 1997).

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In these applications, the Delphi technique has shown advantages, particularly in the identification and selection of variables or parameters in different stages of decision making processes. The method has been effectively contributed to reaching consensus on particular issues among selected experts. Considering the past successful applications of the Delphi technique, it is believed that this method will be a useful tool for achieving a consensus in the identification of components, indicators and threshold values of a water sustainability index.

In the first paper of this two-part series on the development of a water sustainability index for West Java, a conceptual framework of West Java Water Sustainability Index (WJWSI) was developed. It consists of three main parts: components, indicators/sub-indicators and threshold values. This paper discusses the application of the Delphi technique, followed by in-depth interviews with selected key experts, to refine the conceptual WJWSI framework. The Delphi application includes the design of the questionnaires, the selection of the respondents, the distribution and collection of the completed questionnaires and the analysis of data.

APPLICATION OF DELPHI TECHNIQUE AND IN-DEPTH INTERVIEWS

The Delphi Technique

The Delphi technique is a method of reaching a properly thought-through consensus among experts. One of the advantages of the Delphi technique is that it compiles several judgements from different experts from various backgrounds (Best, 1974; Delbecq, Ven & Gustafon, 1975; Linstone & Turoff, 1975; Lang, 1995; Franklin & Hart, 2007). Later, the information obtained from consensus of these experts will provide strong basis and contribution in further decision making processes (Toward & Ostwald, 2002). In the Delphi technique, even though majority views are sought, the minority views are not completely rejected. These views are taken into account and discussed in the larger group. The discussion on the minority views is essential to ensure that important issues, raised by the minority group, are not omitted.

The method is also believed to produce a more accurate result compared to other alternative group decision methods (Jolson & Rossow, 1971; Rowe & Wright, 1999). This is due to the fact that the method removes biases occurred in face-to-face group meetings (Annells & Australian Institute of Nursing Research, 1997). The Delphi method also provides more time to the experts to analyse issues or problems (Franklin & Hart, 2007) and has a better accuracy as it reduces variance (Rowe & Wright, 1999). The variance is reduced as some respondents change their answers, after the results of previous round(s) are provided. Another advantage of the Delphi technique is that it provides a conceptual framework of problems or issues to the respondents (Uhl, 2006; Franklin & Hart, 2007). In most of the cases, the conceptual framework enriches the existing knowledge of the experts (Linstone & Turoff, 1975).

In spite of the advantages, the Delphi technique also has some limitations. One of the limitations is that the extreme views of the respondents tend to be overlooked (Bardecki, 1984). As the method seeks to find consensus, the views of the majority dominate the extreme (minority) opinions, which possibly leads to the withdrawal of the minority. In these cases, researchers need to be aware of this possibility of extreme views being expelled, which might hide important insights (Hosokawa & Zweig, 1990). Another limitation of the method relates to the design of initial questionnaires, which is time consuming and potentially biased (Annells & Australian Institute of Nursing Research, 1997) .Also, the limitations include the overwhelming inputs and comments from the experts, which

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might lead to the over-expanded research topic (Franklin & Hart, 2007), and the possibility of omitting key respondents as the method focuses on the experts (Annells & Australian Institute of Nursing Research, 1997).

For the questionnaires in the application of the Delphi technique in this study, Likert scales were used to assess the initially-identified components, indicator and threshold values. A study by Matell and Jacoby (1972) showed that uncertain and neutral responses were found more often in the 3-point and 5-point scales and less found in the 7-point and above scales. Recent studies also show that 7-point scales were used in numerous Likert applications. Therefore, in this study a 7-point scale was used in the Delphi questionnaires. The scale 1 to 7 ranges from least important to very important with 4 being neutral.

In the application of the Delphi questionnaires, Alexandrov et. al (1996) found that a consensus is achieved if more than 67% of the respondents agree on the offered option. The 67% or two-third threshold has also been used by Chang et al. (2009) and Lehmann et al. (2004). In statistical term, the 67% is considered significant to be used as decision threshold (Alexandrov et al., 1996). Thus, if a 7-point scale is used, consensus is reached if at least 67% of the respondents agree on the 'important' options (by selecting 6 or 7 on the Likert scale) for each question offered in the questionnaires. In this study, a cut-off of 67% is used to decide if a consensus is achieved or not.

The concept of sustainability has also entered the field of water resources. As issues related to water resources are becoming complex, extensive studies have been conducted to combine the concept of sustainability with water resource management issues (Mays, 2006; Chaves & Alipaz, 2007; Policy Research Initiative, 2007; Sullivan & Meigh, 2007). Loucks and Gladwell (1999) state that the main characteristic of water resource sustainability lies in the attitude of key stakeholders to constantly review and re-examine their approaches to address the changing problems of water resources. At all times, in all plans and processes, key stakeholders need to strive for decisions that fulfil economic, environmental and social satisfaction, by involving all other stakeholders.

In the development of WJWSI, prior to the Delphi application, components, indicators and threshold values are identified based on sustainability criteria and water resource guidelines. Then, in the Delphi application, components, indicators and threshold are finalised through the involvement of various water resources stakeholders in rounds of questionnaires. As the consensus reached in the Delphi application, it provides strong and sustainable basis for the stakeholders to conduct further work together in managing water resources in West Java.

For WJWSI, the sustainability is based on both resource allocation and consensus opinion principles. The resource allocation principle is applied to identify threshold values for some indicators (e.g. *availability*, *demand*, *water quality*), whilst the consensus opinion takes place during the application of the Delphi technique.

The application of Delphi technique in this study comprises of the following steps:

(i) identification of water-related stakeholders
(ii) design of the questionnaires
(iii) distribution and collection of completed questionnaires
(iv) analysis of the results

Each of these steps is discussed below.

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Identification of Water-related Stakeholders

One of the critical steps in the Delphi application is the identification of water-related stakeholders. In this study, the stakeholders were identified from four different categories from West Java: lecturers, government officials, consultants and community representatives. These categories are considered to represent stakeholders with strong interests in the development of a water sustainability index in West Java. For Round one of the Delphi questionnaire, about 40 to 50 stakeholders were targeted to represent the four respondent categories.

The targeted stakeholders were then contacted either via email or phone calls. Most of the stakeholders expressed their willingness to participate in this study, but few refused. At the end, 43 stakeholders confirmed to participate in the study. The numbers of stakeholders for each category are 15 for Academic, 10 for Consultant, 10 for Government and 8 for Community.

Initially, it was planned to have equal numbers of stakeholders in each category and it was targeted to have a minimum of 10 stakeholders for each category. However, it was difficult to find prospective stakeholders from the category of community, especially with extensive knowledge of the overall water resource issues in West Java. Thus, there were only 8 stakeholders from the community, who agreed to participate. For the academic category, there are many universities in West Java with many lecturers and researchers who have interests in water resource issues. Therefore, the list consisted of more stakeholders from the academic category.

The relatively higher number of academic stakeholders may create biases in the analysis, such as the domination of their opinion over other stakeholders. However, this can also be an advantage, as these academic stakeholders are known to have extensive knowledge on water resource issues in West Java and have been involved in water resource projects at community basis.

Design of the Questionnaires

The main component of the questionnaire is the conceptual framework of the water sustainability index. The framework, which comprises of the initial set of components, indicators and threshold values, was developed through extensive literature review, considering sustainability concepts, water resource guidelines and existing water sustainability indices of WPI, CWSI and WSI. These criteria for developing the conceptual framework are very important to reduce the bias of the researcher.

In the questionnaire, for each component, indicator and threshold values, respondents are asked their agreement with the component/indicator/threshold values using the 7-point Likert scale. Respondents are considered ‘agree’ to the component/indicator/threshold values if they answered 6 or 7 on the Likert scale, and are considered ‘disagree’ if they answered of 1 or 2 on the Likert scale. The answer of 3, 4 or 5 on the Likert scale is considered a neutral response. After the respondents are asked their agreement on the provided component/indicator/threshold values, they are also allowed to add, modify and change the component/indicator/threshold values in the conceptual framework, if necessary.

After the final draft for Round one questionnaire was developed, it was distributed to a few selected respondents in Melbourne as a pilot study to seek early inputs and comments on the draft questionnaire. Since the questionnaire was meant to be distributed in West Java, the draft of the questionnaire was distributed to several Indonesian students in Melbourne, who had water resource

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related background. Based on this pilot study, revisions were made to develop the final questionnaire for Round one of the Delphi application.

Distribution and Collection of Completed Questionnaires

The distribution of the questionnaires was undertaken by the first author in West Java. It started by making appointments with the 43 selected respondents. In Round one questionnaire distribution, a face-to-face meeting was chosen as some of the respondents might not be familiar with the topic, and need to be explained directly. During the distribution, it was important to have the confirmation from the respondents before the meeting, probably in the early morning on the day of the meeting. As most respondents were very busy, confirming availability of the respondents via short message service (SMS) or phone call was required. For some respondents, the appointments had to be rescheduled as they were not available or had failed to remember the appointment.

During the face-to-face meetings, the respondents were allowed to raise questions. At the end of the meetings, respondents were informed about the date for questionnaire collection. They were requested to complete the questionnaire within a week.

For the collection of completed questionnaires, a reminder or confirmation, as was done during the distribution, was also important. At the point of questionnaire collection, respondents were asked about the possibility of their participating in the next round of the Delphi questionnaire.

In Round two, questionnaires were distributed to 37 respondents out of the 43 respondents in Round one, as some of the respondents withdrew their participation after Round one for various reasons. In Round two, the numbers of stakeholders for each category were 13 for Academic, 8 for Consultant, 10 for Government and 6 for Community.

In-Depth Interview with Selected Key Experts

One of the limitations of the Delphi technique is its time-consuming nature, particularly if the Delphi technique needs to be done in a large number of rounds (Annells & Australian Institute of Nursing Research, 1997). Some other researchers also found that the accuracy of the Delphi technique diminishes after the completion of few early rounds (Boje & Murnighan, 1982), as the willingness and motivation of some respondents decline (Franklin & Hart, 2007).

For this study, as consensus has been reached for most of the components and indicators/sub-indicators after the completion of Delphi Round two, it was then followed by an in-depth interview with selected key experts. It was expected that this interview would increase the effectiveness for reaching consensus of other remaining indicators and threshold values, as well as keeping the motivation of respondents at a high level.

Criteria for the selection of key experts for the in-depth interview includes their understanding on the water resource issues, their interest and motivation in the study, their influence in the decision making process related to water resources in West Java and recommendations from other respondents. Prior to the in-depth interview, potential representations from each group of respondents were identified. However, no one from the consultant group was available for the interview. Then, for this study, four key experts were chosen representing three respondent groups , which are the academic (two experts), community (one expert) and government (one expert).

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In the interview, the experts were asked of their opinion on the results of the Delphi application and their further comments to refine the WJWSI framework. The questions asked include their opinions on the components, indicators and threshold values of the WJWSI.

ANALYSIS OF RESULTS AND DISCUSSION

Round one

After the distribution of 43 questionnaires to the respondents, 93.18% of the respondents returned the questionnaires. Two respondents who did not return the questionnaires were both from the Academic category. In general, the respondents were asked to assess the initial set of components, indicators and threshold values, as well as provide relevant comments on the conceptual framework. The conceptual framework was presented in the first paper of this two-part series on the development of WJWSI.

*Components***.** The responses from respondents on the component-related questions are shown in Figure 1.

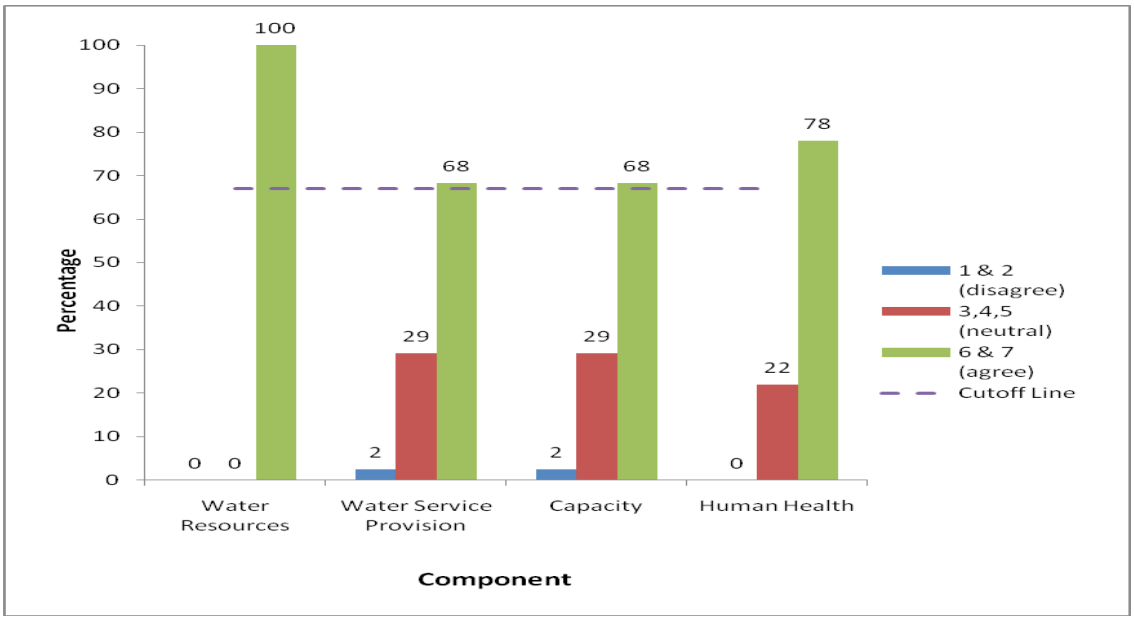

Figure 1. Response Percentage on Components – Round one

Figure 1 shows that for the component of *Water Resources*, 100% of the respondents agreed on the component (chose 6 or 7 on the 7-point Likert-scale), whereas for *Water Service Provision*, *Capacity* and *Human Health* components, 68%, 68% and 72% of the respondents respectively agreed. As mentioned previously, in this study, a consensus is achieved if more than 67% of the respondents agreed on the option offered in the Delphi technique. It means that for this study, all the offered components in the first-round questionnaire have been agreed by the respondents as the components of the WJWSI.

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For the component of *Water Resources*, none of the respondents 'disagree' nor has a neutral response. For the component of Water Service Provision, Capacity, and Human Health, neutral responses are 29%, 29% and 22% respectively. This shows that respondents valued the component of Water Resources higher than other three components. In addition, with less percentage of 'disagree' and neutral responses, the component of Human Health is valued more by the respondents compared to the components of Water Service Provision and Capacity.

However, despite their agreement on the provided components, few respondents suggested that the components should be modified to reflect the National Regulation No. 7/2004 on Water Resources (Presiden Republik Indonesia, 2004). This regulation provides general guidance on how to manage water resources in Indonesia. It comprises of three main components of water resource management, which are conservation, water use, and policy and governance. This suggestion, provided by minority of respondents, was decided to be included in the next round for further discussion by other respondents.

Indicators. With regards to the initially identified indicators of the WJWSI, the responses are shown in Figure 2.

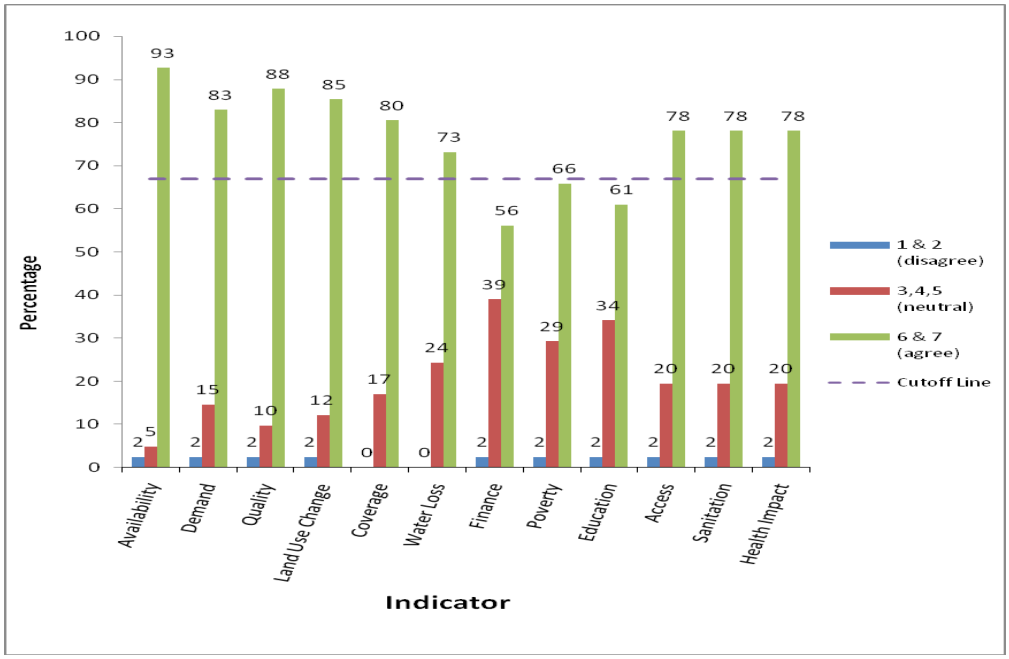

Figure 2. Response Percentage on Indicators – Round one

As can be seen from Figure 2, more than 67% of the respondents answered 6 or 7 on the 7- point Likert-scale for 9 indicators, namely, the *availability*, *demand*, *quality*, *land use change*, *coverage*, *water loss*, *access*, *sanitation* and *health impact*. For these indicators, as the consensus was reached, they were not brought into the next round(s) of the Delphi application. For the other 3 indicators, which are *finance*, *poverty* and *education*, 6 or 7 Likert-scale was chosen by 56%, 66% and 61% of the respondents respectively. As the percentages of these three indicators fell below 67%, these indicators were taken into Round two of the Delphi application.

It is also important to be noted that 'disagree' percentages for all indicators are 2% or less, which indicated the majority of the respondents preferred the indicators to be included in the WJWSI framework. However, as the 'neutral' and 'no responses' for the indicators of *finance*, *poverty* and

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education are high, they were brought into Round two of the Delphi application for further assessment.

Apart from the indicators in the conceptual framework, few respondents also suggested new indicators to be included in the WJWSI framework. Indicators that were suggested by the respondents were *population pressure*, *information disclosure*, *governance structure*, *public participation* and *law enforcement*. This suggestion was included in the next round for further discussion by other respondents.

Threshold Values. The conceptual framework of WJWSI also includes threshold values for their respective indicators. The respondents were asked to assess these threshold values, and their responses are illustrated in Figure 3.

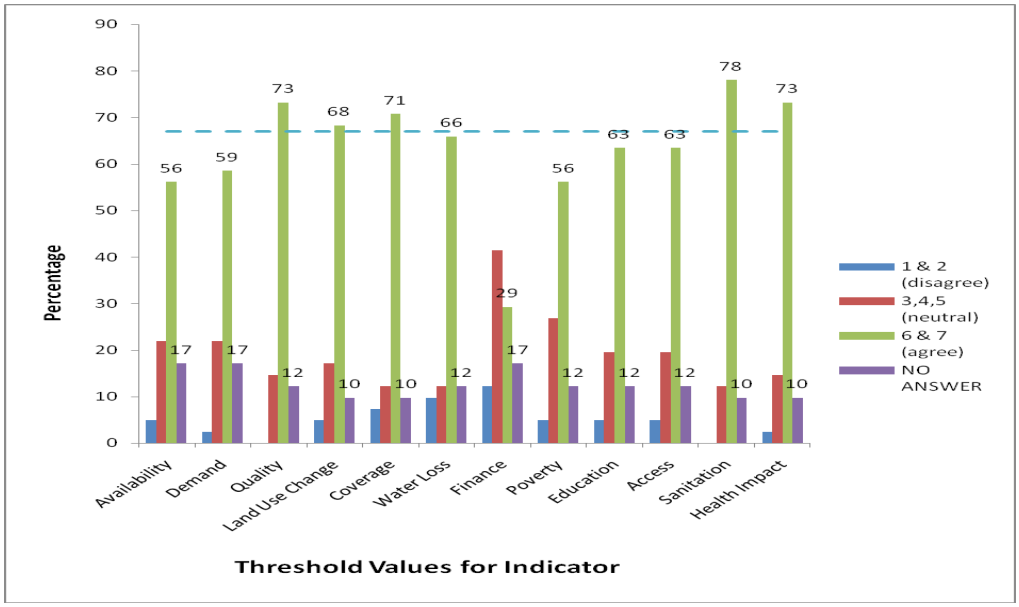

Figure 3. Response Percentage on Threshold Values – Round one

The figure shows that consensus is reached for few threshold values, considering the 67% cut-off is used. The threshold values above 67% cut-off are for *quality*, *land use change*, *coverage*, *sanitation* and *health impact*. For threshold values of these indicators, as the consensus was reached, they were not brought into the next round(s) of the Delphi application.

For other threshold values (i.e., threshold values for indicators of *availability*, *demand*, *water loss*, *finance*, *poverty*, *education* and *access*), most of the respondents have 'neutral responses', 'disagree' or 'no answer'. Most of them did not have other alternative threshold values, and only few respondents provided alternative threshold values for some indicators. Compared to the responses for components and indicators, responses on threshold values have higher percentages on 'disagree', 'neutral' and 'no answer'. These responses show that respondents were less confident to include these threshold values in the WJWSI framework.

Based on the results from Round one of the Delphi application, the conceptual framework of WJWSI was modified, as shown in Table 1. The modified framework in Table 1 incorporated suggestions from Round one to suit the components with three major components of water resource management stated in the National Regulation on Water Resources; *Conservation*, *Water Use* and

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Policy and Governance. Table 1 also includes indicators and sub-indicators suggested in Round 1. The new indicators and sub-indicators were *population pressure*, *information disclosure*, *governance structure*, *public participation* and *law enforcement*.

Table 1. WJWSI Framework after Round one of Delphi Application

Component	***Indicator***	***Sub-indicator***	***Threshold values***	
			Max	***Min***
Conservation	Availability (1)			
	Land Use Changes (2)		1 [b]	0 [a]
	Water Quality (3)		0 [a]	-31 [b]
Water Use	Demand (4)			
	Access (5)			
	Water Service Provision	Coverage (6)	80 [a]	0 [a]
		Water Loss (7)		
		Finance (8)		
	Population Pressure (9)			
Policy and Governance	Information Disclosure (10)			
	Governance Structure (11)			
	Public Participation	Education (12)		
		Poverty (13)		
		Sanitation (14)	100 [a]	0 [b]
		Health Impact (15)	100 [b]	0 [a]
	Law Enforcement (16)			

a: preferable; b: not preferable

In Round 1, consensus was reached on threshold values for the following indicators/sub-indicators: *land use changes*, *water quality*, *coverage*, *sanitation and health impact*. For other indicators/sub-indicators, shown by the shaded area in the table, their threshold values have not been agreed.

Thus, for Round 2, questions to be asked on the modification of the components to align with the National Regulation of Water Resources, indicators that had not been agreed in Round one (*finance*, *poverty* and *education)*, the newly suggested indicators (*population pressure*, *information disclosure*, *governance structure*, *public participation* and *law enforcement)*, indicators/sub-indicators under different components/indicators in the new framework (*sanitation* and *health impact)*, and new threshold values suggested in Round 1 (threshold values for *poverty*, *coverage* and *demand* indicators).

With regards to potential bias in the conceptual framework, as consensus was reached for all the components in the conceptual framework, some of the biases have been removed. However, biases might still exist as consensus has not been reached for some indicators and threshold values.

Round two

For this round, questionnaires were distributed to 37 respondents as some of the respondents in Round one withdrew, due to their reluctance to participate further in the study.

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The responses in Round two are described in the sub-sections below.

Components. As it was suggested in Round one that the components were modified to suit the National Regulation No. 7/2004 on Water Resources, in Round two, respondents were asked to assess the modified components to suit the national regulation. Figure 4 shows responses of the respondents on the new components.

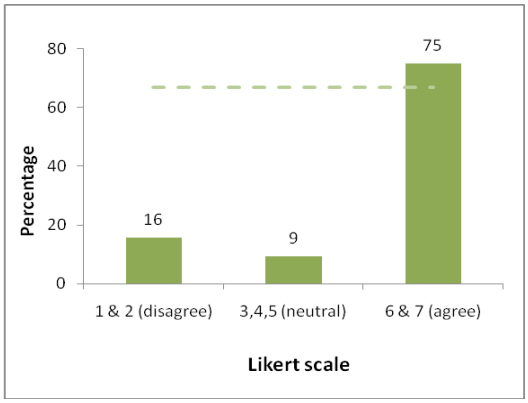

Figure 4. Response Percentage on the Component – Round two

This figure shows 75% of the respondents agreed on the modifications of the initial components to suit the national regulation on water resources management. Another 16% of the respondents did not agree on the component modifications. As the 67% cut-off is used in this application, the modified components will be used in the WJWSI.

Indicators and sub-indicators. In Round two, 9 indicators and sub-indicators were asked to the respondents. The 9 indicators and sub-indicators were the indicators chosen by less than 67% of the respondents and new indicators suggested by the respondents in Round one. The responses are shown in Figure 5.

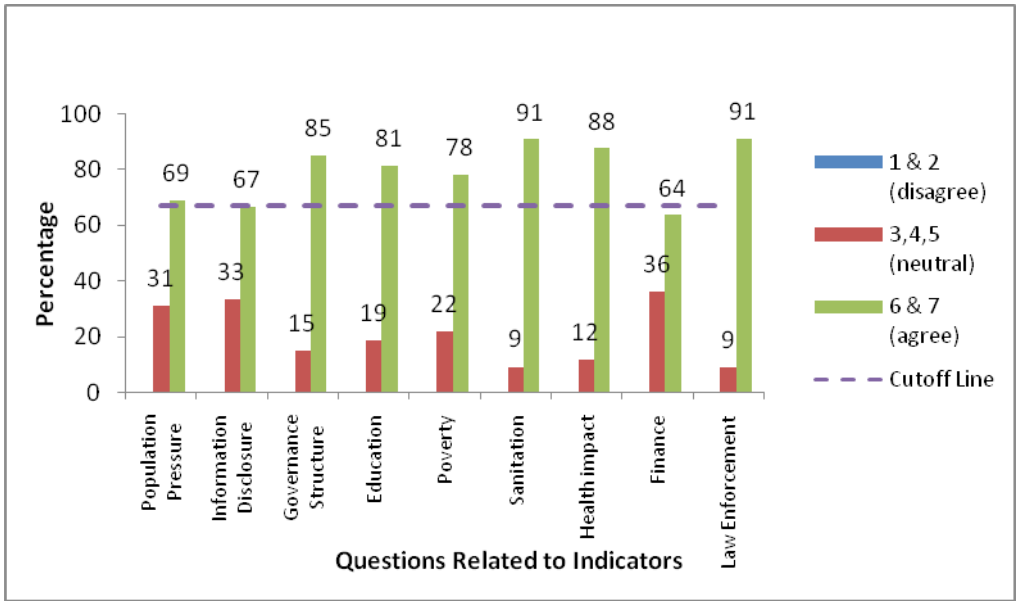

Figure 5. Response Percentage on Indicators – Round two

This figure shows that eight out of nine indicators had the percentage responses of 67% or more. Only the indicator of *Finance* had a percentage of response below 67%. The indicators with percentage response of 67% or more (i.e., *population pressure*, *information disclosure*, *governance structure*, *education*, *poverty*, *sanitation*, *health impact* and *law*) were, then, included in the WJWSI framework.

The figure also shows that there is no 'disagree' response for all indicators, including the finance. However, as the 'agree' percentage for finance is below 67%, this indicator was brought into an in-depth interview with selected key experts for further discussion.

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Threshold Values. In Round one, it was revealed that there were only three new threshold values suggested by the respondents, which were threshold values for *poverty*, *coverage* and *demand*. For other threshold values, the respondents had neutral responses. Thus, in Round two, only these three threshold values were presented to the respondents, to be compared with the old values in the conceptual framework. They were asked to assess which threshold values (new or old) were preferred. The new threshold values in comparison with the threshold values in the conceptual framework are shown in Table 2.

Table 2. New Threshold Values for Delphi Round Two

Indicator	Threshold values	
	Old	New
Poverty	0 – 100%	0% - 20%
Coverage	0 – 80%	0 – 60%
Demand	0 – 40%	10 – 40%

The responses from respondents on new threshold values are shown in Figure 6. This figure shows that for *poverty* and *demand*, 81% and 89% of the respondents preferred the new threshold values respectively. For the indicator of *coverage*, 65% of the respondents chose the old threshold values. Based on these responses, considering the 67% cut-off, new threshold values for *poverty* and *demand* was used in WJWSI, while the *coverage* threshold values were brought into the in-depth interview with selected key experts.

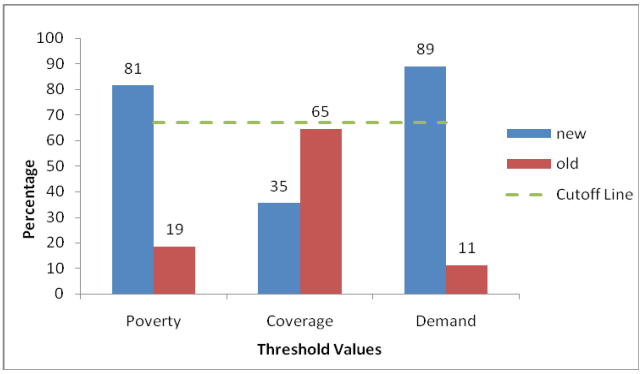

Figure 6. Response Percentage on Threshold Values – Round two

Based on the results of Round two, further modifications were made to the components, indicators and threshold values, as shown in Table 3. This table includes components, indicators/sub-indicators and threshold values which have been agreed after two rounds of the Delphi application. Threshold values which have not been agreed are indicated by the shaded area. They are threshold values for the indicators of *demand, access, coverage, water loss, population pressure, information disclosure, education* and *law enforcement*.

Table 3. Framework of WJWSI after Delphi Questionnaire Round two

Component	***Indicator***	***Sub-indicator***	***Threshold values***	
			Max	***Min***
Conservation	Availability (1)			
	Land Use Changes (2)		1 [b]	0 [a]

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Table 3. Framework of WJWSI after Delphi Questionnaire Round two

Component	***Indicator***	***Sub-indicator***	***Threshold values***	
			Max	***Min***
	Water Quality (3)		0 [a]	-31 [b]
Water Use	Demand (4)		40 [b]	10 [a]
	Access (5)			
	Water Service Provision	Coverage (6)		
		Water Loss (7)		
	Population Pressure (8)			
Policy and Governance	Information Disclosure (9)			
	Governance Structure (10)			
	Public Participation	Education (11)		
		Poverty (12)	20 [b]	0 [a]
		Sanitation (13)	100 [a]	0 [b]
		Health Impact (14)	100 [b]	0 [a]
	Law Enforcement (15)			

a: preferable; b: not preferable

This new framework of WJWSI was brought into an in-depth interview and discussion with selected key respondents to be finalised. The key respondents were four experts who have advanced expertise compared to others, and selected from different categories of respondents. In the in-depth interview, the overall structure of the framework, including indicators/sub-indicators and threshold values, which have not been agreed in previous two rounds, were discussed.

According to results of Round two, consensus was reached for all indicators except for the finance, and more threshold values were agreed by the respondents. These indicate further removal of bias, which potentially occurred during the design of the conceptual framework.

IN-DEPTH INTERVIEW

During the in-depth interview, three major elements of WJWSI framework, namely components, indicators/sub-indicators and threshold values, were discussed. The experts considered that consensus on the components of WJWSI have been reached after Round two of the Delphi application, and agreed with the results.

With regards to indicators/sub-indicators, the experts concluded that positions of indicator and sub-indicators under certain components were relatively not important. The main important aspect was the inclusion or exclusion of those indicators and sub-indicators in the framework. This was also supported by the results of the Delphi application, which showed no responses from the Delphi respondents when positions of some indicators in Round one were changed in Round two. Table 4 illustrates the final framework of WJWSI based on the in-depth interview.

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Table 4. Final Framework of WJWSI after the In-depth Interview

Component	***Indicator***	***Sub-indicator***	***Threshold values***	
			Max	***Min***
Conservation	Availability (1)			
	Land Use Changes (2)		1 [b]	0 [a]
	Quality (3)		0 [a]	-31 [b]
Water Use	Demand (4)		40 [b]	10 [a]
	Water Service Provision	Coverage (5)	80 [a]	0 [b]
		Water Loss (6)		
Policy and Governance	Information Disclosure (7)			
	Governance Structure (8)			
	Public Participation	Education (9)		
		Poverty (10)	20 [b]	0 [a]
		Health Impact (11)	100 [b]	0 [a]
		Sanitation (12)	100 [a]	0 [b]
	Law Enforcement (13)			

a: preferable; b: not preferable

The in-depth interview also concluded that indicators of *access* and *population pressure* need to be removed from the framework. The indicator of *access* was too similar with *coverage*, and the *population pressure* has been represented by the *availability*.

The experts also expressed their concerns on the three indicators; information disclosure, governance structure and law enforcement. They believe that these indicators have unique characteristics, because quantitative data to assess these indicators are not available. Thus, methods to quantify available information on these indicators need to be identified, and the most appropriate method needs to be chosen. Threshold values for these indicators can be later defined after the quantification method was chosen.

As for the other threshold values, the experts highlighted the importance to carefully identify them. They considered that, at this stage, most of the values are not available at relevant water-resource institutions. Relevant agencies and institutions responsible for water resources have not realised the importance of those indicators, let alone their respective threshold values. The shaded area indicates threshold values which have not yet been identified.

The consensus reached by these selected experts, along with consensus reached in Round one and two of the Delphi application, indicates that potential bias in the conceptual framework is no longer existed.

SUMMARY

The Delphi application is an important part of this study, which aims at refining the initial framework of the West Java water sustainability index (WJWSI). This paper presented the application of the Delphi technique for reaching a consensus among 43 selected experts and stakeholders on the initially identified components, indicators and threshold values of the WJWSI. The Delphi application comprised of various steps, which included the identification of the

respondents, design of questionnaires, distribution and collection of the completed questionnaires, and analysis of the results. At the end of two rounds of the Delphi questionnaire application and an in-depth interview with selected key experts, the respondents have reached a consensus for the components, indicators/sub-indicators and some of the threshold values to be used in the WJWSI. Further literature review will be undertaken to finalise the remaining threshold values.

In the near future, the WJWSI will be applied to three different catchments in West Java, which will be the basis for recommendations to water resource decision makers on relevant water resource management programs for each catchment.

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